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EPA Task Order Project Manager: Ed Hathaway

VOLUME 1 OF 2

SPECIFICATIONS
DURHAM MEADOWS WATERLINE
REMEDIAL DESIGN

100% Design Submittal

Durham Meadows Superfund Site
Durham, Connecticut

April 2018

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TABLE OF CONTENTS

VOLUME 1 OF 2:

DIVISION 2

SITE WORK

SECTION 02012

PROTECTING EXISTING UNDERGROUND UTILITIES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Protecting existing underground utilities.

1. Removing and plugging abandoned lines.

2. Compaction.

3. Protecting thrust blocks.

1.02 REFERENCES:

A. American Society for Testing and Materials International (ASTM):

1.03 DEFINITIONS:

A. Controlled Low Strength Fill: Refer to Section 02210.

B. Class C Concrete: Refer to Section 03300.

1.04 SUBMITTALS:

A. Submit the following shop drawings in accordance with Section 01300.

1. Record drawings to include record survey coordinates and elevations.

2. Proposed locations for test pits.

1.05 QUALITY ASSURANCE:

A. Comply with the requirements specified in Section 01400.

1.06 PROJECT/SITE CONDITIONS:

A. Pipelines will be indicated on the drawings, but the right is reserved to the Contracting Officer to make such modifications in location as may be found desirable to avoid interference with existing utilities.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Except as indicated, or as specifically authorized by the Contracting Officer, where existing utilities to remain must be removed, reconstruct utilities with new material of the same size, type, and quality as that removed.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Comply with the requirements in Section 01046.

B. Notify Dig-Safe at least 72 hours before digging operations are scheduled to begin.

C. Test Pits: Excavate test pits to field verify the locations, depth of bury, diameter, and pipe material of existing underground utilities at crossings and at tie-in points before ordering materials or commencing excavation. Immediately notify the Contracting Officer if conflicts are encountered.

3.02 PREPARATION:

A. Where utilities are parallel to or cross work, but do not conflict with work, notify the utility owner at least 48 hours in advance of construction at the crossing. Coordinate the construction schedule with the utility owner.

3.03 PROCEDURES:

A. Protect in Place: Protect utilities in place, unless abandoned, and maintain the utility in service, unless otherwise indicated or specified.

B. Damage to Utilities to Remain: If existing utilities to remain are damaged, immediately notify utility owner, and repair to owner’s satisfaction.

3.04 COMPACTION:

A. Protecting Existing Utilities:

1. Backfill and compact under and around utilities. Compaction shall conform to Section 02210.

2. Where compaction cannot adequately be performed around utility due to the presence of encroaching existing utilities, protect using Controlled Low Strength Fill.

3.05 PROTECTION OF THRUST BLOCKS:

A. Protect thrust blocks on existing waterlines or sewer force mains in place or shore to resist the thrust by a means accepted by the Contracting Officer, and reconstruct. If the thrust blocks are exposed or rendered to be ineffective in the opinion of the Contracting Officer, reconstruct them to bear against firm unexcavated or backfill material.

1. Provide firm support by backfilling affected portion of the trench for a distance of 2 feet on each side of the thrust block to be reconstructed from the pipe bedding to the pavement subgrade with either:

a. Controlled low strength fill, or

b. Native material compacted to a relative compaction of 95 percent. See Section 02210 for compaction requirements.

2. Excavate the backfill material for construction of the thrust block.

3. Test compaction of the backfill material before pouring any concrete thrust block. Concrete shall conform to Section 03300.

3.06 CLOSEOUT ACTIVITIES:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 02013

CONNECTIONS TO EXISTING BURIED PIPELINES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Connecting to Existing Buried Pipelines

1. Tapping existing buried ductile iron pipelines.

1.02 REFERENCES:

A. American Society of Mechanical Engineers (ASME):

1. B16.1: AN Standard for Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800

B. American Society for Testing and Materials International (ASTM):

1. A36: Standard Specification for Carbon Structural Steel

2. A325: Standard Specification for Structural Bolts, Steel, Heat-Treated 120/105 ksi Minimum Tensile Strength

3. A325M: Standard Specification for Structural Bolts, Steel, Heat-Treated 830 MPa Minimum Tensile Strength (Metric)

4. A536: Standard Specification for Ductile Iron Castings

C. American Water Works Association (AWWA):

1. C110: Ductile Iron and Gray Iron Fittings

2. C153: Ductile-Iron Compact Fittings for Water Service

3. C213: Fusion Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines

4. C223: Fabricated Steel and Stainless Steel Tapping Sleeves

5. C509: Resilient Seated Gate Valves for Water Service

6. C550: Protective Interior Coatings for Valves and Hydrants

7. C800: Underground Service Line Valves and Fittings

D. Manufacturer's Standardization Society (MSS):

1. SP-60: Connecting Flange Joint Between Tapping Sleeves and Tapping Valves

2. SP-111: Gray Iron and Ductile Iron Tapping Sleeves

3. SP-113: Connection Joint Between Tapping Machine and Tapping Valve

E. NSF International (NSF):

1. 61: Drinking Water System Components Health Effects

1.03 SUBMITTALS:

A. Submit the following shop drawings in accordance with Section 01300.

1. Manufacturer’s catalog data for products to be used.

1.04 QUALITY ASSURANCE:

A. Comply with the requirements specified in Section 01400.

1.05 DELIVERY STORAGE AND HANDLING:

A. Comply with the requirements specified in Section 01610.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Tapping Sleeves (for tapping outlets 4-inch to 12-inch diameter) for Ductile Iron pipe.

1. Manufacturers:

a. Smith-Blair

b. Mueller

2. Products:

a. Complies with AWWA C223.

b. Ductile Iron.

c. Bolts, Nuts, and Washers: Type 304 Stainless Steel, coated to protect from galvanic corrosion.

d. Outlet: Recessed for tapping valve per MSS-SP 60.

e. Pressure Rating: To match or exceed rating of existing piping.

B. Tapping Valves (4-inch to 12-inch diameter):

1. Manufacturers:

a. Mueller

b. US Pipe

c. American Pipe

2. Products:

a. Conforms to AWWA C509.

b. Ends: Conform to ANSI B16.1, Class 125, and MSS SP-60 and MSS SP-113.

c. Wedge: Iron, fully encapsulated in rubber.

d. Stem: Non-rising.

e. Bonnet and Stuffing Box: 304 stainless steel.

f. Nuts and Bolts: 304 stainless steel.

3. Coating:

a. Fusion bonded epoxy, conforming to AWWA C550.

b. Certified to meet NSF 61 standard.

4. Rubber Stopper:

a. Fully expandable rubber, minimum 100 psi pressure rating, or

b. Carbon steel pivoting head with Buna-N sealing element, minimum 100 psi pressure rating.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Tapping: Expose the existing pipeline to be tapped. Verify material of construction and outside diameter prior to ordering tapping materials.

3.02 PREPARATION:

A. Coordinate work to be performed with Contracting Officer.

3.03 INSTALLATION:

A. Line Stopping:

1. Install concrete and support thrust blocking before installing the temporary pressure tapping machinery and valve.

2. After tapping and line stopping operations have been completed, seal the tee fitting with an ASTM A36 steel pin-locked completion plug with Buna-N O-ring seal.

3. Close the fitting with a blind flange meeting the requirements of AWWA C110.

4. Repair any damage that occurs to line stop fitting, accessories, or existing pipeline.

5. Dispose of water and existing pipeline at no additional cost to Contracting Officer.

3.04 CLOSEOUT ACTIVITIES:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 02018

VIBRATION MONITORING

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide vibration monitoring as indicated and in compliance with Contract Documents.

1. Furnish, install, maintain, monitor, and remove vibration monitoring equipment as specified and as indicated.

2. Monitor vibrations, air blast overpressures and noise levels originating from construction operations as indicated or specified.

3. Modify construction operation procedures if existing operation creates vibration, air blast overpressure, or noise exceeding specified amounts.

4. Vibration monitoring for blasting shall conform to the requirements of this specification section and the requirements of all applicable Local and State Authorities.

1.02 QUALITY ASSURANCE:

A. Provide in accordance with Section 01400.

B. Retain the services of an independent vibration consulting firm with the following in-house personnel to conduct the following vibration monitoring requirements:

1. Preparation, signing and stamping of monitoring plans and daily reports, and overseeing monitoring and interpretation of monitoring equipment shall be performed by personnel with the following qualifications:

a. Be a Connecticut Licensed Professional Engineer.

b. Have a minimum of five (5) years experience in the vibration consulting field.

c. Have successfully completed at least five (5) projects with vibration-inducing operations, air blast overpressures, and noise levels equal to or more severe than those to be encountered.

2. Installation, monitoring and interpretation of monitoring equipment shall be performed by personnel with the following qualifications:

a. Have at least three (3) years of experience in the operation of monitoring equipment proposed for use and interpretation of records produced by such equipment.

b. Have installed, operated, monitored and interpreted equipment and records on at least three (3) projects with vibration-inducing operations, air blast overpressures, and noise levels from similar construction activities.

3. Performed and maintained calibration records on all instruments used to monitor the blasting program.

1.03 SUBMITTALS:

A. Submit the following shop drawings in accordance with Section 01300.

1. Qualifications of the independent vibration consulting firm's Professional Engineer as specified in subparagraph 1.02B.1 including the names of the five (5)successful projects with names, current addresses, and telephone numbers of persons in charge of representing the owners or the owners at the time of monitored vibration-inducing operation, air blast overpressures, and noise levels.

2. Qualifications of the vibration consulting firm's personnel to install, operate and interpret the monitoring equipment as specified in subparagraph 1.02B.2 including the name of the personnel and the names of the three (3) projects per person which they installed, operated, monitored, and interpreted monitoring equipment with names, current addresses and telephone numbers of persons in charge of representing the owners or the owners at the time of monitored vibration-inducing operations, air blast overpressures, and noise levels.

3. Two weeks prior to commencement of blasting or other vibration inducing operations, submit in writing the plan for monitoring operations and equipment to be used to assure compliance with the vibration, air blast overpressure, and noise limitation. As a minimum, this plan shall provide for the following:

a. Recommended vibration limiting methods to meet the specified peak particle velocity limitations and locations for taking measurements.

b. Manufacturer's brochures and written operation instructions for seismograph recording equipment intended to be used for each vibration occurrence.

4. Daily reports, while blasting or performing other vibration-inducing operations, detailing each source of vibration, location of monitoring, and the vibration records highlighting peak particle velocities. For blasting, include the air blast overpressure records as well as a plot of particle velocity versus scaled distance. All daily reports shall be stamped and signed by the Vibration Consulting Firm's Professional Engineer.

PART 2 - PRODUCTS

2.01 EQUIPMENT:

A. Provide a low frequency sensitive three-component seismic recording instrument with wave paper trace, variable trigger level setting, peak particle velocity memory operation (in inches/second) and air blast overpressure and sound level readout capability that meets the following criteria:

1. Seismic Frequency Range: 2 to 200 Hz (+/- 3 dB)

2. Acoustic Frequency Range: 2 to 200 Hz (+/- 1 dB)

3. Velocity Range: 0.02 to 4.0 inches per second.

4. Sound Range: 90 to 140 dB linear.

5. Transducer: Three mutually perpendicular axes: radial, transverse, and vertical.

6. Recording: Time-history of waveform capability.

B. Manufacturers:

1. Instantel, Inc., Kanata (Ottawa) Ontario, Canada.

2. Slope Indicator Co., Seattle, WA.

3. Thomas Instruments, Inc., Spoffard, NH.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Furnish specified instrumentation to be installed, operated and interpreted by the vibration consulting firm's personnel, as specified below and indicated.

B. Monitor vibrations and record the entire particle velocity wave train, not just peak velocities. Obtain accurate, legible seismometer records of monitored vibrations.

C. Perform all blasting and other vibration-inducing operations so that vibrations reaching adjacent structures and facilities are within specified limits.

D. Monitor vibrations by measuring the peak particle velocity in the vicinity of work. Peak particle velocity is defined as a maximum vector sum of three velocity components, measured concurrently in mutually perpendicular directions at any point by an instrument. The peak particle velocity as measured by the vibration consulting firm's personnel on or at the location as specified in the submitted vibration monitoring plan, shall not exceed the limits specified below:

Type of Concrete	Age of concrete (hrs)	Peak Particle Velocity in./sec
Mass Concrete (footings, mats, slab-on-grade, fill concrete, etc.)	0-10	1.0
	11 and over	2.0
Concrete Structures (walls, columns, elevated slabs, etc.)	0-11	0.5
	11-24	1.0
	24 and over	2.0
Existing Structures, residences or utilities	-	0.5

E. Air blast over pressures resulting from the blasting shall be recorded. Operate the instruments to make a permanent record for each blast.

F. In the event any recordings indicate that vibration or air over pressure limits are being exceeded, immediately suspend all blasting and other vibration-inducing operations and submit a report to the Contracting Officer. Revise operations to reduce vibrations and submit a copy of the revised procedure to the Contracting Officer at no additional cost to the Contracting Officer.

G. If evidence of displacement or damage to utilities, equipment, or structures is observed or reported, immediately notify the Contracting Officer and discontinue operations creating the vibrations. Revise operation to reduce vibrations and submit a copy of the revised procedure to the Contracting Officer.

H. Restore or replace utilities, equipment, or structures damaged by vibrations or air blast overpressures at no additional cost to the Contracting Officer.

3.02 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 02053

EXCAVATED MATERIAL MANAGEMENT PLAN

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall comply with the requirements of this section for transport, access, institutional and regulatory requirements for disposal of excavated materials from the Durham Manufacturing Company located at 201/203R Main Street, Durham CT in the area shown on the Drawings. The Contractor shall be responsible for managing excavated materials so as to conduct the Work as described herein, within the boundaries of this property.

B. The Contractor is responsible, subject to review by the Contracting Officer, for characterizing excavated materials, as needed for disposal and to transport and dispose of the materials in a safe and legal manner. The Contractor may characterize soil on-site following excavation, or may precharacterize soil in place prior to excavation, as appropriate to meet disposal facility requirements. Excavated materials shall not be stored off-site prior to transport for disposal. The Contractor shall determine the destination facilities subject to approval by EPA, and means of transport using a licensed hauler, and shall prepare appropriate shipping documentation. Available soil data from this location are included in Appendix D of the Contract Documents.

C. Requirements of this section apply to soil from trenching or other excavation activities at 201/203R Main Street as shown on the Drawings.

D. For contaminated soils/waste that are encountered during pipeline trenching and other excavation activities outside of the limits of the Durham Manufacturing Company property or on property not owned by the utility, and contamination was not created by the utility, the Contractor shall comply with the requirements of the CT DEEP Guidance for Utility Company Excavation (included as Attachment A).

1.02 RELATED SECTIONS

A. Section 01070 – Regulatory Requirements

B. Section 01300 – Submittals

C. Section 01120 – Health & Safety

D. Section 01400 – Quality Assurance

E. Section 01410 – Sampling Procedures and Laboratory Services

F. Section 02241 – Construction Water Management

G. Section 02210 – Earth Excavation, Backfill, Fill, and Grading

1.03 REFERENCES

Compliance with all applicable regulations, including but not limited to the following, is required. All Work shall be conducted in compliance with applicable regulations and policies, as well as any changes or addenda to the same as set forth prior to the completion of the Work. Nothing in this section will limit the Contractor's responsibility to adhere to these regulations and recognized standards and regulatory practices. The EPA will not be responsible at any time for Contractor's violations of any applicable local, state, or federal regulations or endangerment of his employees or of his Subcontractors.

A. Code of Federal Regulations (CFR)

1. Code of Federal Regulations (CFR) Title 40: Protection of Environment, including but not limited to the following:
   a. 40 CFR Part 261 - Identification and Listing of Hazardous Waste
   b. 40 CFR Part 262 - Standards Applicable to Generators of Hazardous Waste
   c. 40 CFR Part 263 - Standards Applicable to Transporters of Hazardous Waste
   d. 40 CFR Part 264 - Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
   e. 40 CFR Part 265 - Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
   f. 40 CFR Part 266 - Standards for the Management of Specific Hazardous Waste and Specific Types of Hazardous Waste Management Facilities
   g. 40 CFR 300.440 - Procedures for planning and implementing off-site response actions

2. CFR Title 49: Transportation, including but not limited to the following:
   a. 49 CFR Part 172 - Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, Training Requirements, and Security Plans
   b. 49 CFR Part 173 - Shippers -- General Requirements for Shipments and Packaging.
   c. 49 CFR Part 178 - Specifications for Packaging
   d. 49 CFR Part 179 - Specifications for Tank Cars
   e. Resource Conservation and Recovery Act (40 CFR 260 through 267)

B. State Regulations

1. Connecticut Regulation of Department of Environmental Protection concerning Remediation Standard (Sections 22a-133k-1 thru 22a-133k-3 of Regulations of Connecticut State Agencies).

2. Connecticut Hazardous Waste Management Regulations (Sections 22a-454-1 and 22a-209-17 of the Regulations of Connecticut State Agencies).

3. Connecticut Hazardous Waste Transporter Permit Regulations (Section 22a-449(c)-11 of the regulations of Connecticut State Agencies).

4. Connecticut Solid Waste Management Regulations (Chapter 446d).

5. Connecticut General Permit for Contaminated Soil and/or Sediment Management (Staging and Transfer) (Section 22a-208a(i).

6. Connecticut Permit Requirements for Waste Facilities (Section 22a-6h and 22a-454)

7. Connecticut RCRA "Contained-In" Policy.

C. Local Fire Department regulations.

1.04 DEFINITIONS

A. CT RSR: Connecticut Regulation of Department of Environmental Protection concerning Remediation Standard

B. EPA: U.S. Environmental Protection Agency

C. Embedded Debris: Man-made debris greater than 6" length in any dimension, encountered within or in contact with soil which is excavated. Embedded Debris may include pavement and foundations.

D. Excavated Material: Excavated soil and embedded debris

E. OSHA: Occupational Safety and Health Administration

F. PID: Photoionization Detector

G. Shipping documents: refers to Uniform Hazardous Waste manifests or other manifests, Bills-of-Lading, Material Shipping Records, or any other document required by State or Federal regulation, or by the destination facility, to be carried by the excavated material transporter. The Transport document must also provide for certification of receipt by the destination facility. The Transport document shall describe the contents of the load in accordance with State or Federal regulations or destination facility requirements.

H. Classifications for Excavated Material:

1. Characteristic Hazardous Waste: Excavated soil defined as RCRA characteristic hazardous waste as determined by the Toxic Characteristic Leaching Procedure in

accordance with 40 CFR 261, but not otherwise listed waste. Note: based on available data, as provided in Appendix D, soil that meets the definition of RCRA Characteristic Hazardous Waste is not known to be present in the water service line work area; however, RCRA Characteristic Hazardous Waste is present in soil at the Durham Manufacturing Facility.

2. Connecticut-Regulated Soils containing VOCs: Soil with one or more volatile organic compounds at concentrations exceeding applicable CT Remediation Standard Regulations and/or Cleanup Levels, but not hazardous waste.

3. Connecticut-Regulated Soils not containing VOCs: Soil with one or more compounds not including VOCs at concentrations exceeding applicable CT Remediation Standard Regulations and/or Cleanup Levels, but not hazardous waste.

1.05 SUBMITTALS

A. Submit in accordance with Section 01300 – Submittals.

B. Submittals shall include all required information specified in this section.

C. Soil Management Plan: The Contractor shall provide the plan to the Engineer for review 60 calendar days after NTP.

D. Destination Facilities: No less than three weeks prior to transport of any contaminated material off-site, the Contractor shall submit a written list of proposed destination facilities, including facility name, address, contact name and phone number, title of contact person, and EPA permit numbers for the facility, the facility criteria for acceptance (test type and frequency) of soil, and any other relevant information related to the facility, including but not limited to: working hours; days of operation; name, address, and telephone number of the chief municipal officer and health officer of the town/city in which the landfill or recycling/disposal facility is located; and information on landfill closure schedule, if applicable. A complete copy of the EPA Off-Site Compliance Request Form shall be provided.

E. Transporters: No less than one week prior to transportation, provide name and address of all hazardous material transporters to be used to complete project including state transporter identification number and expiration date and proof of permit, license, or authorization to transport hazardous material in all affected states.

F. Shipping documents for excavated materials: The Contractor shall submit the signature-ready shipping documents to Contracting Officer for signature 14 days prior to soil removal. Submittals shall be prepared in accordance with applicable regulations.

G. Excavated Material Disposal Report: The Contractor shall provide the completion report to the Contracting Officer within 30 days of completion of soil removal.

H. Completed Shipping documents: Within twenty-one (21) days after final transport off-site of contaminated soil or water, the Contractor shall submit completed copies of the documentation related to the disposal, including but not limited to certified disposal facility weight slips. The Contractor shall submit final shipping documents to state agencies as required by state regulations of Connecticut and the destination states, with copies provided to the Contracting Officer.

1.06 PERFORMANCE REQUIREMENTS

A. General Requirements:

1. The Contractor shall provide all facilities, labor, materials, tools, equipment, transportation, supervision, and related Work necessary to complete the Work specified in this section.

2. The Contractor shall be responsible for excavation and removal of material for legal disposal. The Contractor shall excavate, manage, handle, segregate, store, load, treat, recycle, reuse, transport, discharge, and/or dispose of soils in compliance with the provisions of CT RSRs and all other applicable federal, state, and local regulations and bylaws, and the criteria of this section.

3. The Contractor shall be responsible for all material characterization, sampling and analysis.

4. The Contractor may choose to characterize excavated soil from on-site stockpiles or may choose to precharacterize soils in place prior to excavation to allow direct loading of excavated materials. Characterization methods must comply with the requirements of the disposal facility.

5. Excavated material storage, transportation, disposal and treatment, dust and vapor control measures, field monitoring, and contingencies for materials suspected or confirmed to be contaminated are also included in the Work to be performed by the Contractor.

6. Construction workers, surrounding human populations and environmental receptors shall be protected from exposure to oil or hazardous materials during excavation activities.

B. Excavation Requirements

Excavation activities shall be limited to only those actions that are necessary for completion of the project. Excavation shall be performed in a local and controlled manner, such that it does not result in exacerbation of existing contamination.

1. Excavate materials by methods that will permit observation to identify, test, and segregate excavated materials, and that will reduce the potential for mixing materials with different classifications.

2. The Contractor shall allow sufficient time for the Contracting Officer to observe the excavation and excavated materials, and shall collect representative samples for use by the Contracting Officer as directed by the Contracting Officer

3. Excavated material removed from the project area shall be managed in compliance with the provisions of all applicable Federal, State and local laws.

4. The Contractor shall notify the Contracting Officer immediately of excavated material that is observed to be contaminated with a separate phase product, or a waste not otherwise specified that cannot be identified by field inspectors. Further excavation shall be halted until the Contractor and the Contracting Officer evaluate the situation and determine the appropriate course of action to safeguard workers, the public, and the environment.

C. Excavated Material Handling and Storage

1. The Contractor shall implement a soil tracking system in compliance with the Soil Management Plan.

2. The Contractor shall manage materials encountered during excavation in a manner that is protective of health, safety, public welfare, and the environment.

3. The handling and storage of excavated soil material shall be within the Site boundary designated on the Drawings, according to the procedures presented herein and as directed by the Contracting Officer.

4. Excavated material stockpiles, if used, shall be covered and secured as required in this section, to minimize airborne transport of material, runoff, and saturation and seepage from precipitation. The Contractor has the option of drumming excavated material for off-site disposal.

5. The Contractor shall be responsible for scheduling and coordinating the removal of material from the Site based on the available space. It shall be the Contractor's responsibility to obtain the required chemical testing data in a timely manner consistent with the Contractor's schedule for removing excavated materials.

6. The Contractor shall perform an analytical characterization program of the material as required by the destination facility. The Contractor shall obtain a laboratory and provide all labor and materials to collect soil samples and to transport the samples to the laboratory for chemical analysis in accordance with the requirements of the contract documents. The Contractor shall provide the characterization data to the Contracting Officer.

7. Based on the characterization results and comparison to material classifications identified herein, the Contractor may elect to perform supplemental characterization testing to provide information necessary to obtain facility approval at no additional cost to the Contracting Officer.

D. Excavated Material Transport and Disposal

1. The Contractor shall be responsible for the legal disposal of all excavated material generated during the Work.

2. All excavated material shall be transported to and disposed of at a permitted disposal facility approved by EPA for such materials.

3. The Contractor shall evaluate the material based on the testing data and propose the destination facility and contract directly with the facility for the disposal of the material. The Contractor shall provide documentation to the Contracting Officer, with supporting analytical data and rationale, that the facility may accept the material under its governing permit(s).

4. The Contractor shall prepare signature-ready drafts of shipping documents for shipment of the material, and submit them and all supporting data to the Contracting Officer for review.

5. The Contracting Officer reserves the right to direct the Contractor to re-evaluate the destination facility determination, based on the Contracting Officer's interpretation of the excavated material characterization data, any analytical results from split samples the Contracting Officer may collect, or regulatory status of the facility. Upon approval of the destination facility and shipping papers by the Contracting Officer, the Contractor shall coordinate and make all necessary arrangements for transportation of the material to the appropriate reuse/disposal/treatment facility.

6. The Contractor shall not remove any excavated material from the Site without a shipping document signed by the Contracting Officer,

1.07 QUALITY ASSURANCE

A. Provide in accordance with Section 01400 – Quality Assurance.

B. General: The Contractor shall conform to all applicable requirements, ordinances, regulations, and laws.

C. Inspection

1. The Contracting Officer will observe the Contractor's activities associated with the Work under this section on behalf of the EPA and will provide on-site observation of excavation operations to assess:
   a. requirements for excavated material segregation, storage, and handling;
   b. requirements for excavated material transportation and final destination based on observations, screening and results of chemical characterization by the Contractor;
   c. Environmental controls at all excavated material storage areas.

2. All services shall be subject to inspection by the Contracting Officer. The Contracting Officer shall have the right, but not the duty, to inspect and obtain copies of all written licenses, training records, permits, and approvals issued by any government entity or agency to the Contractor, which are applicable to the performance of services under this section; to inspect and test, at its own expense, transportation vehicles or vessels, containers, and treatment facilities provided by the Contractor; and to inspect the handling, loading, storage, transportation, treatment, and disposal operations conducted by the Contractor in the performance of the Work.

3. The Contracting Officer will have the right to inspect and obtain duplicates of all samples collected by the Contractor. If requested, the Contractor shall collect and supply these samples to the Contracting Officer for analyses by the Contracting Officer's laboratory. Contractor shall resolve any discrepancies between Contractor and Contracting Officer analytical results to the satisfaction of the Contracting Officer at no additional cost to the Contracting Officer. Actions to resolve discrepancies may include review of data or resampling and analysis at no additional cost to the Contracting Officer.

4. The Contracting Officer will be afforded free access to any facility used by the Contractor and any Subcontractors in performing the services described in this section, including offices and facilities where contract-related records are retained.

5. The Contractor is solely and exclusively responsible for the quality of all services performed under this contract. The Contracting Officer's right to conduct inspections at Contractor or Subcontractor facilities does not relieve the Contractor of this responsibility. Neither the Contracting Officer's failure to make such inspection, nor failure to discover nonconforming services, impose any liability on the Contracting Officer, shall prejudice the rights of the Contracting Officer thereafter to reject services, nor relieve the Contractor of its obligation to perform Work strictly in accordance with the contract and applicable local, State and Federal regulations.

6. The Contractor shall be responsible for all corrective actions required to address non-compliance issues discovered during inspections at no additional cost to the Contracting Officer.

1.08 PROJECT/SITE CONDITIONS

A. Environmental sampling and analysis has been conducted throughout the project area. Subsurface soils and groundwater were sampled and analyzed as summarized in the referenced reports. Refer to Soil Analytical Results Table, provided in Appendix D of the Contract Documents.

B. The Contractor is responsible for determining if such information is valuable for completing the Work. No basis for claim shall result from the Contractor's failure to completely characterize any waste material.

C. Historic data in Appendix D are made available to the Contractor for information only and shall not be interpreted as a warranty of subsurface conditions.

PART 2 - PRODUCTS

2.01 PRODUCTS

A. Soil Management Plan: The Soil Management Plan shall identify: (a) specific plans and proposed implementation schedule for Work, including excavated material storage, erosion control, and soil transportation and disposal, (b) contingency procedure for notification of the Contracting Officer of unexpected contamination and of modifications to the plan, and (c) proposed environmental monitoring. The Soil Management Plan shall include:

1. Proposed destination facilities.

2. Characterization data to be collected by the Contractor as needed by their disposal facilities.

3. Plan for building and removing stockpiles relative to the disposal categories identified in this section, including a location map.

4. Transport document procedures for transport from the Site to final destination. Documentation required by the destination state must be provided.

5. Soil tracking system to track all excavated soils between excavation and final disposition. The tracking system shall consist of, for each category of soil transported:
   a. Location, depth, and date of excavation
   b. Stockpile or drum identification and location, if applicable
   c. Stockpile sampling locations, if applicable
   d. Daily log sheets and field records documenting field screening and chemical characterization sampling

6. Procedures for routine field screening and observation during excavation, including:
   a. Frequency of screening and observations

b. Checklist for visual and olfactory observations
c. Instructions for headspace screening
d. Equipment and instrument requirements

B. Shipping documents for excavated materials: The Contractor shall submit the signature-ready shipping documents to Contracting Officer for signature 14 days prior to soil or waste removal. Submittals shall be prepared in accordance with applicable regulations.

C. Excavated Material Disposal Report. The report shall include details of waste quantities, means and location of disposal and following information, as applicable:

1. Description of Work performed, including deviations from the Soil Management Plan

2. Soil characterization data

3. Summary of soil quantities removed and transported to each destination facility and dates of transport

4. Certificates of final treatment/disposal signed by the responsible facility official

D. Completed Shipping documents.

1. Each transport document shall note the truck registration number, state of registration, driver, and date of removal.

2. Within twenty-one (21) days after final transport off-site of any material, the Contractor shall submit completed copies of the documentation related to the disposal, including but not limited to: certified disposal facility weight slips.

3. The Contractor shall submit final shipping documents to state agencies as required by state regulations of Connecticut and the destination states, with copies provided to the Contracting Officer.

2.02 MATERIALS

A. Polyethylene plastic: Provide polyethylene plastic sheeting with a minimum thickness of 20 mil (liner) and polyethylene sheeting with a thickness of 6 mil (cover).

B. Jersey barriers and/or hay bales to segregate the Work areas and excavated material storage perimeters.

C. Granular absorbent: Provide granular absorbent such as Speedy-Dry or approved equal.

D. Furnish all drums, storage containers, packing materials, and related products, and materials required for collecting, storing and transporting hazardous materials in compliance with State, EPA, and U.S. DOT requirements.

2.03 EQUIPMENT

A. Photoionization detector capable of calibrating to 100 parts per million by volume (ppmv) for use in field screening. Photoionization detector shall have a minimum detection limit of 1 ppmv. Calibration standard shall be suitable for known site-related contaminants.

PART 3 - EXECUTION

3.01 APPLICATION

A. Characterization of Site Soil

1. The Contractor shall be responsible for characterizing soil for appropriate disposal. The Contractor may choose to perform precharacterization of soil prior to excavation to allow load and go operations.

2. The Contractor shall be responsible for collection, transporting, and analyzing all soil samples.

3. The Contractor shall inform the Contracting Officer prior to collecting samples so that the Contracting Officer can observe the sampling locations and procedures.

4. All sampling shall be performed in accordance with Sampling and Analysis Plan prepared by the Contractor and approved by the Contracting Officer (Section 01410).

5. The Contractor shall evaluate the soil based on the testing data and proposed destination facility based on the resultant classification of the material.

B. Field Screening and Observation During Excavation

1. The Contractor shall conduct field screening of excavated materials, as it is generated, to identify gross contamination (if present) that could affect construction safety and subsequent handling of excavated materials.

2. Excavated soils will be field-screened for the presence of oil and hazardous materials, using appropriate visual, ambient air, and jar headspace evaluations. For ambient air and jar headspace screening, a photoionization detector or suitable equivalent and calibrated daily shall be used.

3. Headspace Screening Criteria: Headspace screening will be performed whenever there are obvious visual or olfactory changes in the material or at least once every hour during the excavation or for every 50 cubic yards of material or as required to fully evaluate the soil. Excavated material will be segregated based on headspace readings

for separate chemical characterization by laboratory analysis in order to isolated soils with different levels of contamination that may be suitable for different destination facilities. Excavated materials shall be segregated by headspace reading as follows: less than 10 ppmv, 10 ppmv to 100 ppmv, and greater than 100 ppmv.

4. Visual and Olfactory Criteria: Excavated soils shall be monitored for visual and olfactory evidence of contamination, including, but not limited to, discoloration, texture, and odor. If material has staining or odor; or exhibits unnatural color, product, unidentified waste or other indications of contamination, the excavated material will be segregated from other excavated materials for separate chemical characterization by laboratory analysis.

C. Embedded Debris

1. Embedded debris which exceeds size requirements of the destination facility shall be separated from soil.

2. Embedded debris shall be cleaned of loose materials and inspected for staining, odor, or evidence of contamination.

3. The Contractor shall notify the Contracting Officer of embedded debris which has evidence of contamination prior to off-site transport.

4. Embedded debris which has evidence of contamination shall be set aside for evaluation by the Contracting Officer.

5. Embedded debris shall be broken to a size to facilitate hauling and disposal.

6. All embedded debris shall be disposed of at an EPA-approved facility

7. Embedded debris that is free of evidence of contamination shall be classified as a Connecticut-Regulated Soil not containing VOCs.

D. Management of Excavated Material Storage Areas

1. The Contractor shall coordinate with the Contracting Officer and with to identify a suitable location within the property boundary for the temporary storage of excavated material prior to transport off-site.

2. The Contractor shall store material in a manner that is protective of health, safety, public welfare, and the environment.

3. Excavated material that has been characterized and is awaiting disposal shall be segregated from uncharacterized soils and from grossly contaminated soils.

4. Stockpiling, if used, shall be done according to the following procedures:

a. All excavated material storage shall be performed within the security of continuous construction fencing.
b. The Contractor shall be responsible for protecting each stockpile from precipitation, stormwater runoff, and other forms of moisture.
c. The Contractor shall place polyethylene sheeting (20 mil) on ground in excavated material stockpile area or drum storage area, with a minimum overlap of 18 inches for adjacent sheets, and overhanging the berm or containment.
d. All stockpiles shall be shaped and graded to facilitate surface drainage. The Contractor shall take appropriate measures to prevent dust and leachate from leaving any stockpile.
e. Place stockpiled soil on prepared surface.
f. Cover the stockpiles at all times with polyethylene or other suitable tarp, secure the cover in place to prevent dust blow off and withstand wind and rain.
g. Hold downs which will not tear the sheeting (i.e., tires or sand bags) shall be used approximately every 15 feet.
h. Collect drainage water for transport and treatment in accordance with Section 02241 – Construction Water Management. Alternately, the Contractor may elect to dispose of water at an off-site facility in lieu of on-site treatment and discharge, at no additional cost to the Contracting Officer, the EPA, or the State.
i. Minimize the contact of workers and passers-by with stockpiled material.
j. Clearly label, mark, and classify stockpiles or drums by type, for recycling, reuse or disposal.
k. Alternatively, excavated material shall be stored as directed in the Soil Management Plan in a manner that provides similar level of control of emissions, runoff, and leachate.

5. Based on analytical results and as approved by the Contracting Officer, the Contractor may merge or further segregate stored materials.

6. Storage shall comply with the substantive requirements of the Connecticut General Permit for Contaminated Soil and/or Sediment Management (Staging and Transfer) (Section 22a-208a(i)).

7. Under no circumstances will stored excavated material be allowed to remain in storage for longer than 45 days.

E. Transportation and Disposal of Excavated Material

1. No excavated material shall be transported from the Site until all shipping documents are completed.

2. The Contractor shall be responsible for proper handling, loading, transportation and disposal of materials in accordance with applicable federal, state and local laws.

3. Prior to transport the Contractor shall drain all materials of free liquid. Liquids shall be collected and transported to a location designated by the Contracting Officer for treatment and disposal, in accordance with Section 02241 – Construction Water Management. Alternately, the Contractor may elect to dispose of water at an off-site facility in lieu of on-site treatment and discharge, at no additional cost to the Contracting Officer, the EPA, or the State.

4. The Contractor shall not remove excavated material from the Site without approval of the Contracting Officer.

5. The Contractor shall load and transport material to the receiving facilities in accordance with U.S. DOT, EPA, OSHA, and State regulations.

6. The Contractor shall utilize hauler(s) that are licensed in all states affected by transport.

7. The Contractor shall coordinate the schedule for truck arrivals and departures at the storage areas to meet the approved project schedule.

8. Materials shall not be delivered to any facility other than that listed on the transport document.

9. The Contractor shall be responsible for inspecting the access routes for road conditions, overhead clearance, and weight restrictions, and shall provide traffic control when needed.

10. Materials removed for disposal shall be loaded within the limits of the storage area. A tarpaulin shall cover all trucks leaving the project areas. Soil material shall be removed from truck tires within a designated decontamination area prior to leaving the storage area. The Contractor shall take all steps necessary to prevent debris and fluid from being spilled from trucks or tracked from the storage area onto local streets. Each workday or more often as conditions warrant or as directed by the Contracting Officer, the Contractor shall clean local streets of any spillage, soil, and debris.

F. Handling of Characteristic Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations (if applicable).

1. All materials shall be disposed of in accordance with the EPA Off-Site Rule.

2. The Contractor shall prepare hazardous waste manifest(s) identifying the EPA Region 1 as the generator. Contracting Officer shall sign the manifests as an agent for the EPA prior to transport and disposal of hazardous wastes. The Contractor shall track and distribute all copies of the manifest to the appropriate agencies and the Contracting Officer. The Contractor shall provide a copy of the manifest for review by the Contracting Officer prior to scheduling waste pick-up.

3. The Contractor shall provide for the safe transportation of all hazardous waste materials for proper final disposal at a licensed facility.

4. Disposal Facility Requirements:
   a. The Contractor shall furnish to the Contracting Officer, no less than three weeks prior to disposal, the names, locations, EPA/RCRA ID numbers, facility contacts, and documentation that the facilities will accept the waste, for at least two eligible disposal facilities. The Contractor shall designate one disposal facility as the primary facility and the other as the alternate facility should project conditions require the use of a back-up facility. Any additional costs if an alternate facility is used shall not be incurred by the Contracting Officer.
   b. The final disposal facilities shall be approved by EPA prior to removal of any hazardous wastes. A completed copy of the EPA Off-Site Rule Compliance Request Form shall be provided to the Contracting Officer. Coordination of this approval shall be conducted by Contracting Officer.
   c. Contractor-selected disposal facilities shall be established, fully operational, and in full compliance with all applicable federal, state and local regulations. The Contractor shall document that the disposal locations proposed have all certifications and permits as required by local, State, and Federal regulatory agencies to receive and dispose of hazardous materials or wastes, including tank, drums and tank and drum contents.
   d. The Contractor shall obtain approvals or letters of intent and facility information for the disposal facilities and/or recycle facilities selected to receive wastes. The Contractor shall furnish such documents to the Contracting Officer no less than one week prior to disposal. The facilities information shall include the following:
      1) The disposal facilities shall provide written confirmation that they are permitted to accept and will accept the hazardous waste of the general quality and quantity described by these specifications.
      2) The disposal facilities shall provide a listing of all permits, licenses, letters of approval, and other authorizations to operate that they hold, pertaining to the receipt and management of the waste specified in these specifications.

5. Transportation Requirements
   a. Before offering hazardous waste for transportation off-site, the Contractor shall package that waste in compliance with applicable regulations of the Department of Transportation (DOT), 49 CFR Parts 173, 178, and 179.
   b. Before offering hazardous waste for transportation off-site, the Contractor shall label each package in compliance with the applicable regulations of the DOT, 49 CFR Part 172, as may be amended from time to time.
   c. Before transporting hazardous waste off-site, the Contractor shall placard, or offer the initial transporter the appropriate placards, in compliance with regulations of the DOT, 49 CFR Part 172, as may be amended from time to time.
   d. The Contractor shall transport material off-site for final disposal to the disposal facility approved by the EPA and Contracting Officer.
   e. The Contractor shall transport material from the Site to the disposal facilities in accordance with all DOT, EPA, state, local, and other applicable regulations.

f. The Contractor and/or transporter(s) shall be licensed in all states affected by transport.
g. The Contractor shall be responsible for ensuring that all containers are labeled and sealed properly and that spillage does not occur during transport.
h. The Contractor shall maintain complete control of the transport of waste and in case of a spill, shall be responsible for all clean-up.
i. The vehicle which is used for the transport of hazardous waste shall bear all markings, including placards, required by any federal or state statute or regulation.
j. The Contractor shall have in place:
    1) Current registration with DOT via the Hazardous Materials Certificate of Registration;
    2) Insurance coverage based on type of waste/vehicle;
    3) DOT safety rating;
    4) Results of state inspections of terminals which usually address level of maintenance and the general condition of the company's equipment;
    5) Verification that Contractor keeps transportation manifests on file for three years from the date of transport, including emergency telephone numbers;
    6) Name and address of all hazardous waste transporters; and
    7) EPA identification number and expiration date.

6. Vehicle for off-site transport of hazardous waste must be DOT approved and must display the proper DOT placard. Such vehicles must also conform with appropriate State(s), local, Federal hazardous materials requirements and/or other relevant transportation requirements.

I. Spill Responsibility

1. The Contractor is solely responsible for any and all spills or leaks of hazardous materials during the performance of the Work which occur as a result of or are contributed to by the actions of its agents, employees, or Subcontractors. The Contractor agrees to clean up such spills or leaks to the satisfaction of the Contracting Officer and in a manner that complies with applicable Federal, State and local laws and regulations.

END OF SECTION

CT DEEP Guidance for Utility Company Excavation

The Department of Energy & Environmental Protection (DEEP) currently recommends the following procedure to be followed by utilities that encounter contaminated soil during repair or construction activities. This applies to cases where:

1. Contaminated soils/waste are encountered on property not owned by the utility, and
2. Contamination was not created by the utility.

The utility may reuse the contaminated soil in the same excavation within the same area of concern without prior approval by DEEP provided:

1. Any condition that would be a significant environmental hazard as defined in CGS Section 22a-6(u) is reported by the utility and that the location is identified on a map submitted to the DEEP Remediation Division.
2. Any excess contaminated material is disposed in accordance with solid and hazardous waste regulations as appropriate.
3. The upper 1 foot of the excavation is filled with clean fill material or paved.

Any sampling required to make a determination as to whether a significant environmental hazard exists or how excess soils will be disposed will be the responsibility of the public or private entity performing the excavation.

SECTION 02100

SITE PREPARATION

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide labor, material, tools, and equipment to prepare site as indicated and specified.

1.02 RELATED WORK:

A. Section 02210: Earth Excavation, Backfill, Fill and Grading

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 EXISTING TREES AND VEGETATION:

A. Avoid cutting or injuring trees and vegetation outside easement line and outside areas to be cleared as indicated, without Contracting Officer's permission.

B. Accept responsibility for damages outside these lines.

C. Remove trees and stumps within permanent and temporary easement as designated by Contracting Officer or as indicated.

3.02 EXISTING STRUCTURES AND PROPERTY:

A. Remove existing signs, posts, catchbasin frames and grates, manhole frames and covers, and granite curbing within construction path unless directed otherwise.

B. Store at a site designated by Contracting Officer, items in reusable condition as determined by Contracting Officer.

C. For work in loamed areas, strip loam to one side to avoid mixing with excavation materials. Do not take loam from site.

3.03 CLEARING:

A. Cut or remove trees, brush, and other vegetable matter such as snags, bark and refuse, from areas to be cleared. Clear ground to width of permanent easement unless otherwise directed.

B. Cut trees, stumps, and stubs to be cleared, except where clearing done by machinery, as close to ground surface as practicable, but no more than 6 in. above ground surface for small trees and 12 in. for larger trees.

C. Bury elm bark, at least 1 ft. deep, or burn in incinerators off site with antipollution controls and fire prevention controls, to prevent spread of Dutch Elm disease as required by applicable laws.

3.04 CLEARING IN WOODED AREAS:

A. Chip and stockpile wood cleared at location directed by Contracting Officer. Do NOT PERMIT use of elm wood and elm bark as wood chips.

3.05 GRUBBING, STRIPPING, DISPOSAL:

A. Remove stumps and roots larger than 1/2 in. in diameter to the depth of 12 in below proposed water main.

B. Strip stumps, roots, foreign matter, topsoil, loam and unsuitable earth from ground surface. Utilize topsoil and loam insofar as possible for finished surfacing. Do not take loam from site.

C. Promptly dispose off site material from clearing and grubbing not reused or stockpiled. In doing so, observe all applicable laws, ordinances, rules and regulations. Do not consider work completed until final cleaning, unless otherwise directed.

3.06 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 02160

EXCAVATION SUPPORT SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide excavation support systems as indicated and in compliance with Contract Documents.

B. Design, furnish, and install excavation support systems to maintain lateral support, prevent loss of ground, limit soil movements to acceptable limits and protect from damage existing and proposed improvements including pipelines, utilities, structures, roadways, railroads and other facilities.

C. The requirement of specified excavation support systems in areas indicated on the drawings does not relieve the Contractor from the responsibility of furnishing and installing proper temporary excavation support systems in other areas.

D. Common types of excavation support system include, but are not limited to; singular or multiple stages comprised of cantilevered or internally braced soldier piles and lagging, steel sheetpile wall, timber sheetpile wall, trench box, or combinations thereof. Trench box temporary excavation support system is only acceptable for pipe or utility trench excavations approved by the Contracting Officer. Temporary unsupported open cut excavation with stable sloping sides is allowed where applicable.

E. Extraction of steel sheetpile wall, timber sheetpile wall, or solider piles are not permitted unless otherwise indicated, specified or approved by the Contracting Officer.

F. Wherever the word "sheeting" is used in this section or on the contract drawings, it shall be in reference to any type of excavation support system specified except trench box.

G. Construction of the excavation support systems shall not disturb the existing structures or the completed proposed structures. Damage to such structures shall be repaired at Contractor’s expense.

H. Adjacent structures are those that are bear upon soils above the proposed excavation depth and within a distance equal to twice the total depth of the excavation away from the closest edge of the excavation. Monitor and protect adjacent structures as specified and indicated.

I. Vibration monitoring for excavation support systems shall be performed as specified in Section 02180.

J. Bear the entire cost and responsibility of correcting any failure, damages, subsidence, upheaval, or cave-ins as a result of improper installation, maintenance or design of the excavation support systems. Pay for all claims, costs and damages that arise as a result of the Work performed at Contractor's expense.

1.02 REFERENCES:

A. American Concrete Institute (ACI):

1. 304: Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.

B. American Society for Testing and Materials International (ASTM):

1. A36: Standard Specification for Structural Steel.

2. A416: Standard Specification for Strand Steel, Uncoated Seven Wire for Prestressed Concrete.

3. A572: Standard Specification for High-Strength Low Alloy Columbium-Vanadium Structural Steel.

4. A615: Standard Specifications for Deformed and Plain Billet Steel Bars for Concrete Reinforcement

5. A722: Specification for Uncoated High Strength Steel Bar for Prestressing Concrete

C. American Wood-Preserves Association (AWPA) Standards.

1. P23-10: Standard for Chromated Copper Arsenate Type C (CCA-C).

2. P50-10: Standard for Fire Retardant FR-2 (FR-2).

D. American Welding Society (AWS)

1. D1.1: Structural Welding Code.

E. Occupational Safety and Health Administration (OSHA) Standards and Regulations contained in Title 29: Subpart P - Excavations, Trenching, and Shoring.

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01300.

1. Submit the following qualifications four (4) weeks prior to the construction:

a. Qualifications of Contractor's excavation support system designer as specified in Paragraph 1.04.G.

b. Qualifications of Contractor's excavation support system installer as specified in Paragraph 1.04.H.

c. Qualifications of Contractor's independent tieback testing laboratory as specified in Paragraph 1.04.I, if a tieback system is utilized.

d. Qualifications of Contractor's excavation support system installation supervisor as specified in Paragraph 1.04.J.

e. Qualifications of vacuum excavation subcontractor as specified in Paragraph 1.04.F, if DMPs for utilities are utilized.

2. Submit an excavation support plan stamped and signed by a Registered Professional Engineer at least two weeks prior to start of the construction. Do not submit design calculations. The review will be only for the information of the Contracting Officer and third parties for an overall understanding of the project relating to access, maintenance of existing facilities and proper utilization of the site. The Contractor remains responsible for the adequacy and safety of the means, methods, and sequencing of construction. The plan shall include the following items as a minimum:

a. Proposed excavation support system(s), details, location, layout, depths, extent of different types of support relative to existing features and the permanent structures to be constructed, and methods and sequence of installation and removal.

b. Certificate of Design: Refer to Section 01300.

c. A list of all design assumptions, including safety factors used for the excavation support system(s) and all lateral pressures used for each system.

d. If utilizing a tieback system, include tieback installation procedures and criteria for acceptance of tiebacks for performance and proof tests. Submit the tieback testing results to the Contracting Officer for information only.

e. Requirements of dewatering during the construction.

f. Minimum lateral distance from the edge of the excavation support system for use for vehicles, construction equipment, and stockpiled construction and excavated materials.

g. List of equipment used for installing the excavation support systems.

h. Monitoring schedule, installation procedures and location plans for vibration/noise monitoring, geotechnical instrumentation (deformation

monitoring points and inclinometers) and observation wells/piezometers to monitor ground, excavation support system, adjacent structures and groundwater fluctuation during the entire construction period.

3. Submit a Construction Contingency Plan specifying the methods and procedures to maintain excavation support system stability if the allowable movement of the adjacent ground and adjacent structures is exceeded.

4. Monitoring data within one (1) day of data collection from vibration and noise recording equipment, observation wells, deformation monitoring points and offset lines. Data shall include:

   a. Horizontal and vertical movements of geotechnical instruments and groundwater readings.

   b. New movements since the initial readings of the geotechnical instruments.

   c. Weekly summary in tabular and graphic form at the end of each week.

   d. A schematic plan of excavation and/or relevant construction activities at the time of monitoring.

5. For excavation support systems left in place, submit the following as-built information prior to backfilling and covering the excavation support systems:

   a. Survey locations of the excavation support systems, including coordinates of the ends and points of change in direction.

   b. Type of the excavation support system.

   c. Elevations of top and bottom of the excavation support systems left in place.

1.04 QUALITY ASSURANCE:

A. Provide in accordance with Section 01400.

B. Conform to the requirements of the OSHA Standards and Interpretations: "Part 1926 Subpart P - Excavation, Trenching, and Shoring

C. Construction operations to conform to noise regulations provided in the Noise Control Plan and this Section.

D. Retain the services of an independent vibration consulting firm meeting the requirements as specified in Section 02018.

E. The peak particle velocity for pile driving, or other vibration-inducing operations, shall meet the requirements as specified in Section 02018.

F. If utilizing deformation monitoring points (DMPs) for utilities, vacuum excavation shall be performed by subcontractor having five (5) years of experience in non-destructive vacuum excavation methods for utilities.

G. Prepare design, including calculations and drawings, under the direction of a Professional Engineer registered in the state where the project is located and having the following qualifications:

1. Not less than ten (10) years experience in the design of specific excavation support systems to be used.

2. Completed not less than five (5) successful excavation support system projects of equal type, size, and complexity within the last five (5) years.

H. Excavation Support System Installer's Qualifications:

1. Not less than three (3) year experience in the installation of similar types and equal complexity as the proposed system.

2. Completed not less than three (3) successful excavation support systems of similar type and equal complexity as the proposed system.

I. If utilizing a tieback system, employ an independent testing laboratory to test the tieback system with the following qualifications:

1. Be accredited by the American Association of State Highway and Transportation Officials (AASHTO) Accreditation Program.

2. Employ personnel conducting testing who are trained in the methods and procedures to test and monitor tieback systems of similar type and equal complexity, as the proposed system.

3. Have not less than five (5) years experience in testing of tieback systems of similar type and equal complexity as the proposed system.

4. Have successfully tested at least three (3) tieback systems of similar type and equal complexity as the proposed system.

J. Install all excavation support systems under the supervision of a supervisor having the following qualifications:

1. Not less than five (5) years experience in installation of systems of similar type and equal complexity as the proposed system.

2. Completed at least five (5) successful excavation support systems of similar type and equal complexity as the proposed system.

K. All welding shall be performed in accordance with AWS D1.1.

1.05 DESIGN CRITERIA:

A. Design of excavation support systems shall meet the following minimum requirements:

1. Support systems shall be designed for earth pressures, hydrostatic pressure, equipment, temporary stockpiles, construction loads, roadways, railroads, and other surcharge loads.

2. Design a bracing system to provide sufficient reaction to maintain stability.

3. Limit movement of ground adjacent to the excavation support system to be within the allowable ground deformation as specified.

4. Design the embedment depth below bottom of excavation to minimize lateral and vertical earth movements and provide bottom stability. Toe of braced temporary excavation support systems shall not be less than 5 feet below the bottom of the excavation.

5. Design excavation support systems to withstand an additional 2 feet of excavation below proposed bottom of excavation without redesign except for the addition of lagging and/or bracing.

6. Maximum width of pipe trench excavation shall be as indicated on the drawings.

7. Do not cast permanent structure walls directly against excavation support walls.

8. The design location of the excavation support wall shall be determined such that the installed wall and bracing system components are all located outside the limits of the permanent structure. Construction tolerances (e.g. wall verticality) shall be considered in determining the plan location.

1.06 DELIVERY, STORAGE AND HANDLING:

A. Provide in accordance with Sections 01610 and as specified.

B. Store sheeting and bracing materials to prevent sagging which would produce permanent deformation. Keep concentrated loads which occur during stacking or lifting below the level which would produce permanent deformation of the material.

1.07 PROJECT CONDITIONS:

A. Subsurface Soil Conditions: Refer to Section 02100 and Appendix A.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Structural Steel: All soldier piles, wales, rakers, struts, wedges, plates, waterstop and accessory steel shapes shall conform to ASTM A36.

B. Steel Sheet Piling: ASTM A572, continuous interlocking type.

C. Timber Lagging Left in Place: Pressured treated per AWPA standards.

D. Tieback Tendons: Tieback tendons shall be high strength steel wire strand cables conforming to ASTM A416, or bars conforming to ASTM A722. Splicing of individual cables shall not be permitted.

E. Raker Ties: ASTM A615 Grade 60.

F. Cement Grout Materials And Admixtures For Tieback Anchorages: Grout cube strength shall be a minimum 3500 psi at 7 days and 5000 psi at 28 days.

G. Concrete: Section 03300.

H. Tamping tools adapted for backfilling voids after removal of the excavation support system.

I. Provide specific trench box sizes for each pipe and utility excavation with structural capacity of retaining soil types as described in OSHA's 29 CFR Part 1926 Subpart P.

2.02 EQUIPMENT:

A. A vibratory hammer shall be utilized for driving the sheet piling providing that such operations do not exceed vibration/noise requirements of the specifications. Impact hammer shall be utilized when vibratory hammer is unable to drive sheet piling to required depth and/or unable to meet vibration requirements. Impact hammer shall also meet noise requirement.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Installation of the excavation support systems shall not commence until the related earth excavation and dewatering submittals have been reviewed by the Contracting Officer with all Contracting Officer’s comments satisfactorily addressed.

B. Install excavation support systems in accordance with the excavation support plan.

C. If utilizing a tieback system, all performance and proof tests shall be conducted in the presence of the Contracting Officer. Testing performed without the Contracting Officer present is considered invalid. Repeat testing in the Contracting Officer's presence at Contractor’s expense.

D. Do not drive sheeting within 100 feet of concrete less than seven (7) days old.

E. Carry out program of excavation support in such a manner as to prevent undermining or disturbing foundations of existing structures of Work ongoing or previously completed.

F. Bottom of the trench box excavation support system shall be above the pipe invert prior to installing the pipe.

G. Install and read geotechnical instrumentation in accordance with the excavation support plan. Notify the Contracting Officer immediately if any geotechnical instrumentation is damaged. Repair or replace damaged geotechnical instrumentation at the sole option of the Contracting Officer and at Contractor’s expense.

H. Continuously monitor movements of the ground adjacent to excavation support systems and adjacent structures. In events of the measured movements approaching or exceeding the allowable movements, take immediate steps to arrest further movement by revising procedures such as providing supplementary bracing, filling voids behind the trench box, supporting utilities or other measures (Construction Contingency Plan).

I. Notify utility owners if existing utilities interfere with the excavation support system. Modify the existing utility with the utility owner’s permission or have the utility owner make the modifications at Contractor’s expense.

3.02 GROUND DEFORMATION ADJACENT TO EXCAVATION SUPPORT SYSTEMS:

A. Allowable Vertical (heave/settlement) and Lateral Movements: 2 inches maximum for the trench box excavation support system, and 1 inch maximum for other types of excavation support systems at any location behind the excavation support system.

B. Monitoring personnel shall use a procedure for reading and recording geotechnical instrumentation data which compares the current reading to the last reading during data collection to eliminate spurious readings.

C. Plot the observed ground deformation readings versus time. Annotate the plots with construction loading and excavation events having an impact on the readings. Evaluate plots by means of secondary rate-of-change plots to provide early warning of accelerating ground movements.

D. Notify the Contracting Officer when the allowable ground deformation is exceeded.

E. Implement Construction Contingency Plan under direction of the temporary excavation support system designer and the Contracting Officer.

3.03 REMOVAL OF EXCAVATION SUPPORT SYSTEMS:

A. Sheeting shall be left in place unless otherwise indicated.

B. When indicated, remove the excavation support system without endangering the constructed or adjacent structures, utilities, or property. Immediately backfill all voids left or caused by withdrawal of excavation support systems with bank-run gravel, screened gravel or select borrow by tamping with tools specifically adapted for that purpose.

C. When tiebacks are used, release tension in tiebacks as the excavation is backfilled. Do not leave tensioned tieback in place at the completion of the Work.

D. The excavation support system left-in-place shall be cut-off a minimum of 2 feet below the bottom of the next higher foundation level or a minimum of 5 feet below finished grade.

E. Conduct survey of the locations and final cut-off elevations of the excavation support systems left in place.

3.04 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 02210

EARTH EXCAVATION, BACKFILL, FILL, AND GRADING

PART 1 - GENERAL

1.01 DESCRIPTION:

1. Perform the following earth excavation, backfill, fill and grading as indicated or specified:

2. Make excavations to accommodate piping, conduits, foundations and other structures.

3. Provide materials for backfilling excavations and constructing embankments and fills as indicated and specified.

4. Construct embankments of compacted materials.

5. Grade surfaces to meet finished grades indicated.

6. Immediately notify the Contracting Officer if suspected hazardous materials are encountered and cease operations in that part of work.

7. Remove boulders within the excavation limits.

1.02 REFERENCES:

A. American Society for Testing and Materials (ASTM) Publications:

1. C33: Specification for Concrete Aggregates.

2. C136: Sieve Analysis of Fine and Coarse Aggregates.

3. D421: Practice for Dry Preparation of Soil Samples for Particle Size Analysis and Determination of Soil Constants.

4. D422: Test Method for Particle-Size Analysis of Soils.

5. D1140: Test Method for Amount of Material in Soils Finer than the No. 200 (75 Fm) Sieve.

6. D1556: Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.

7. D1557: Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft^3).

8. D2167: Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.

9. D2922: Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods. (Shallow Depth).

10. D3017: Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

11. D4318: Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

12. D4718: Practice for Correction of Unit Weight and Water Content for Soils Containing Oversized Particles.

13. D4944: Test Method for Field Determination of Water (Moisture) Content of Soil by the Calcium Carbide Pressure Tester Method.

14. D4959: Test Method for Field Determination of Water (Moisture) Content of Soil by Direct Heating Method.

15. D5080: Test Method for Rapid Determination of Percent Compaction.

16. Occupational Safety and Health Administration (OSHA) Standards and Regulations contained in Title 29: Subpart P - Excavations, Trenching, and Shoring.

1.03 DEFINITIONS:

A. Percentage of compaction is defined as the ratio of the field dry density, as determined by ASTM D1556 to the maximum dry density determined by ASTM D1557 Procedure C, multiplied by 100.

B. Proof Roll: Compaction with a minimum of 4 passes of a vibratory steel drum or rubber tire roller. Vibratory plate compactors shall be used in small areas where vibratory steel drum or rubber tire roller can not be used.

C. Acceptable Material: Material which does not contain marine silt or marine clay, organic silt or organic clay, peat, vegetation, wood or roots, stones or rock fragments over 6-inch in diameter, porous biodegradable matter, loose or soft fill, excavated pavement, construction debris, or refuse. Stones or rock fragments shall not exceed 40 percent by weight of the backfill material.

D. Unacceptable Materials: Materials that do not comply with the requirements for the acceptable material or which cannot be compacted to the specified or indicated density due to excessive moisture content or other reasons.

1.04 SUBMITTALS:

A. Submit the following in accordance with Section 01300:

1. Qualifications of the Contractor's Independent Testing Laboratory as specified in Paragraph 1.06 H, four (4) weeks prior to the execution of any earth excavation, backfilling, filling, or compaction process.

2. Submit an excavation, backfilling, and filling plan at least two weeks prior to start of any earth moving activities. The review will be only for the information of the Contracting Officer and third parties for an overall understanding of the project relating to access, maintenance of existing facilities and proper utilization of the site. The Contractor shall remain responsible for the adequacy and safety of the means, methods, and sequencing of construction. The plan shall include, but not be limited to the following items:

a. Detailed sequence of work.

b. General description of construction methods.

c. Numbers, types, and sizes of equipment proposed to perform excavation and compaction.

d. Details of dust control measures.

e. Proposed locations of stockpiled excavation and/or backfill materials.

f. Proposed surplus excavated material off-site disposal areas and required permits.

g. Details of erosion and sedimentation control measures which will prevent erosion and sedimentation during the earth moving activities.

3. The following material submittals shall be submitted to the Contracting Officer prior to backfilling and filling:

a. Screened Gravel: As specified in Section 02223.

b. Bank Gravel: As specified in Section 02224.

c. Select Borrow: As specified in Section 02225.

d. Crushed Stone: As specified in Section 02435.

e. Other Acceptable Materials: Laboratory testing results of gradation and moisture-density relationship. Submittal shall include specific location of the source and the date when sample was taken.

4. During Construction, submit written confirmation of fill lift thickness, in-place soil moisture content, and percentage of compaction to the Contracting Officer before placing the next lift or constructing foundations.

1.05 QUALITY ASSURANCE AND CONTROL:

A. Provide in accordance with Section 01400 and as specified.

B. Dewatering and Groundwater Control: Provide and maintain as specified in Section 02240.

C. Excavations shall be performed in the dry, and kept free from water, snow, and ice during construction. Bedding and backfill material shall not be placed in water. Water shall not be allowed to rise upon or flow over the bedding and backfill material.

D. Excavation Support Systems: Provide and maintain as specified in Section 02160.

1. The Contractor shall be solely responsible for making all excavations in a safe manner. All excavation, trenching, and related sheeting, bracing, etc. shall comply with the requirements of OSHA excavation safety standards (29 CFR Part 1926 Subpart P) and State requirements. Where conflict between OSHA and State regulations exists, the more stringent requirements shall apply.

2. Do not excavate, construct embankments, or fill until all the required submittals have been reviewed by the Contracting Officer.

3. Formulate excavation, backfilling, and filling schedule and procedures to eliminate possibility of undermining or disturbing foundations of partially and completed structures, pipelines and embankments or existing structures and pipelines.

4. Employ an independent testing laboratory to perform particle size and gradation analyses in accordance with ASTM D422, and to determine compactibility in accordance with ASTM D1557 for all the proposed backfill and fill materials, and monitoring field compaction operations. The Contractor’s independent testing laboratory shall have the following qualifications:

5. Be accredited by the American Associates of State Highway and Transportation Officials (AASHTO) Accreditation Program or the National Institute of Standards

and Technology (NIST) National Voluntary Laboratory Accreditation Program for at least the past 3 years.

6. Have three (3) years of experience in sampling, testing, and analysis of soil and aggregates, and monitoring field compaction operations.

7. Able to provide three (3) references from previous work.

8. Field Testing and Inspections:

9. By Contractor's independent testing laboratory, acceptable to the Contracting Officer, at Contractor's expense as specified in Paragraph 1.06 J.

10. Location of tests mutually acceptable to testing laboratory and the Contracting Officer or as directed by the Contracting Officer.

11. In the event compacted material does not meet specified in-place density, re-compact material and retest this area until specified results are obtained at no additional cost to the Contracting Officer.

12. Contractor's testing laboratory to perform inspection at least once daily to confirm lift thickness and compaction effort for entire fill area.

13. Contracting Officer may retain the services of an independent testing laboratory to conduct confirmatory testing and inspection.

14. Methods of Field Testing:

15. In-Place Density: ASTM D1556, ASTM D2167, or ASTM D2922.

16. In-Place Moisture Content: ASTM D3017, ASTM D4944, or ASTM D4959.

17. Material Testing Frequency: The following testing frequencies are minimum required for all structural and non-structural fill, grading, and embankment.

18. Field In-Place Density and Moisture Content - Screened gravel and crushed stone shall be compacted as specified and indicated. For other backfill and fill materials, minimum test frequency shall be as follows, and no less than one test per:

19. Trenches under structures, foundation preparation, or roadways sub-base: Every 500 linear feet per lift.

20. Trenches in areas without structures or roadways: Every 500 linear feet per alternate lift.

21. Paved Roadways or Parking Areas: Every 200 linear feet per lift.

22. Under Structure: 1,000 square feet per lift.

23. Around Structures: 1,500 square feet per lift.

24. Moisture Density - One per source, except for screened gravel and crushed stone. Repeat the moisture density test for every 500 cubic yard of material use, and whenever visual inspection indicates a change in material gradation as determined by the Contracting Officer.

25. Gradation Analysis - A minimum of one per source and for each moisture density test and whenever visual inspection indicates a change in material gradation.

26. Liquid Limit, Plastic Limit and Plasticity Index - Minimum of one test per 500 cubic yard of soil for use as fill material and whenever classification of material is in doubt as determined by the Contracting Officer.

27. Contracting Officer's testing laboratory may conduct confirmatory testing at a minimum frequency of 25% of the specified frequencies in paragraph 1.05 K, 1-4, or as directed by the Contracting Officer.

28. Construction Tolerances:

29. Construct finished surfaces to plus or minus ½ inch of the elevations indicated.

30. Grade cut and fill areas to plus or minus 0.20 foot of the grades indicated.

31. Complete embankment edges to plus or minus 6 inches of the slope lines indicated.

32. Provide the Contracting Officer with adequate survey information to verify compliance with above tolerances.

33. Cut pavement with a saw to prevent damage to remaining pavement without extra compensation. Where pavement is removed in large pieces, dispose of pieces before proceeding with excavation.

34. Pipes, drains, and other utilities may exist in certain locations not indicated on drawings. No attempt has been made to show all services. Completeness or accuracy of information given is not guaranteed.

35. Dig test pits considered as incidental to the normal excavation as indicated and specified in this Section, at no additional compensation.

36. Carefully support and protect from damage, existing pipes, poles, wires, fences, curbing, property line markers, and other structures, which the Contracting Officer determines must be preserved in place without being temporarily or permanently relocated. Should such items be damaged, restore without compensation therefore, to at least as good condition as that in which they were found immediately before the work was begun.

37. Whenever certain existing structures, as described below, are encountered, and the Contracting Officer so directs, change the location, remove and later restore, or replace such structures, or assist the Contracting Officer in doing so. Such work to be paid for under applicable items of work, otherwise as Extra Work.

38. In removing existing pipes or other structures, include for payment only those new materials which are necessary to replace those unavoidably damaged as determined by the Contracting Officer.

39. The preceding two paragraphs apply to pipes, wires, and other structures which meet the following: (a) are not indicated on the drawings or otherwise provided for, (b) encroach upon or are encountered near and substantially parallel to the edge of the excavation, and (c) in the opinion of the Contracting Officer, will impede progress to such an extent that satisfactory construction cannot proceed until they have been changed in location, removed (to be later restored), or replaced.

40. Restore existing property or structures as promptly as practicable.

41. If material unacceptable for foundation (in the opinion of the Contracting Officer) is found at or below the grade to which excavation would normally be carried in accordance with the drawings and/or specifications, remove such material to the required width and depth as directed by the Contracting Officer and replace it with screened gravel, select borrow, or concrete.

42. Do not remove excavation materials from the site of the work or dispose of except as directed or permitted by the Contracting Officer.

43. Haul away and dispose of surplus excavated materials at locations directed by the Contracting Officer at no additional cost to the Contracting Officer.

44. During progress of work, conduct earth moving operations and maintain work site so as to minimize the creation and dispersion of dust. Furnish and spread calcium chloride if the Contracting Officer decides that it is necessary for more effective dust control.

45. Provide suitable and safe bridges and other crossings where required for accommodation of travel, and to provide access to private property during construction, and remove said structures thereafter.

1.06 SITE CONDITIONS:

A. Subsurface Conditions: Refer to Appendix A.

PART 2 - PRODUCTS

2.01 GENERAL:

A. Use only acceptable materials from excavations or borrows as specified herein.

B. Provide 1,500 psi concrete, screened gravel, bank-run gravel, fine aggregate, select borrow, and crushed stone.

C. Provide Fine Aggregate conforming to ASTM C33.

D. Provide erosion/sedimentation control devices as indicated, including geotextile fabric in accordance with Section 02273.

E. Provide geotextile fabric as indicated, meeting the requirements and conforming to Section 02273.

2.02 EQUIPMENT:

A. The compaction equipment shall be selected by the Contractor, and shall be capable of consistently achieving the specified compaction requirements. The selected compaction equipment shall meet the following minimum requirements:

1. Manually operated vibratory plate compactors weighing no less than 200 pounds with vibration frequency no less than 1600 cycles per minute.

2. Vibratory steel drum or rubber tire roller weighing at least 12,000 pounds.

PART 3 - EXECUTION

3.01 SITE MAINTENANCE:

A. Roadway and Site Leveling: Grade roadway and site as to maintain them in a level unrutted condition and to eliminate puddling of surface and subsurface water.

3.02 EXCAVATION:

A. Execution of any earth excavation shall not commence until the related dewatering, excavation support systems, and backfill and fill materials submittals are reviewed by the Contracting Officer and all Contracting Officer's comments satisfactorily addressed.

B. Carry out program of excavation, dewatering, and excavation support systems to eliminate possibility of undermining or disturbing foundations of existing structures or of work previously completed under this contract.

C. Excavate to widths that give suitable room for building structures or laying and jointing piping.

D. Do not plow, scrape, or dig by machinery near to finished subgrade in a manner that would result in disturbance of subgrade.

E. Excavate to lines and grades indicated in an orderly and continuous program.

F. Establish limits of excavation to allow adequate working space for installing forms and for safety of personnel.

G. Excavate to elevations indicated, or deeper, as directed by the Contracting Officer, to remove unacceptable bottom material.

H. Exercise care to preserve material below and beyond the lines of excavations.

I. Place excavated material at the approved stockpile locations and in no case closer than 3 feet from edge of excavations to prevent cave-ins of bank slides.

J. Regard small, less than one cubic yard, boulders, rock fragments, and concrete encountered during excavation as a normal part of in-place soils and not included for payment as rock.

K. Excavate for depressed foundations, where mat foundations are indicated as depressed. Sheet and shore existing ground so that adjacent sections of foundation mat will rest on undisturbed ground as indicated. Installation of sheeting shall be in accordance with Section 02160.

3.03 SEPARATION OF EXCAVATED MATERIALS FOR REUSE:

A. Remove only existing pavement that is necessary for prosecution of work.

B. Carefully remove loam and topsoil from excavated areas. Store separately for further use or furnish equivalent loam and topsoil as directed.

C. Carefully remove acceptable material from excavated areas and store separately. Materials from excavated areas shall not be assumed to be acceptable for reuse and shall be legally disposed of.

3.04 TRENCH EXCAVATION:

A. When pipe is to be laid in gravel bedding or concrete cradle, excavate trench by machinery to, or just below designated subgrade. If material remaining at bottom of trench is disturbed, recompaction shall be required.

B. When pipe is to be laid directly on bottom of trench, do not excavate lower part of trenches by machinery to subgrade. Remove remainder of material to be excavated just before placing of pipe by use of hand tools. Form a flat or shaped bottom, true to grade, so pipe will have a uniform and continuous bearing. Support on firm and undisturbed material between joints, except for limited areas where use of pipe slings have disturbed bottom.

3.05 DEPTH OF TRENCH:

A. Excavate trenches to depths so as to permit pipe to be laid at elevations, slopes, or depths of cover indicated on drawings, and at uniform slopes between indicated elevations.

3.06 WIDTH OF TRENCH:

A. Make pipe trenches as narrow as practicable and do not widen by scraping or loosening materials from the sides. Make every effort to maintain sides of trenches firm and undisturbed until backfilling has been placed and compacted.

B. Excavate trenches with approximately vertical sides between the invert of the pipe and elevation 1 foot above the top of pipe.

3.07 TRENCH EXCAVATION IN FILL:

A. Place and compact material to top of fill or to a minimum height of 1 ft. above top of pipe, whichever is less, when pipe is to be laid in embankment or other recently filled material. Take particular care to ensure maximum consolidation of material under pipe location. Excavate pipe trench as though in undisturbed material.

3.08 EXCAVATION NEAR EXISTING STRUCTURES:

A. Discontinue digging by machinery when excavation approaches pipes, conduits, or other underground structures. Continue excavation by use of hand tools. Include such manual excavation in work to be done when incidental to normal excavation and under items involving normal excavation.

B. Excavate test pits when determination of exact location of pipe or other underground structure is necessary for doing work properly.

3.09 REMOVAL OF SUBSURFACE OBSTRUCTIONS:

A. Remove indicated subsurface structures and related obstructions to extent shown.

B. Promptly notify the Contracting Officer when any unexpected subsurface facilities are encountered during excavation such as utility lines and appurtenances, walls and foundations.

3.10 UNAUTHORIZED EXCAVATION:

A. When the bottom of any excavation for structures is taken out beyond limits indicated or specified, backfill, with screened gravel and crushed stone wrapped with non-woven geotextile fabric or with 1,500 psi concrete.

3.11 REUSE AND DISPOSAL OF SURPLUS EXCAVATED MATERIALS:

A. Reuse surplus acceptable excavated materials for backfill only for non-paved, or nonstructural locations. Deposit neatly and grade so as to make or widen fills, flatten side slopes, or fill depressions; or legally dispose off-site; all as directed or permitted and without additional compensation.

B. Any fly ash materials encountered in trench excavations are to be placed back into the excavated trench and are not to be removed from the project site.

3.12 SUBGRADE PREPARATION AND PROTECTION:

A. Remove loam and topsoil, loose vegetable matter, stumps and large roots from areas upon which embankments will be built or material will be placed for grading. Shape subgrade as indicated on drawings, and prepare by forking, furrowing, or plowing so that the first layer of new material placed thereon will be well bonded to it.

B. As directed by the Contracting Officer, over excavate unacceptable materials below the foundation subgrade. Backfill the over excavation with compacted screened gravel or crushed stone wrapped with nonwoven geotextile fabric. In no case shall the screened gravel be placed directly on the exposed subgrade prior to placing the geotextile fabric.

C. Proof roll the foundation subgrade prior to backfilling and filling operation, or placing foundation concrete.

1. Proof roll the pipe trench foundation subgrade prior to backfilling and filling operation, or placing soil-supported pipeline.

3.13 CARE AND RESTORATION OF PROPERTY:

A. Enclose uncut tree trunks adjacent to work in wooden boxes of such height as may be necessary for protection from injury from piled material, equipment, operations, or otherwise due to work. Operate excavating machinery and cranes of suitable type with care to prevent injury to trees not to be cut and particularly to overhanging branches and limbs.

B. Cut all branches, limbs, and roots smoothly and neatly without splitting or crushing. Neatly trim, cut the injured portions and cover with an application of grafting wax or tree healing paint as directed.

C. Protect cultivated hedges, shrubs, and plants which might be injured by the Contractor's operations by suitable means or dig up and temporarily replant and maintain. After construction operations have been substantially completed, replant in original positions and care for until growth is reestablished. If cultivated hedges, shrubs, and plants are injured to such a degree as to affect their growth or diminish in their beauty or usefulness, replace by items of equal kind and quality existing at the start of the work.

D. Do not use or operate tractors, bulldozers, or other power-operated equipment on paved surfaces when their treads or wheels of which are so shaped as to cut or otherwise damage such surfaces.

E. Restore surfaces damaged by the Contractor's operations to a condition at least equal to that in which they were found immediately before work commenced. Use suitable materials and methods for such restoration.

3.14 BACKFILLING - GENERAL:

A. Do not place frozen materials in backfill or place backfill upon frozen material. Remove previously frozen material or treat before new backfill is placed.

B. Do not place, spread, roll or compact fill material during unfavorable weather conditions. If interrupted by heavy rain or other unfavorable conditions, do not resume until ascertaining that the moisture content and density of the previously placed soil are as specified.

C. Do not use puddling, ponding or flooding as a means of compaction.

3.15 MATERIAL PLACEMENT AND COMPACTION REQUIREMENTS:

A. Select Borrow, Bank Gravel and Fine Aggregate:

1. Dump and spread in layers not to exceed 8-inches uncompacted thickness.

2. Compact, fill and backfill under structure, paved areas, and bedding for pipes (from below pipe to spring line) as indicated but to not less than 95 percent. Compact to not less than 90 percent in other areas unless otherwise indicated.

3. Screened Gravel and Crushed Stone:

4. Dump and spread in layers not to exceed 8-inches uncompacted thickness.

5. Compact using self-propelled vibratory steel drum or rubber tire rollers with a minimum of 4 passes in directions perpendicular to one another in open areas. In small areas, use manually operated vibratory plate compactors with a minimum of 4 passes.

6. Bank Gravel and Acceptable materials for use as non-structural fill:

7. Dump and spread in layers not to exceed 12-inches uncompacted thickness.

8. Compact to not less than 90 percent unless otherwise indicated.

9. Backfilling and filling operation shall be suspended in areas where tests are being made until tests are completed and the testing laboratory has advised the Contracting Officer that adequate densities are obtained.

3.16 STRUCTURAL FILL AND BACKFILL UNDER STRUCTURES:

A. Compact fill and backfill under structures and pavements with screened gravel, crushed stone, select borrow, or fine aggregate as specified and indicated.

3.17 NON-STRUCTURAL BACKFILL AROUND STRUCTURES:

A. Use acceptable materials for non-structural backfill around structures and compacted as specified and indicated.

1. Conduct hydraulic testing as soon as practicable after structures are constructed and other necessary work has been done. Start backfilling promptly after completion of tests.

2. Deposit material evenly around structure to avoid unequal soil pressure.

3. Do not place backfill against or on structures until they have attained sufficient strength to support the loads (including construction loads) to which they will be subjected, without distortion, cracking, or other damage.

3.18 BACKFILLING PIPE TRENCHES:

A. General:

1. Begin backfilling and proceed until completed after: the pipes and conduits have been laid, joints have acquired maximum degree of hardness, pipelines and conduits have successfully passed tests and inspections as required in the Specifications, and concrete or masonry structures within the trench have reached their design strength to support all loads.

2. Backfill and compact indicated material under, around, and above pipes, conduits, and other structures to the indicated or specified compaction density requirement. Utilize compaction devices which will not damage the pipe, conduit, or structure within the trench.

3. Do not drop backfill material into trench from a height of more than 5 ft, or in a manner which will damage the pipe, conduit, or other structure within trench.

4. Pipe Trenches:

5. Materials:

6. From below pipe to 1 foot above top of pipe: Use screened gravel, sand, or crushed stone as indicated in the trench detail, unless otherwise indicated.

7. One foot above top of pipe to finished grade or to pavement subbase: Use screened acceptable material from onsite excavations, unless otherwise indicated.

8. Compacting Around Pipes: Compact material around circumference of pipe and the area between the trench wall and the pipe by hand tamping in 6 inches layers.

9. Compacting Above Pipe: Compact material by hand tamping. If trench width is wide enough to accommodate power tools and the compacted material over the pipe will support the load of the power tools without damage to the pipe, use rollers or other powered compaction equipment able to more readily achieve compaction requirements.

3.19 MATERIAL FOR FILLING AND EMBANKMENTS:

A. Use acceptable materials for filling and building embankments unless otherwise indicated.

3.20 PLACING AND COMPACTING EMBANKMENT MATERIAL:

A. Compact fill material as specified and indicated.

B. Perform fill operation in an orderly and systematic manner using equipment in proper sequence to meet the specified compaction requirements.

C. Place fill on surfaces which are free of unacceptable materials.

D. Begin filling in lowest section of work area. Grade surface of fill approximately horizontal but provide with sufficient longitudinal and transverse slope to allow for runoff of surface water from every point.

E. Conduct filling so that no obstruction to drainage from other sections of fill area is created at any time.

F. Install temporary dewatering sumps in low areas during filling operation where excessive amounts of rain runoff collect.

G. Reduce moisture content of fill material, if necessary, in source area by working it over under warm and dry atmospheric conditions. A large disc harrow with two to three foot diameter disks may be required for working soil in a drying operation.

H. Compact uniformly throughout. Keep surfaces of fill reasonably smooth and free from humps and hollows which would prevent proper and uniform compaction. Do not permit hauling equipment to follow a single track on the same layer but direct equipment to spread out to prevent over compaction in localized areas. Take care in obtaining thorough compaction at edges of fill.

I. Slightly slope surface of fill to ensure drainage during periods of wet weather. Do not place fill while rain is falling or after a rain-storm until the Contracting Officer considers conditions satisfactory. During such periods and upon suspension of filling operations for any period in excess of 12 hours, roll smooth the surface of fill using a smooth wheel static roller to prevent excessive absorption of rainfall and surface moisture. Prior to resuming compaction operations, remove muddy material off surface to expose firm, compacted material, as determined by the Contracting Officer.

J. When fill is placed against an earlier fill or against in-situ material under and around structures, including around piping beneath structures or embankments, slope junction between two sections of fill, 1 vertical to 1.5 horizontal. Bench edge of existing fill 24-in. to form a serrated edge of compact stable material against which to place the new fill. Ensure that rolling extends over junction between fills.

K. When fill is placed directly upon another older fill, clean surface thoroughly of debris and remove any loose material. Then proof roll the entire old surface.

L. After spreading each loose lift to the required thickness and adjusting its moisture content as necessary, roll with sufficient number of passes to obtain the required compaction. One pass is defined as the required number of successive trips which by means of sufficient overlap will insure complete coverage and uniform compaction of an entire lift. Do not make additional passes until previous pass has been completed.

M. In case material of any fill sinks and weaves under roller or under hauling units and other equipment, required degree of compaction is not being obtained. Reduce the moisture content. If such sinking and weaving produces surface cracks, suspend operations on that part of the embankment until it becomes sufficiently stabilized. Ideal condition in fill is that attained when the entire fill below the surface being rolled is so firm and hard as to show only the slightest weaving and deflection as roller passes. Spread out rolling operations over the maximum practicable area to minimize condition of sinking and weaving.

N. If because of defective workmanship, compaction obtained over any area is less than that required, remedy condition at no cost to Contracting Officer. If additional rolling or other means fail to produce satisfactory results, remove material in that area down to a level of satisfactory density. Perform removal, replacement, and rerolling without additional compensation.

3.21 COMPACTION CONTROL OF BACKFILL, FILL, AND EMBANKMENT:

A. Compact to density specified and indicated for various types of material. Control moisture content of material being placed as specified or if not specified, at a level slightly lower than optimum.

B. The soil testing laboratory shall provide inspection during filling or backfilling operations to ensure compaction of screened gravel or crushed stone and record compaction equipment in use.

C. Moisture control may be required either at the stockpile area, pits, or on embankment or backfill. Increase moisture content when material is too dry by sprinkling or other means of wetting uniformly. Reduce moisture content when material is too wet by using ditches, pumps, drainage wells, or other devices and by exposing the greatest possible area to sun and air in conjunction with harrowing, plowing, spreading of material or any other effective methods.

3.22 ALLOWANCE FOR SHRINKAGE:

A. Build embankments or backfill to a height above finished grade which will, in the opinion of the Contracting Officer, allow for the shrinkage or consolidation of material. Initially,

provide at all points, an excess of at least one percent of total height of backfill measured from stripped surface to top of finished surface.

B. Supply specified materials and build up low places as directed, without additional cost if embankment or backfilling settles so as to be below the indicated level for proposed finished surface at any time before final acceptance of the work.

3.23 CONTRACT CLOSEOUT

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 02211

ROCK EXCAVATION AND DISPOSAL

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide rock excavation and disposal as indicated and in compliance with Contract Documents.

B. Remove and dispose of rock, as defined in Section 01150, Measurement and Payment, and furnish acceptable material for backfill in place of excavated rock as indicated.

C. Rock excavation shall be performed by any of the following methods typically used in the construction industry:

1. Expansive agents or tools.

2. Mechanical means.

3. Blasting.

4. Combinations of the above.

1.02 REFERENCES:

A. National Fire Protection Association (NFPA):

B. Local rules and regulations regarding blasting.

1.03 SUBMITTALS:

A. Submit the following shop drawings in accordance with Section 01300.

1. For each kind of blasting agents and explosives to be used, submit the perchlorate content provided by the suppliers and/or manufacturers. The Contractor has to obtain written permission from the Contracting Officer and the Local Authority to use perchlorate-containing explosive products.

2. Submit the blasting program and distance-quantity tables to the Contracting Officer 21 days prior to commencement of production blasting.

3. Keep and submit to Contracting Officer and at time specified by Contracting Officer, a record of each blast showing general location of blast, depth and number of drillholes, kind and quantity of explosive used, kind and number and interval of delay periods used, and all monitoring data required for a complete record.

1.04 QUALITY ASSURANCE:

A. Comply with the requirements specified in Section 01400.

B. If rock is excavated beyond the limits of payment indicated on the drawings, specified, or authorized in writing by the Contracting Officer, backfill excess excavation, whether resulting from overbreakage or other causes, at no additional compensation and as specified in Part 3 - EXECUTION.

C. Employ an approved, independent, vibration/blasting consultant to conduct test blasting prior to production blasting, to devise suitable blasting procedures for production blasting, and to monitor production blasting. Require the vibration/blasting consultant to be a Registered Professional Engineer in the State of Connecticut and to have a minimum of 10 years experience as a vibration/blasting consultant. Prior to starting the work, submit the name of the vibration/blasting consultant to the Contracting Officer.

D. Conduct pre and post construction surveys of structures and utilities within 50 feet of proposed blasting operations in accordance with Section 01390.

E. Test blast to develop control procedures for production blasting so that no disturbance or damage shall be done to utilities, equipment, buildings, or structures.

F. Based on the results of test blasting, have the vibration blasting consultant develop a suitable blasting program and distance-quantity of explosive tables for the production blasting. Conduct production blasting operations in accordance with the blasting program and NFPA 495.

G. Require the vibration/blasting consultant to perform continuous monitoring of blasting operations. Perform vibration monitoring as specified in Section 02018.

H. If evidence of disturbance or damage to utilities, equipment, buildings, or structures is observed or reported, immediately notify the Contracting Officer and discontinue blasting operations and require vibration/blasting consultant to recommend revised blasting procedures.

I. Initiate the revised procedures before blasting is continued.

J. Restore or replace utilities, equipment, buildings, or structures damaged by blasting operations at no cost to the Contracting Officer.

1.05 SAFETY REQUIREMENTS:

A. Keep explosives on the site only in such quantity as needed for work under way and only during time as being used. Notify Contracting Officer at least 24 hours in advance of intention to store and use explosives. Store explosives in a secure manner and separate from all tools. Store caps or detonators safely at a point over 100 feet distant from explosives. Promptly remove from premises remaining material when need for explosives has ended.

B. Conform to State, Federal, and municipal laws, ordinances, and regulations relating to transportation, storage, handling, and use of explosives. If any of above-mentioned laws, ordinances, or regulations require a licensed blaster to perform or supervise the work of blasting, employ a licensed blaster. Require him to have his license on site and permit examination by Contracting Officer or other officials having jurisdiction.

C. Conduct operations involving explosives with all possible care to avoid injury to persons and property. Do blasting only with such quantities and strengths of explosives and in such manner as will break rock approximately to intended lines and grades, leaving rock not to be excavated in an unshattered condition. Avoid excessive cracking of rock upon or against which any structure will be built. Prevent injury to existing pipes, structures and property above or below ground. Cover rock with logs or mats, or both. Give sufficient warning to persons in vicinity of work before a charge is exploded.

D. Complete blasting within a distance of 50 feet before any portion of a masonry structure is placed or any pipe is laid.

E. Determine presence of two-way-radios, stray electrical currents and other conditions adversely affecting blasting operations and implement necessary precautions to prevent accidents and premature blasts.

1.06 JOBSITE CONDITIONS:

A. Protect structures, underground utilities, and other construction from damaged caused by pile driving.

B. A geotechnical report was prepared for this Project and is provided as an attachment to the Contract Documents.

PART 2 - PRODUCTS

2.01 EXPLOSIVE PRODUCTS:

A. To the extent practical, avoid the use of perchlorate-containing explosive products when surface or groundwater can be affected.

2.02 CONCRETE AND GRAVEL:

A. Class A Concrete, Class B Concrete and Screened Gravel.

PART 3 - EXECUTION

3.01 ROCK REMOVAL – MECHANICAL METHODS:

A. Excavate and remove rock by the mechanical methods.

1. Drill holes and utilize expansive agents, tools or wedges, mechanical disintegration compound to fracture rock.

B. Cut away rock at bottom of excavation to form level bearing.

C. Remove shaled layers to provide sound and unshattered base for footings and foundations.

D. In utility trenches, excavate to 6 inch below invert elevation of pipe and 24 inch wider than pipe diameter.

E. Remove excavated materials from site and reuse for site landscaping.

F. Correct unauthorized rock removal in accordance with backfilling and compacting requirements of Section 02210 as specified.

3.02 PROCEDURE:

A. Excavate rock in pipe trenches to no less than 6 inches below the proposed invert of the pipe. Backfill trench, before pipe is laid, to correct subgrade elevation. Use compacted, specified material indicated on drawings, or the material specified for bedding pipe to backfill excess excavation. Furnish and place at no additional compensation.

B. Fill excess excavation below elevation of the top of bedding, cradle, or envelope when in pipe trenches with material of same type and placed and compacted in same manner as specified for bedding, cradle, or envelope.

C. At option of Contractor, fill excess excavation in rock beneath foundations with Class C concrete in accordance with Section 03300.

D. Drill and blast a single line of holes in vertical face of rock at end of trench, when shattering rock at ends of pipe or elsewhere as indicated. Provide minimum depth drillholes of 4 feet and maximum spacing of 18 inch centers. Use sufficient explosive to shatter rock for future excavation. Complete shattering before any pipe or fitting is placed within 50 feet of rock to be shattered.

E. If allowed by local rules and regulations, the use of perchlorate-containing products shall be reviewed by the Contracting Officer:

1. Institute rigorous “housekeeping” practices: The explosive products shall be properly detonated so that perchlorates are destructed to the maximum degree possible. Also, minimize the loss of product via spills or debris that could cause environmental pollution. In the event of spills or debris, reasonable effort should be made to collect and properly manage or dispose of perchlorate-containing materials.

2. Take reasonable steps to prevent and address misfires: In cases where explosives or blasting agents are washed or removed for a borehole following a misfire,

reasonable efforts should be made to collect and properly manage or dispose of perchlorate-containing materials.

F. Remove shattered rock. If rock below normal depth is shattered due to drilling or blasting operations of Contractor and Contracting Officer considers such shattered rock to be unfit for foundations, remove it and backfill excavation with concrete as specified, except that in pipe trenches, use screened gravel for backfill. Do such removal and backfilling at no additional compensation.

G. Remove dirt and loose rock, as directed, from designated areas and clean surface of rock using steam to melt snow and ice, if necessary. Remove water in depressions, so that whole surface of designated area can be inspected to determine whether seams or other defects exist.

H. Roughen surfaces of rock foundations sufficiently, cut into benches or steps to bond well with masonry and embankments to be built thereon.

I. Remove from the rock surface to remain all vegetation, dirt, sand, clay, boulders, scale, excessively cracked rock, loose fragments, ice, snow, and other objectionable substances. Use picking, barring, wedging, streams of water under sufficient pressure, stiff brushes, hammers, steam jets, and other effective means to accomplish this cleaning, and remove free water left on the surface of rock. Perform all of above before any masonry or embankment is built on or against rock.

J. Remove piles of boulders or loose rock encountered within limits of earth embankments for disposal.

K. Use excavated rock in backfilling trenches subject to following limitations:

1. Do not use pieces of rock larger than permitted under Section 02210.

2. Do not allow rock quantities used in backfill in any location to result in formation of voids.

3. Do not place rock backfill within 16 inches of surface of finish grade.

L. Backfill with material obtained from outside sources at no additional compensation, when material specified for backfilling is not available in sufficient quantity from other excavations.

3.03 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 02223

SCREENED GRAVEL

PART 1 – GENERAL

1.01 DESCRIPTION:

A. Provide and compact screened gravel as indicated and specified.

B. Also referred to as “crushed stone.”

1.02 RELATED WORK:

A. Section 02210: Earth Excavation, Backfill, Fill and Grading

1.03 REFERENCES:

A. American Society for Testing and Materials (ASTM) Publications:

1. C33: Specification for Concrete Aggregates

2. D422: Test Method for Particle-Size Analysis of Soils.

1.04 SUBMITTALS:

A. Submit the following in accordance with Section 01300:

1. Gradation test result from the soil testing laboratory, at least two (2) weeks prior to hauling material, for the Contracting Officer’s acceptance.

2. Submit a 20-lb. sample of the material when requested by the Contracting Officer.

1.05 QUALITY ASSURANCE:

A. Provide in accordance with Section 01400 and as specified.

B. Qualifications of the independent soil testing laboratory as specified in Section 02210.

C. Maximum particle size and gradation analyses shall be performed in accordance with ASTM D422.

Material testing frequency and requirements as specified in Section 02210.

PART 2 – PRODUCTS

2.01 MATERIAL:

A. Screened gravel: Gradation and physical property requirements of screened gravel shall conform to ASTM C33, gradation as indicated on the Drawings.

B. Screened gravel shall be free from roots, leaves, and other organic materials, and free of ice, snow, frost and frozen soil particles.

C. Crushed rock of equivalent size and grading may be used instead of screened gravel.

D. Recycled materials shall not be used.

PART 3 – EXECUTION

3.01 PLACEMENT AND COMPACTION:

A. Specified in Section 02210 and as indicated on the drawings.

3.02 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 02224

BANK-RUN OR CRUSHED GRAVEL

PART 1 – GENERAL

1.01 DESCRIPTION:

A. Provide and compact bank or crushed gravel as indicated and specified.

1.02 RELATED WORK:

A. Section 02210: Earth Excavation, Backfill, Fill and Grading

1.03 REFERENCES:

A. American Society for Testing and Materials (ASTM) Publications:

1. D422: Test Method for Particle-Size Analysis of Soils.

2. D1140: Test Method for Amount of Material in Soils Finer than the No. 200 (75 µm) Sieve.

3. 3. D1557: Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3).

1.04 SUBMITTALS:

A. Submit the following in accordance with Section 01300:

1. Gradation and compaction test results from the soil testing laboratory, at least two (2) weeks prior to hauling material, for the ’s acceptance.

2. Submit a 20-lb. sample of the material when requested by the .

1.05 QUALITY ASSURANCE:

A. Provide in accordance with Section 01400 and as specified.

B. Qualifications of the independent soil testing laboratory as specified in Section 02210.

C. Maximum particle size and gradation analyses shall be performed in accordance with ASTM D422. Soil compaction test shall be performed in accordance with ASTM D1557 Procedure C.

D. Material testing frequency and requirements as specified in Section 02210.

PART 2 – PRODUCTS

2.01 MATERIAL:

A. Bank or crushed gravel shall consist of sound, tough, durable particles of crushed or uncrushed gravel free from soft, thin, elongated or laminated pieces and vegetable or other deleterious materials.

B. Bank or crushed gravel shall be unfrozen and substantially free from vegetation, roots, loam, and other organic matter, clay, snow, frozen particles and other fine or harmful substances.

C. Bank or crushed gravel shall meet the following gradation criteria, Grading B, as measured at the source of supply or at the project site:

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves
5 in.	100
3-1/2 in.	90 - 100
1-1/2 in.	55 – 95
1/4 in.	25 – 60
No. 10	15 - 45
No. 40	5 - 25
No. 100	0 - 10
No. 200	0 – 5

D. Reclaimed miscellaneous aggregate materials shall not be utilized under this Contract.

PART 3 – EXECUTION

3.01 PLACEMENT AND COMPACTION:

A. Specified in Section 02210 and where indicated on the drawings.

3.02 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 02225

SELECT BORROW

PART 1 – GENERAL

1.01 DESCRIPTION:

A. Provide and compact select borrow as indicated and specified.

1.02 RELATED WORK:

A. Section 02210: Earth Excavation, Backfill, Fill and Grading

1.03 REFERENCES:

A. American Society for Testing and Materials (ASTM) Publications:

B. C33: Specification for Concrete Aggregates

C. D422: Test Method for Particle-Size Analysis of Soils.

D. D1140: Test Method for Amount of Material in Soils Finer than the No. 200 (75 µm) Sieve.

E. D1557: Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3.

F. D2487: Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

1.04 SUBMITTALS:

A. Submit the following in accordance with Section 01300:

B. Gradation and compaction test results from the soil testing laboratory, at least two (2) weeks prior to hauling material, for the Contracting Officer's acceptance.

C. Submit a 20-lb. sample of the material when requested by the Contracting Officer.

1.05 QUALITY ASSURANCE:

A. Provide in accordance with Section 01400 and as specified.

B. Qualifications of the independent soil testing laboratory as specified in Section 02210.

C. Maximum particle size and gradation analyses shall be performed in accordance with ASTM D422. Soil compaction test shall be performed in accordance with ASTM D1557 Procedure C.

D. Material testing frequency and requirements as specified in Section 02210.

PART 2 - PRODUCT

2.01 MATERIAL:

A. Use only material free from roots, leaves, and organic matter, and free of ice, snow, frost and frozen soil particles.

B. Select borrow shall be well-graded coarse-grained soil in accordance with ASTM D2487 and shall meet the following gradation:

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves
3 in.	100
1-1/2 in.	70 - 100
3/4 in.	50 - 85
No. 4	30 - 60
No. 50	10 - 25
No. 200	0 - 5

C. Soil particles shall conform to the physical property requirements of ASTM C33.

PART 3 – EXECUTION

3.01 PLACEMENT AND COMPACTION:

A. Specified in Section 02210 and as indicated on the drawings.

3.02 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 02230

SITE CLEARING

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide site clearing as indicated and in compliance with Contract Documents.

B. Section Includes:

1. Clearing and grubbing.

2. Tree and shrub protection and removal.

3. Removal of debris related to clearing and grubbing operations.

1.02 DEFINITIONS:

A. Caliper: Instrument used to measure tree diameter.

B. Clearing: Removal and disposal of above-ground items defined herein.

C. Grubbing: Removal and disposal of below-ground items defined herein.

1.03 SUBMITTALS:

A. Submit the following in accordance with Section 01300.

1. Permits

a. Erosion & Sediment Control Compliance Agreement for work conducted in the City of Middletown, CT

2. Certificates

a. Copy of herbicide label bearing EPA registration number.

b. Copy of Arborist Certification

1.04 QUALITY ASSURANCE:

A. Comply with the requirements specified in Section 01400.

B. Certified Arborist: All tree pruning, tree repair, and tree removal shall be performed by competent workers, under the supervision of an arborist holding certification from the International Society of Arboriculture (ISA).

1.05 DELIVERY STORAGE AND HANDLING:

A. Comply with the requirements specified in Section 01610.

B. Herbicide: Comply with Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) – Title 7 U.S.C. Section 136. Submit copy of herbicide label, bearing EPA registration number.

1.06 SITE CONDITIONS:

A. Existing facilities, structures, and utilities are shown in accordance with available surveys and records. The indicated locations of underground utilities and structures are approximate. Other utilities may exist which are not indicated.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Verify survey benchmarks and intended elevations for the Work are as indicated.

B. Verify temporary erosion and sediment control measures are installed before commencing with any other work at the site.

C. Verify location and existence of all underground utilities and structures by contacting utility owners, as required by law. Go to "Call Before You Dig" to receive state-specific information. Access this information by dialing 811 or going to http://www.cbyd.com.

D. Provide 72-hour notice to existing utility owners, prior to beginning construction.

E. Contact utility companies and authorities to make arrangements for handling and disposal of utilities encountered during construction.

3.02 PREPARATION:

A. Protect bench marks, survey control points, and existing structures to remain from damage or displacement.

B. Protect trees and vegetation to remain. Do not cut or injure trees and vegetation outside easement lines and outside designated clearing areas.

C. Protect all underground utilities and structures that are to remain. If damage occurs, immediately notify the utility owner within the hour.

D. Protect site features to remain from damage by construction equipment and vehicular traffic.

E. Identify waste and salvage areas for stockpiling of removed materials.

3.03 RESTORATION:

A. Existing surfaces, features, utilities, or structures that are to remain but are damaged during construction shall be restored to at least the condition in which they were found immediately before work began, unless noted otherwise.

B. Restore damaged utilities to the satisfaction of the utility owner.

C. Restore damaged private property to the satisfaction of the property owner.

3.04 CLEARING:

A. Remove and dispose of off site:

1. Trees, snags, brush, shrubs, downed timber, decayed wood, and other vegetative growth.

2. Rocks, tiles, lumps of concrete, trash piles, debris, refuse, rubbish, and fencing. Remove all evidence of their presence from the surface.

B. Clear ground within limits of work, unless otherwise noted.

C. Manual cutting of trees, stumps, and stubs during clearing shall be as close to ground surface as practicable but no higher than 6 inches above ground for small trees (8 inches or less), and not higher than 12 inches above ground for larger trees (greater than 8 inches).

D. Obey all federal, state and local regulations and guidance regarding the cutting, burning, and disposal of diseased trees and vegetation.

3.05 CLEARING IN WOODED AREAS:

A. Chip and stockpile cleared wood at location directed by the Contracting Officer.

3.06 GRUBBING:

A. Remove and dispose of all stumps, buried logs, matted roots, roots larger than 2 inches, and organic materials off site.

B. Roots larger than 2 inches in diameter shall be removed to a depth of 12 inches, and roots larger than 1/2-inches in diameter to a depth of 6 inches.

C. Areas designated to receive pavement or structures shall be grubbed a depth of 18 inches. Measure depths of cut from existing ground surface or proposed finished grade, whichever is lower.

D. Apply herbicide to remaining roots and vegetation to inhibit growth.

E. Depressions made by grubbing shall be filled with suitable material and compacted to conform to original adjacent grade.

F. Do not grub areas within drip line of trees to remain to avoid damage to roots.

3.07 TREE AND SHRUB REMOVAL:

A. Remove trees and shrubs within permanent and temporary easement by felling or cutting individual vegetation and grubbing.

3.08 TREE AND SHRUB PROTECTION:

A. Protect indicated trees and shrubs within the clearing limits.

3.09 PRUNING:

A. Trim dead branches 1-1/2-inches or more in diameter and branches to heights and in a manner as indicated. Neatly cut limbs and branches close to the bole of the tree or main branches. Paint cuts more than 1-1/4-inches in diameter tree wound paint.

3.10 BURNING:

A. Burning is not permitted on site.

3.11 CLEANING:

A. Promptly dispose of excess and unsuitable material off site.

B. Remove debris, junk, and trash from site.

C. Leave site in clean condition, ready for subsequent work.

D. Clean up spillage and wind-blown debris before entering public or private property, adjacent to site.

3.12 CLOSEOUT ACTIVITIES:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 02240

DEWATERING

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide dewatering as indicated and in compliance with Contract Documents.

B. Design, furnish, operate, maintain, and remove temporary dewatering systems to control groundwater and surface water to maintain stable, undisturbed subgrades, and permit work to be performed under dry and stable conditions. Work to be done as part of dewatering includes, but is not limited to:

1. Lower the groundwater level.

2. Lower hydrostatic pressure.

3. Prevent surface water from entering the excavation during construction.

4. Implement erosion control measures for disposing of discharge water.

C. Groundwater within the excavation area shall be lowered to at least 2 feet (60 cm) below the lowest excavation levels as specified and as indicated.

D. Common dewatering methods include, but are not limited to, sump pumping, deep wells, well points, vacuum well points, or combinations thereof.

E. Common groundwater recharge methods include, but are not limited to, deep wells, large sumps or combination thereof.

F. The Contractor shall obtain the required permits for discharge from the Contractor's dewatering systems in accordance with 40 CFR Part 122 for all discharges outside of the Town of Durham, CT. The discharge location shall be in accordance with permit requirements. The Connecticut Department of Energy and Environmental Protection (CT DEEP) General Permit will apply. Work conducted in Durham is exempt but substantive compliance is required.

1.02 REFERENCES:

A. Code of Federal Regulations, Title 40 – Protection of Environment (CFR):

1. 40 CFR Part 122: EPA Administered Permit Programs: The National Pollutant Discharge Elimination System.

1.03 SUBMITTALS:

A. Submit the following in accordance with Section 01300.

1. Qualification of the Contractor’s dewatering specialist's or firm's qualifications a minimum of 4 weeks prior to dewatering work. The submittal shall include, but not be limited to:

   a. Qualifications of specialist's or firm's Registered Professional Engineer.

   b. Qualifications of specialist's or firm's field representative who will oversee the installation, operation, and maintenance of the dewatering system.

2. Submit a dewatering plan, and, if applicable, a groundwater recharge plan at least 2 weeks prior to start of dewatering work. Do not submit design calculations. The review will be only for the information of the Contracting Officer and third parties for an overall understanding of the project relating to access, maintenance of existing facilities and proper utilization of the site. The Contractor shall remain responsible for the adequacy and safety of the means, methods and sequencing of construction. The plan shall include the following items as a minimum:

   a. Dewatering plan and details stamped and signed by a Registered Professional Engineer registered in the state where the project resides.

   b. Certificate of Design: Refer to Section 01300.

   c. A list of equipment including, but not limited to, pumps, prime movers, and standby equipment.

   d. Detailed description of dewatering, maintenance, and system removal procedures.

   e. Monitoring plan and details, including, but not limited to, number and locations of observation wells, and geotechnical instruments such as settlement and, and frequency of reading the monitoring devices.

   f. Erosion and sedimentation control measures, and methods for disposal of pumped water.

   g. List of all applicable laws, regulations, rules, and codes to which dewatering design conforms.

   h. List of assumptions mode for design of dewatering, including but not limited to groundwater levels, soil profile, permeabilities, and duration of pumping.

3. Measurement records consisting of observation well groundwater records and the geotechnical instrumentation readings within one day of monitoring.

4. A modified dewatering plan within 24 hours, if open pumping from sumps and ditches results in boils, loss of fines or softening of the ground.

1.04 QUALITY ASSURANCE:

A. Comply with the requirements specified in Section 01400.

B. Employ the services of a dewatering specialist or firm having the following qualifications:

1. Have completed at least 5 successful dewatering projects of equal size and complexity and with equal systems within the last 5 years.

2. Retain the services of a Professional Engineer Registered in Connecticut having a minimum of 5 years experience in the design of well points, deep wells, recharge systems, or equal systems.

3. Retain the services of a field representative having a minimum of 5 years experience in installation of well points, deep wells, recharge systems, or equal systems.

C. If subgrade soils are disturbed or become unstable due to dewatering operation or an inadequate dewatering system, notify the Contracting Officer, stabilize the subgrade, and modify system to perform as specified.

D. Notify the Contracting Officer immediately if settlement or movement is detected on structures. If the settlement or movement is deemed by the Contracting Officer to be related to the dewatering, take actions to protect the adjacent structures and submit a modified dewatering plan to the Contracting Officer within 24 hours. Implement the modified plan and repair damage incurred to adjacent structures.

E. Immediately notify the Contracting Officer if oil or other hazardous materials are encountered after dewatering begins.

1.05 PRECAUTIONS AGAINST HYDROSTATIC UPLIFT DURING CONSTRUCTION:

A. The Contractor shall maintain a low groundwater elevation in the vicinity of the structures until they are complete. In case of extremely high water during construction of the structures, it may be necessary to flood the structures to maintain stable conditions.

1.06 DELIVERY STORAGE AND HANDLING:

A. Comply with the requirements specified in Section 01610.

1.07 SITE CONDITIONS:

A. Subsurface Conditions: Refer to Appendix A.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Provide settlement markers, piezometers and other geotechnical instruments in accordance with the submitted dewatering plan or as specified.

B. Provide casings, well screens, piping, fittings, pumps, power and other items required for dewatering system.

C. Provide sand and gravel filter around the well screen. Wrapping geotextile fabric directly around the well screen shall not be allowed.

D. When deep wells, well points, or vacuum well points are used, provide pumping units capable of maintaining high vacuum and handling large volumes of air and water at the same time.

E. Provide auxiliary dewatering equipment in the event of breakdown. Equipment shall consist of pumps and hoses and be stored on site. Provide at least 1 pump for every 5 pumps used.

F. Provide and maintain erosion and sedimentation control devices as indicated or specified and in accordance with the dewatering plan.

G. Provide temporary pipes, hoses, flumes, or channels for the transport of discharge water to the discharge location.

H. Provide cement grout having a water cement ratio of 1 to 1 by volume.

3.01 INSTALLATION:

A. Execution of earth excavation, installing earth retention systems, and dewatering shall not commence until the related submittals have been reviewed by the Contracting Officer and comments have been satisfactorily addressed and the geotechnical instrumentation has been installed.

B. Provide and maintain dewatering system in accordance with the dewatering plan.

C. Carry out dewatering program in such a manner as to prevent undermining or disturbing foundations of existing structures or of work ongoing or previously completed.

D. Do not excavate until the dewatering system is operational.

E. Unless otherwise specified, continue dewatering uninterrupted until all structures, pipes, and appurtenances below groundwater level have been completed such that they will not be floated or otherwise damaged by an increase in groundwater elevation.

F. Discontinue open pumping from sumps and ditches when such pumping results in boils, loss of fines, softening of the ground, or instability of the slopes. Modify dewatering plan and submit revised plan to the Contracting Officer for acceptance.

G. Where subgrade materials are disturbed or become unstable due to dewatering operations, remove and replace the materials in accordance with Section 02210.

H. Dewatering Discharge:

1. Install sand and gravel filters in conjunction with well points and deep wells to prevent the migration of fines from the existing soil during the dewatering operation.

2. Transport pumped or drained water to discharge location without interference to other work, damage to pavement, other surfaces, or property.

3. Provide separately controllable pumping lines.

4. The Contracting Officer reserves the right to sample discharge water at any time.

5. Immediately notify the Contracting Officer if suspected contaminated groundwater is encountered. Do not pump water found to be contaminated with oil or other hazardous material to the discharge locations.

I. Monitoring Devices and Records:

1. Install, maintain, monitor, and take readings from the observation wells and geotechnical instruments in accordance with the dewatering plan.

2. Install settlement markers on structures within the zone of influence for dewatering a distance equal to twice the depth of the excavation, from the closest edge of the excavation. Conduct and report settlement surveys to 1/8-inch.

J. Install and maintain erosion/sedimentation control devices at the point of discharge as indicated or specified and in accordance with the dewatering plan.

K. Removal:

1. Do not remove dewatering system without written acceptance from the Contracting Officer.

2. Backfill and compact sumps or ditches with screened gravel or crushed stone wrapped with geotextile fabric in accordance with Section 02273.

3. All dewatering wells shall be abandoned upon completion of the work, and completely backfilled with cement grout.

3.02 CLOSEOUT ACTIVITIES:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 02241

CONSTRUCTION WATER MANAGEMENT

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall manage liquids generated during equipment decontamination activities, and water from wells being abandoned ("Construction Water") in a manner that is protective of health, safety, public welfare, and the environment.

B. The Contractor shall provide all labor, equipment, and materials to handle, store, treat, and discharge or dispose of Construction Water. On-site treatment shall consist of unit operations necessary to remove Site contaminants to achieve discharge criteria compliant with the Contractor's method of discharge. Site contaminants that may be detected in Construction Water include volatile organic compounds (VOCs), as well as chlorine and particulate matter.

C. Alternately, the Contractor may elect to dispose of groundwater generated during well abandonment at a Publically Owned Treatment Works (POTW), in accordance with the CT DEEP General Permit for the Discharge of Groundwater Remediation Wastewater to a Sanitary Sewer (DEP-WD-GP-007).

D. The Contractor shall develop a Construction Water Management Plan describing the handling, storage, treatment, and discharge of Construction Water and disposal of associated sludge generated during the Work.

E. The Contractor shall be responsible for all measures needed to comply with the intent of applicable State and Federal discharge permits.

F. The Contractor may, at no additional cost to the Contracting Officer, elect to transport and dispose of water at an off-site facility in lieu of on-site treatment and discharge.

1.02 RELATED SECTIONS

A. Section 01300 - Submittals

B. Section 01410 - Sampling Procedures and Laboratory Requirements

C. Section 01568 - Erosion Control, Sedimentation, and Containment of Construction Materials

D. Section 02053 - Excavated Material Management Plan

E. Section 02210 – Earth Excavation, Backfill, Fill, and Grading

1.03 REFERENCES

A. Connecticut Department of Energy and Environmental Protection (CTDEEP), Bureau of Water Management requirements.

B. CTDEEP General Permit for the Discharge of Groundwater Remediation Wastewater, February 21, 2018.

C. CTDEEP Comprehensive General Permit for Discharges to Surface Water and Groundwater, December 14, 2017.

D. Maximum Contaminant Levels (MCLs) for Drinking Water, EPA 816-F-09-0004, U.S. Environmental Protection Agency, Summer 2009.

1.04 DEFINITIONS

A. Construction Water shall be defined as the following:

1. Water that is collected from water supply wells that are being abandoned.

2. Water removing during trenching activities in designated areas on the Durham Manufacturing Company property.

3. Liquids generated during decontamination activities.

1.05 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Construction Water Management Plan. Submit no later than 30 days prior to initiating on-site activities that may result in the generation of Construction Water.

C. The Contractor shall submit to the Contracting Officer for review all analytical test results for effluent water samples and shall not discharge any treated water until approved by the Contracting Officer.

D. Prior to project closeout, the Contractor shall submit to the Contracting Officer a report of treatment system operation including dates of operation, results of testing, average pumping rate, in gallons per minute (gpm), and total volume discharged.

1.06 PERFORMANCE REQUIREMENTS

A. The Work of this Section shall be performed in accordance with all substantive requirements of the applicable Federal, State, and local regulations, laws, codes, and ordinances for all activities carried out on-site. Nothing in this section will limit the

Contractor's responsibility to adhere to these regulations and recognized standards and regulatory practices. The EPA, the State, and the Contracting Officer will not be responsible at any time for Contractor's violations of any applicable local, state, or federal regulations or endangerment of his employees or of his Subcontractors.

B. The Contractor shall obtain all necessary permits and state licenses for activities not carried out on-site, including but not limited to the transport and disposal of hazardous materials to off-site facilities. The Contractor shall meet the intent of any discharge permits for activities conducted on-site.

C. Construction Water discharged at the location designated by the Contracting Officer shall be treated to remove Site Contaminants to less than or equal to the Maximum Contaminant Levels (MCLs) for Drinking Water, EPA 816-F-09-0004, U.S. Environmental Protection Agency, Summer 2009 and to achieve any federal or state requirements for discharge to surface water or a POTW.

D. The space requirements for the storage and treatment equipment and transport vehicles shall not exceed 2,000 square feet.

E. If the Contractor elects to dispose of the well abandonment water at a POTW, the Contractor shall complete the General Permit for the Discharge of Groundwater Remediation Wastewater to a Sanitary Sewer for approval by the CT DEEP.

F. Groundwater to be disposed of at a POTW shall be tested in accordance with Section 6.0 and Appendix A of the General Permit for the Discharge of Groundwater Remediation Wastewater to a Sanitary Sewer. Requirements for testing are available on the CT DEEP website at www.ct.gov/deep/waterdischargepermitapps

PART 2 – PRODUCTS

2.01 CONSTRUCTION WATER MANAGEMENT PLAN

A. The Contractor shall submit a plan for managing Construction Water. The plan shall include, but is not limited to:

1. Methods, means, and facilities required to manage Construction Water and residuals generated during the Work.

2. The Contractor's proposed method of handling, sampling, analysis, storage, treatment, disposal, and discharge of Construction Water generated during the Work.

3. Equipment and personnel required to manage Construction Water.

4. A detailed description of the water treatment system including system components provided to store Construction Water prior to treatment; to treat the Construction

Water to remove Site contaminants that may be present; and to store the treated Construction Water while it is sampled and tested prior to discharge.

5. A detailed description of the method of discharge, designed to meet the performance requirements of Section 01568 - Erosion Control, Sedimentation, and Containment of Construction Materials.

6. Procedure for decontamination of equipment prior to demobilization from Site.

B. The acceptable method of handling Construction Water is limited to collection and discharge to the ground surface within the limits of a location to be designated by the Contracting Officer, after appropriate treatment; or containerization and off-site disposal. No water shall be discharged to any other property.

C. The acceptable method of handling any sludge and sediments generated by the Contractor's management of Construction Water is containerization and removal from the Site, in accordance with waste management procedures identified in Section 02053 – Excavated Material Management Plan.

D. If the Contractor elects to dispose of Construction Water off-site, he shall do so in accordance with the off-site transport and disposal requirements of Section 02053 Part 3.01F.

PART 3 – EXECUTION

3.01 GENERAL

A. The Contractor shall provide all labor, materials, and equipment required for sampling, handling, storage, treatment, and disposal of Construction Water in accordance with the approved Construction Water Management Plan.

B. It shall be the responsibility of the Contractor to investigate and comply with all applicable Federal, State, and Local laws and regulations governing the handling, storage, and disposal of Construction Water. All Construction Water shall be disposed of in a manner which meets the intent of applicable permit requirements, laws, and regulations.

C. Any sampling and analysis necessary to protect the health and welfare of the Contractor's employees and/or agents and/or to characterize collected water, treated water, or residuals shall remain the sole responsibility of the Contractor.

D. Construction Water shall be handled using equipment compatible with anticipated contaminants which may be present.

3.02 TREATMENT SYSTEM MOBILIZATION

A. The Contractor shall be responsible for the placement of the water storage, treatment, and disposal systems at the location designated by the Contracting Officer.

B. The Contractor is responsible for providing utilities required for operation of the treatment system.

3.03 DISCHARGE

A. General

1. No Construction Water shall be discharged until the Contractor has demonstrated that it meets regulatory requirements.

2. All testing required for compliance with discharge criteria shall be the responsibility of the Contractor and shall be in accordance with Section 01410 - Sampling Procedures and Laboratory Services.

B. Effluent Testing Frequency

1. One sample shall be collected per batch (10,000 gallons or less) of Construction Water and analyzed in accordance with Section 01410, prior to discharge. Water shall not be discharged until analytical results which demonstrate that treated water meets the discharge criteria have been received and approved by the Contracting Officer.

2. At no time shall the discharged volume sample frequency be less than specified requirements.

3. In the event that stored water does not meet discharge criteria, it shall be re-treated to meet discharge criteria and re-tested prior to discharge.

C. The Contractor shall discharge treated water to the ground surface in a controlled manner to prevent erosion, runoff from the designated location, and flooding or pooling.

3.04 MINIMIZATION OF CONSTRUCTION WATER

A. The Contractor shall make every effort to minimize the generation of Construction Water and associated sediments and sludge in accordance with procedures outlined in Section 02521 Well Abandonment.

END OF SECTION

SECTION 02273

GEOTEXTILE FABRIC

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide nonwoven geotextile fabric in foundation preparation for separation of existing soil from screened gravel or crushed stone.

B. Provide woven geotextile fabric for silt fence as indicated or specified.

1.02 REFERENCES:

A. American Society for Testing and Materials (ASTM) Publications:

1. D4355: Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon ARC Type Apparatus.

2. D4491: Test Methods for Water Permeability of Geotextile by Permittivity.

3. D4533: Test Method for Trapezoid Tearing Strength of Geotextiles.

4. D4632: Test Method for Grab Breaking Load and Elongation of Geotextiles.

5. D4751: Test Method for Determining Apparent Opening Size of a Geotextile.

6. D4833: Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products.

1.03 SUBMITTALS:

A. Submit the following in accordance with Section 01300:

1. At least two weeks prior to shipment, submit manufacturer's certificate of compliance and physical property data sheet indicating that requirements for materials and manufacture are in conformance as specified.

2. For informational purposes only, submit manufacturer’s printed installation instructions.

1.04 QUALITY ASSURANCE:

A. Provide in accordance with Section 01400 and as specified.

B. General:

1. Producer of geotextile fabric to maintain competent laboratory at point of manufacture to insure quality control in accordance with ASTM testing procedures. Laboratory to maintain records of quality control results.

2. Do not expose geotextile fabric, except the geotextile fabric for silt fence, to ultraviolet radiation (sunlight) for more than 14 days total in period of time following manufacture until geotextile fabric is installed and covered with fill or backfill material.

3. Take all precautions to protect geotextile fabric from damage resulting from any cause. Either repair or replace geotextile fabric to Contracting Officer's satisfaction at no additional cost to the Contracting Officer.

1.05 DELIVERY, STORAGE AND HANDLING:

A. Provide in accordance with Section 01610 and as specified.

B. Provide geotextile fabric in rolls wrapped with protective covering to protect geotextile fabric from mud, dirt, dust, and debris. Label each roll of geotextile fabric with number or symbol to identify production run.

C. Protect geotextile fabric from sunlight during transportation and storage. Do not leave geotextile fabric exposed to sunlight for more than two weeks during installation operations.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Provide the following nonwoven geotextile fabric:

1. Geotex 501 as manufactured by Propex.

2. Mirafi 160N as manufactured by TenCate Geosynthetics.

3. 150 EX as manufactured by Thrace - LINQ.

4. Or acceptable equivalent product.

B. Provide the following woven geotextile fabric except for silt fence:

1. 200 ST as manufactured by Propex.

2. Mirafi 500X as manufactured by TenCate Geosynthetics.

3. GTF 200 as manufactured by Thrace-LINQ.

4. Or acceptable equivalent product.

C. Provide the following woven geotextile fabric for silt fence:

1. Geotex 2130 as manufactured by Propex.

2. W100 as manufactured by SKAPS Industries.

3. Beltech 940 by Belton Industries Inc.

4. Or acceptable equivalent product.

2.02 MATERIAL:

A. Geotextile fabric shall conforms to test requirements for minimum average roll value (weakest principle direction) for strength properties of any individual roll tested from manufacturing lot or lots of particular shipment in excess of minimum average roll value (weakest principle direction) as specified hereafter:

B. Physical Properties of Minimum Average Roll of the nonwoven geotextile fabric shall be:

Property	ASTM Test Method	Units	Value
1. Grab Strength	D4632	lbs	150 (min.)
2. Grab Elongation	D4632	%	50 (min.)
3. Trapezoidal Tear Strength	D4533	lbs	60 (min.)
4. Puncture Strength	D4833	lbs	75 (min.)
5. Permittivity	D4491	sec -1	1.3 (min.)
6. Apparent Opening Size	D4751	Sieve Number	70-100
7. Ultraviolet Stability	D4355	Percent	70 (min.)

C. Woven geotextile fabric, except for silt fence, shall be:

Property	ASTM Test Method	Units	Value
1. Grab Strength	D4632	lbs	200 (min.)
2. Grab Elongation	D4632	%	15 (min.)
3. Trapezoidal Tear Strength	D4533	lbs	75 (min.)
4. Puncture Strength	D4833	lbs	80 (min.)
5. Permittivity	D4491	sec -1	0.02 (min.)
6. Apparent Opening Size	D4751	Sieve Number	30-70
7. Ultraviolet Stability	D4355	Percent	70 (min.)

D. Physical Properties of Minimum Average Roll of the woven geotextile fabric for silt fence shall be:

Property	ASTM Test Method	Units	Value
1. Grab Strength	D4632	lbs	100 (min.)
2. Permittivity	D4491	sec -1	0.10 (min.)
3. Apparent Opening Size	D4751	Sieve Number	20-30
4. Ultraviolet Stability	D4355	Percent	70 (min.)

PART 3 - EXECUTION:

3.01 INSTALLATION:

A. Install geotextile fabric in accordance with manufacturer's printed instructions.

B. Place geotextile fabric on the foundation subgrade prior to placing the screened gravel or crushed stone.

C. Overlap geotextile fabric 18 inches minimum for unsewn lap joint. Overlap fabric 6 inches at seam for sewn joint.

D. Do not permit traffic or construction equipment to travel directly on geotextile fabric.

E. Place geotextile fabric in relatively smooth condition to prevent tearing or puncturing. Lay geotextile fabric loosely but without wrinkles or creases so that placement of the backfill materials will not stretch or tear geotextile fabric. Leave sufficient slack in geotextile fabric around irregularities to allow for readjustments.

F. Patch all tears in geotextile fabric by placing additional section of geotextile fabric over tear with a minimum of 3 feet overlay.

G. Extend the geotextile fabric and wrap around the screened gravel or crushed stone along the perimeter of the foundation.

H. Install silt fence in accordance with the manufacturer's printed instructions and as indicated.

3.02 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 02371

RIPRAP

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide riprap as indicated and in compliance with Contract Documents.

B. Section includes:

1. Riprap stone for plunge pool at Storage Tank site.

2. Riprap stone for stream crossing at Allyn Brook.

3. Riprap stone identified on the drawings and as directed by the Contracting Officer.

1.02 REFERENCES:

A. American Association of State Highway and Transportation Officials (AASHTO):

1. M288: Standard Specification for Geotextile Specification for Highway Applications.

B. American Society for Testing and Materials International (ASTM):

1. C33/C33M: Standard Specification for Concrete Aggregates.

2. C88: Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.

3. C127: Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate.

4. C535: Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

5. D5519: Standard Test Methods for Particle Size Analysis of Natural and Man-Made Riprap Materials.

6. D6092: Standard Practicefor Specifying Standard Sizes of Stone for Erosion Control.

7. D6473: Standard Test Method for Specific Gravity and Absorption of Rock for Erosion Control.

1.03 SUBMITTALS:

A. Submit the following in accordance with Section 01300.

1. Material certificates for commercial sources.

2. Material testing results for non-commercial sources.

3. Stone gradation analysis.

1.04 QUALITY ASSURANCE:

A. Comply with the requirements specified in Section 01400.

1.05 DELIVERY STORAGE AND HANDLING:

A. Comply with the requirements specified in Section 01610.

PART 2 - PRODUCTS

2.01 MATERIAL SOURCE:

A. Source: Imported from commercial source.

B. Non-commercial Sources: Provide 3 samples to an independent laboratory for testing. The samples shall represent the quality range as found at the source – poor, average, and best; determined by visual inspection. Samples from weathered surfaces or outcrops shall not be used. Obtain fresh material from trenching or core drilling having a preferred size of 6 inches for individual pieces. Submit test results to Contracting Officer for acceptance.

C. Commercial Sources: Submit material certificate for each source. Certificate shall state soundness, durability, and absorption properties that are representative of the source.

2.02 GRANULAR BEDDING:

A. Bedding: ASTM D6092, 6 inches minimum.

2.03 GEOTEXTILE BEDDING:

A. Geotextile Fabric:

1. Slope Stabilization: AASHTO M288, Table 6 for permanent erosion control.

a. Non-Woven Geotextile: Table 1, Class 1 for strength properties.

2.04 RIPRAP:

A. Physical Properties:

1. Crushed or fractured bedrock fragments, sound, durable, and free from seams, cracks, structural weaknesses, porous structure, and deleterious material.

2. Shape: Angular with 100 percent fractured faces; excluding flat or needle-like shapes where width or thickness is less than 1/3 of length.

3. Soundness: ASTM C88, 5 percent maximum loss, after 5 magnesium sulfate cycles.

4. Durability: ASTM C535, 12 percent maximum loss, at 100 revolutions.

5. Absorption: less than 2 percent.

B. Gradation: Grading of stone shall be according to ASTM D5519. Submit gradation to Contracting Officer for acceptance.

PART 3 - EXECUTION

3.01 PREPARATION:

A. Clear subgrade of all obstacles and objects that could puncture geotextile fabric.

B. Clear subgrade of all obstacles.

C. Trim and dress areas to conform to lines and grades.

D. Provide level subgrade such that depressions or humps do not exceed 6 inches in depth or height, respectively.

E. Compact subgrade, as specified in Section 02740 for pavement, when subgrade is achieved by filling. Compaction is not required when subgrade is achieved by excavating.

F. Place geotextile bedding.

3.02 RIPRAP PLACEMENT:

A. Placing rocks:

1. Machine place rocks with longitudinal axis normal to embankment face.

2. Leave minimum voids so that rock above foundation course has 3-point bearing on underlying rocks.

B. Placing rocks:

1. Provide minimum voids

2. Place larger rocks in foundation course and on outside of slope protection.

3. Spreading by equipment is acceptable.

C. Do not dump stone or bear on gravel used for filling voids.

D. Dress up outer facing to render a smooth surface, without irregularities measuring more than 1/4 of the maximum stone size when measured normal to the slope.

E. Chink voids in outer facing with smaller stones. Remove loose stones.

F. Choke riprap voids with gravel and sand by water jetting.

3.03 CLOSEOUT ACTIVITIES:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 02400

TEMPORARY COFFERDAM

PART 1 - GENERAL

1.01 DESCRIPTION:

A. The work of this section consists of furnishing, installing, maintaining and removing a temporary cofferdam.

B. The cofferdam shall consist of one or combination of systems, such as the following: portable dam, interlocking steel sheet pile, or soldier pile with steel plate lagging.

1.02 RELATED REQUIREMENTS

A. Sediment control devices are specified in Section 01568.
B. Dewatering requirements are specified in Section 02240.

1.03 PROJECT CONDITIONS

A. The temporary cofferdam shall be installed in two phases. In the first phase, the temporary cofferdam shall be installed from one riverbank to approximately the midpoint of the river, allowing flow in the river to be maintained. Following installation of the work in the cofferdam, the cofferdam shall be removed, and installed from opposite river bank to approximately the midpoint of the river, allowing flow in the river to be maintained during the work. After the work is complete and has been tested and accepted, the temporary cofferdam shall be removed and the impacted area shall be restored.

B. The cofferdam shall not extend outside the limits of temporary or permanent easements.

1.04 SUBMITTALS:

A. Shop Drawing: Submit the following in accordance with Section 01300 - SUBMITTALS:

1. Submit the following qualifications two (2) weeks prior to the construction:

a. Qualifications of Contractor’s temporary cofferdam system designer.

b. Qualifications of Contractor’s temporary cofferdam system installer.

2. Manufacturer’s material and installation information.

3. Dewatering Plan to include drawings with written descriptions of the proposed procedures for dewatering and disposal of the fluidized materials. The Dewatering Plan shall provide detailed information of the proposed temporary cofferdam system's materials, dimension, layout and pumping plan.

4. Submit a temporary cofferdam plan stamped and signed by a Registered Professional Engineer at least two (2) weeks prior to start of the construction. Do not submit design calculations. The review will be only for the information of the Contracting Officer and third parties for an overall understanding of the project relating to access, maintenance of existing facilities and proper utilization of the site. The Contractor shall remain responsible for the adequacy and safety of the means, methods and sequencing of construction. The plan shall include the following items as a minimum:

   a. Proposed temporary cofferdam system(s), details, location, layout, depths, extent of different types of support relative to existing features and methods and sequence of installation and removal.

   b. Certificate of Design: Refer to Section 01300.

   c. Requirements of dewatering during the construction.

   d. List of equipment used for installing the temporary cofferdam systems.

1.05 QUALITY ASSURANCE:

A. Provide in accordance with Section 01400 and as specified.

B. Conform to the requirements of the OSHA Standards and Interpretations and all other applicable laws, regulations, rules, and codes.

C. Prepare design, including calculations and drawings, under the direction of a Connecticut Registered Professional Engineer and having the following qualifications:

   1. Not less than ten (10) years experience in the design of specific temporary cofferdam systems to be used.

   2. Completed not less than five (5) successful temporary cofferdam system projects of equal type, size, and complexity within the last five (5) years.

D. Temporary Cofferdam System or Installer's Qualifications:

   1. Not less than three (3) year experience in the installation of similar types and equal complexity as the proposed system.

2. Completed not less than three (3) successful cofferdam systems of similar type and equal complexity as the proposed system.

E. Install temporary cofferdam systems under the supervision of a supervisor having the following qualifications:

1. Not less than five (5) years experience in installation of systems of similar type and equal complexity as the proposed system.

2. Completed at least five (5) successful temporary cofferdam systems of similar type and equal complexity as the proposed system.

1.06 DESIGN CRITERIA:

A. Design of temporary cofferdam systems shall meet the following minimum requirements:

1. Support systems shall be designed for hydrostatic pressure, water current, wave forces, ice forces, and other surcharge loads.

PART 2 - PRODUCTS

2.01 TEMPORARY COFFERDAM

A. A temporary dam to enable the dewatering of the construction area within the river for excavation, formwork erection, concrete placement and gabion installation in the dry.

B. The temporary cofferdam may be a portable dam system, interlocking steel sheeting, soldier piles with steel plate lagging. Selection of the cofferdam type is the Contractor's responsibility.

C. The portable cofferdam shall be as manufactured by Portadam, Inc., or approved equal. The Contractor shall have full responsibility for the structural and protective adequacy of the portable cofferdam system installed. The portable dam shall be capable of being erected on land as well as under water. The cofferdam system shall consist of free standing steel frame supports placed on the existing ground surface. The steel frame support members shall be of welded construction and designed to transfer fluid loading to a near vertical (downward) load. A high strength flexible fabric waterproof membrane shall be supported by the steel frame. The membrane shall be capable of providing the waterstop when positioned along the diagonal face of the steel frame supports and extended around the perimeter of the framework assembly. The fabric membrane shall consist of nylon reinforced vinyl at the upper portion and a lighter, flexible fabric extending out across the riverbed to provide a sealing effect produced by the hydrostatic pressure.

D. Interlocking steel sheeting or soldier piles with steel plate lagging cofferdams shall comply with all the requirements of Section 02160 Excavation Support Systems.

E. Quarry stone cofferdams may be substituted with approval from the Contracting Officer, and providing the preconstruction riverbed topography is maintained upon completion.

PART 3 - EXECUTION

3.01 GENERAL

A. The Dewatering Plan shall be approved by the Contracting Officer. All sediment and erosion control measures shall be in place prior to the commencement of the construction for the portable cofferdam. The Contractor shall notify the Contracting Officer 48 hours in advance of the delivery and onsite erection o the portable cofferdam system.

B. The Contractor shall be responsible for maintaining a safe, clean and accessible construction site. The Contractor shall have full responsibility for the complete and proper diversion of water during all stages of the project and shall repair, at no additional expense to the Contracting Officer, any damage to any equipment, materials or work caused by floods, high water or failure of the diversion of protective works.

C. The temporary cofferdam shall be constructed to provide adequate clearances in all directions are required for the execution of work to be performed in the dewatered area. This shall include room for the dewatering pumps and installation and removal operations.

D. A temporary protective and/or diversionary works shall be installed upstream of the dewatered work area where necessary, to reduce the impact of the stream flow on the cofferdam.

3.02 SUBGRADE PREPARATION

A. The portable dam shall be placed directly on the existing ground of the riverbed. If large obstructions are encountered, such as boulders, their removal is necessary. Softer ground areas may be traversed by using distribution pads under the steel framework or by driving steel poles down to suitable subsurface material. Either of these methods shall be performed in accordance with the manufacturer’s recommendations.

3.03 FRAME INSTALLATION

A. Assembly of the steel framework for the portable dam requires in-water labor to position frame toes properly and can be accomplished using floating, light-lift equipment or landside crane. Assemble the steel framework using bolted clamps and pinned connections. Place appropriate portable dam frames as per the manufacturer’s recommendations.

3.04 MEMBRANE INSTALLATION

A. Membrane for the portable dam shall be installed and sealed after the frames are installed in accordance with the manufacturer's recommendations. The fabric sections are connected on shore, rolled, and floated into position on the assembled framework. After connection of the top of the fabric at the desired elevation, it is unrolled down the diagonal face of the framework and extended over the riverbed to the required distance out from the toes. Sandbags may be used to anchor the ends of the membrane approximately one sandbag per linear foot.

3.05 STEEL SHEETING OR SOLDIER PILE AND LAGGING

A. Steel sheeting or soldier pile and lagging shall be installed in conformance with Section 02160 Excavation Support Systems.

3.06 DEWATERING

A. After the cofferdam has been installed and adequately sealed, the Contractor shall pump out the water behind the membrane into the river. Minor leaks shall be located and sealed. All water pumped after construction has started shall be pumped to a temporary dewatering sediment basin which shall filter the water prior to reentering the river.

B. Temporary sump holes may be installed within the area to be dewatered to create a more suitable pumping area. Pumps shall be capable of dewatering at a faster rate than river water enters the area. Pumps shall be kept in a workable condition and a spare pump shall be available for breakdowns or emergency conditions.

C. A temporary dewatering sediment basin shall be sized, constructed, and located by the Contractor. The sides of the dewatering basin shall be constructed of substantial materials designed for the prevention of siltation. The siltation prevention screening shall extend two feet above normal high water.

3.07 REMOVAL

A. The Contractor shall notify the Contracting Officer 48 hours in advance prior to removing any portion of the temporary cofferdam system. Upon completion, cleanup, inspection, and acceptance of the internal dry work, the enclosed area shall be flooded to equalize the water pressure on both side of the cofferdam. For the portable dam option, the fabric is first removed and then the frames. Sandbags shall be removed and disposed of. The Contractor shall check the ground surface for any stray objects, and dispose all surplus and unsuitable material from the site in accordance with all local, state, and federal rules.

END OF SECTION

SECTION 02435

CRUSHED STONE

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide and compact crushed stone as indicated and specified.

1.02 RELATED WORK:

A. Section 02210: Earth Excavation, Backfill, Fill and Grading

1.03 REFERENCES:

A. American Society for Testing and Materials (ASTM) Publications:

1. C33: Specification for Concrete Aggregates

2. D422: Test Method for Particle-Size Analysis of Soils.

1.04 SUBMITTALS:

A. Submit the following in accordance with Section 01300:

1. Gradation test result from the soil testing laboratory, at least two (2) weeks prior to hauling material, for the Contracting Officer's acceptance.

2. Submit a 20-lb. sample of the material when requested by the Contracting Officer.

1.05 QUALITY ASSURANCE:

A. Provide in accordance with Section 01400 and as specified.

B. Qualifications of the independent soil testing laboratory as specified in Section 02210.

C. Maximum particle size and gradation analyses shall be performed in accordance with ASTM D422.

D. Material testing frequency and requirements as specified in Section 02210.

PART 2 - PRODUCTS

2.01 MATERIAL:

A. Crushed Stone: Gradation and physical property requirements of crushed stone shall conform to ASTM C33, Coarse Aggregate number 67.

B. Crushed stone shall be free from roots, leaves, and other organic materials, and free of ice, snow or frost and frozen soil particles.

PART 3 - EXECUTION

3.01 PLACEMENT AND COMPACTION:

A. Specified in Section 02210 and as indicated on the drawings.

3.02 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 02510

WATER UTILITIES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide water utilities beyond 5 feet from buildings as indicated and in compliance with Contract Documents.

B. Coordinate with Work and Products specified under Sections 15101 and 15400.

C. Section includes:

1. Water mains and fittings

2. Water line, valves, fire hydrants, service connections, accessories, and appurtenances.

D. For water utilities work in the Town of Durham, conform to requirements of "Connecticut Water Company, Purchasing Standards for Waterworks Materials, Revised October 2016."

E. For water utilities work in the City of Middletown, conform to requirements of "City of Middletown, Water and Sewer Department, General Requirements for Water Main and Service Installation, January 2017."

1.02 REFERENCES:

A. American Society of Mechanical Engineers (ASME):

1. B16.1: Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.

2. B16.18: Cast Copper Alloy Solder Joint Pressure Fittings.

3. B16.22: Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

B. American Society of Testing and Materials International (ASTM):

1. A126: Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

2. B88: Standard Specification for Seamless Copper Water Tube.

3. D1785: Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

4. D2441: Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

5. D2466: Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

6. D2467: Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

C. American Water Works Association (AWWA):

1. C104/A21.4: Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.

2. C105/A21.5: Polyethylene Encasement for Ductile-Iron Pipe Systems.

3. C110/A21.10: Ductile Iron and gray Iron Fittings, 3 Inch Through 48 Inch for Water and Other Liquids.

4. C111/A21.11: Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

5. C115/A21.15: Flanged Ductile Iron Pipe with Threaded Flanges.

6. C150/A21.50: Thickness Design of Ductile Iron Pipe.

7. C151/A21.51: Ductile-Iron Pipe, Centrifugally Cast, for Water.

8. C153/A21.53: Ductile Iron Compact Fittings, 3 inch through 24 Inch and 54 Inch Through 64 Inch for Water Service.

9. C500: Metal-Seated Gate Valves for Water Supply Service.

10. C504: Rubber Seated Butterfly Valves.

11. C508: Swing-Check Valves for Waterworks Service, 2 Inch Through 24 Inch.

12. C509: Resilient-Seated Gate Valves for Water Supply Service.

13. C510: Double Check Valve Backflow Prevention Assembly.

14. C511: Reduced - Pressure Principle Backflow Prevention Assembly.

15. C512: Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.

16. C515: Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Services.

17. C550: Protective Interior Coatings for Valves and Hydrants.

18. C600: Installation of Ductile-Iron Water Mains and Their Appurtenances.

19. C700: Cold Water Meters - Displacement Type, Bronze Main Case.

20. C701: Cold Water Meters - Turbine Type, for Customer Service.

1.03 DEFINITIONS:

A. Appurtenances: Additional piping items as required to provide a complete piping system suitable to convey water as specified and intended. These items may or may not be specified, but are necessary to complete the piping system.

1.04 SUBMITTALS:

A. Submit the following in accordance with Section 01300.

1. Pipe materials.

2. Pipe fittings.

3. Pipe couplings.

4. Pipe thrust restraint.

5. Valves.

6. Fire Hydrants.

7. Accessories.

8. Appurtenances.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

C. Instructions: Provide manufacturer's installation instructions for pipe, hydrants**,** valves, and appurtenances.

D. Field Test Reports: Provide results for hydrostatic and bacteriological tests.

E. Project Record Documents: Provide actual locations of piping mains, valves connections, thrust restraints, and invert elevations. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.05 SPARE PARTS:

A. Comply with the requirements specified in Section 01610.

1.06 QUALITY ASSURANCE:

A. Comply with the requirements specified in Section 01400.

B. Perform Work in accordance with Town of Durham and City of Middletown Water Works standards.

C. Valves: Manufacturer's name and pressure rating marked on valve body.

1.07 DELIVERY STORAGE AND HANDLING:

A. Comply with the requirements specified in Section 01610.

B. Deliver and store valves in shipping containers with labeling in place.

1.08 WARRANTY:

A. Provide standard product warranties for piping materials and as required by the Town of Durham and City of Middletown Water Works Standards.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Ductile Iron Water Pipe and Fittings:

1. United States Pipe and Foundry Company or acceptable equivalent product.

2. Restrained joint pipe to be TR FLEX® as manufactured by the United States Pipe and Foundry Company or acceptable equivalent product.
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B. Valves – Provide valves manufactured by the following:

1. Gate Valves: Resilient Seat; Mueller, U.S. Pipe, American Cast Iron Pipe, or acceptable equivalent product.

2. Air Release Valves: APCO Willamette Valve and PRIMER Corp or approved equal.

C. Fire Hydrants: Mueller; Super Centurion 250 Model No. A421 (Middletown), Model No. A-423 (Durham).

D. Accessories – Provide accessories manufactured by the following:

1. Backflow Preventer: RPZ lead-free, Watts LF 909QT-s or acceptable equivalent product.

2. Water Meters: As provided by the Municipality**.**

2.02 PIPE:

A. Ductile Iron:

1. Design conforming to AWWA A21.50.

2. Manufacture conforming to AWWA A21.15 or AWWA A21.51.

3. Thickness class, unless otherwise indicated or specified:

a. Minimum Thickness Class 52.

b. Minimum thickness Class 53 for use with threaded flanges.

c. Minimum thickness Class 53 for use with flanged pipe.

d. Minimum thickness Class 54 for use with grooved couplings conforming to AWWA C606.

4. Pressure Class, Not used.

2.03 PIPE FOR USE WITH COUPLINGS:

A. As specified above except ends shall be plain.

B. With bolted split sleeve couplings, ends cast or machined at right angles to axis.

C. With grooved type coupling:

1. Ductile-Iron of thickness class specified above.

2. Grooved End dimensions conforming to AWWA C606 for flexible or rigid joints to suit joint requirements.

2.04 FLEXIBLE JOINT PIPE:

A. Provide joints with maximum deflection 15 degrees in any direction from pipe axis. Joint design to prevent pulling apart, and to remain watertight at any deflection angle within specified range.

B. Provide boltless type with rubber gaskets.

C. Pipe barrel thickness: According to manufacturer's standard but not less than AN Standard for pipe of corresponding class.

D. Machine joint contact surfaces spherical, without depressions or chatter marks, or rough tool cuts.

1. Smooth by grinding, and buffing.

2. Machining accuracy: Finished pipes interchangeable without loss of watertightness or flexibility.

3. Protect spherical spigot and plain ends of cut lengths by fastened wood lagging.

2.05 FITTINGS:

A. Provide cement lined ductile iron fittings conforming to AWWA A21.10 or AWWA A21.53, at least Class 150 and match piping class.

B. Provide all bell mechanical-joint fittings unless otherwise indicated or specified.

C. Face and drill flanged fittings conforming to AWWA A21.10 except special drilling or tapping for correct alignment and bolting.

D. If flanged fittings are not available under AWWA A21.10 provide fittings conforming to ASME B16.1 in 125 lb. pressure class.

E. Provide standard base fittings where indicated.

F. Provide grooved-end fittings ductile-iron conforming to AWWA A21.10 for center-to-face dimensions.

1. End preparation for grooved-ends conforming to AWWA C606 for flexible or rigid joints as required by type of joint.

2.06 NONSTANDARD FITTINGS:

A. Acceptable design.

B. Same diameter and thickness as standard fittings.

C. Manufactured to meet requirements of same specifications as standard fittings except for laying length and types of ends.

2.07 WALL CASTINGS:

A. Provide size and type indicated and specified.

1. Piping 24-inches (600 mm) and Smaller: Mechanical Joint with specified restraint or Restrained Push-On.

2. Piping 30-inches (750 mm) and Larger: Restrained Push-On.

B. Wall Castings: Conform to requirements of AWWA A21.10 or fabricate of Class 53 ductile iron pipe with screwed on flanges and welded on waterstop. Screwed on mechanical or push-on joints are not acceptable.

C. Provide water stop centered in wall. Weld water stops on in factory under controlled conditions to ensure adequate strength to permit waterstop to absorb thrust up to the pressure rating of the pipe.

Wall Castings with annealed ductile iron water stops	
Pipe Size	**Waterstop thickness, inches**
4 inch-12 inch (100-300 mm)	0.50 (13 mm)
14 inch-24 inch (350 -600 mm)	0.75 (19 mm)
30 inch-36 inch (750-900 mm)	1.00 (25 mm)
42 inch-48 inch (1050-1200 mm)	1.25 (32 mm)

Wall Castings with fabricated steel water stops	
Pipe Size	**Waterstop thickness, in**
4 inch-16 inch (100-400 mm)	0.25 (6 mm)
18 inch-24 inch (450 -600 mm)	0.38 (10 mm)
30 inch-36 inch (750-900 mm)	0.50 (13 mm)
42 inch-48 inch (1050-1200 mm)	0.75 (19 mm)
54 inch-64 inch (1050-1200 mm)	1.00 (25 mm)

D. On flanged wall castings, provide space between the wall and flange to permit mounting the nuts on the flange bolts.

E. Flanged wall castings located with the flange flush with the wall are not acceptable.

F. Locate push-on joint wall castings with space between the bell and the wall to insert the follower bolts.

G. As an option, fabricated wall pipe of Schedule 40 Type 316L stainless steel may be substituted for wall castings specified above. Provide with waterstops of above dimensions and welded continuously on both sides of stop. Flanges of Type 316 stainless steel. Bolts for connection to buried pipe Type 316 stainless steel. Provide flange insulation gaskets, sleeves and washers for all flanges.

H. Testing: Factory pressure test all wall castings to pipe and joint pressure rating for a minimum of 5 minutes. No visible leakage is acceptable.

2.08 ADAPTERS:

A. Furnish and install for joining pipe of different types, unless solid sleeves indicated.

1. Provide ends conforming to above specifications for the correct type of joint, to receive adjoining pipe.

2. Joining two classes of pipe may be of lighter class provided annular space in bell-and-spigot type joints sufficient for jointing.

2.09 JOINTS:

A. Provide push-on joint and mechanical joint pipe with necessary accessories, conforming to AWWA A21.11.

1. Provide SBR gasket composition.

B. Provide pipe flanges and accessories conforming to AWWA A21.15.

1. Provide flat faced flanges.

2. Provide 1/8-inch (3 mm) thick, full faced SBR gaskets designed for exposure to liquid within pipe.

C. Provide restrained joint on pipe and fittings where indicated. Provide restrained joint which is:

1. Boltless

2. Capable of being deflected after assembly

3. Designs using set screws or requiring field welding are not acceptable.

4. Manufacturers:

a. American Cast Iron Pipe Co. Flex-Ring.

b. U.S. Pipe TR FLEX.

c. McWane TR-FLEX.

2.10 MECHANICAL JOINT FITTINGS – RESTRAINT SYSTEM:

A. Provide restraint devices for pipe consisting of multiple gripping wedges incorporated into a follower gland meeting requirements of AWWA A21.10.

1. Mechanical joint restraint shall require conventional tools and installation procedures per AWWA C600, retaining full mechanical joint deflection during assembly and allowing joint deflection after assembly.

2. Provide actuation of the gripping wedges ensured with torque limiting twist off nuts.

3. Provide restraint devices Listed by Underwriters Laboratories (3 inch (75 mm) through 24 inch (600 mm) size) and Designed by Factory Mutual (3 inch (75 mm) through 12 inch (300 mm) size).

4. Gland body, wedges and wedge actuating components must be domestic manufactured in the USA.

B. Working Pressure Rating:

1. 16-inch (400 mm) and Smaller: 350 psi (2450 kPa).

2. 18-inch (450 mm) and Larger: 250 psi (1750 kPa).

3. Minimum safety factor of 2 to 1.

C. Materials:

1. Gland body, wedges and wedge actuating components: Grade 65-45-12 ductile iron in accordance with ASTM A536.

2. Ductile iron gripping wedges: Heat treated, 370 to 470 BHN.

3. Provide three (3) test bars incrementally poured per production shift as per Underwriter's Laboratory (U.L.) specifications and ASTM A536. Testing for tensile, yield and elongation in accordance with ASTM E8.

4. Provide chemical and nodularity tests performed as recommended by the Ductile Iron Society, on a per ladle basis.

5. Provide an identification number consisting of year, day, plant and shift (YYDDD)(plant designation)(Shift number) cast into each gland body.

6. Record all physical and chemical test results such that they can be accessed via the identification number on the casting. Provide the Material Traceability Records (MTRs) available, in hard copy.

7. Provide coating for restraint devices consisting of the following:

a. Process all wedge assemblies and related parts through a phosphate wash, rinse and drying operation prior to coating application.

b. Coating: A minimum of two coats of liquid thermoset epoxy coating with heat cure to follow each coat.

c. Surface pretreat all casting bodies with a phosphate wash, rinse and sealer before drying. The coating shall be electrostatically applied and heat cured. Coating: Polyester based powder to provide corrosion, impact and UV resistance.

d. Coating system: MEGA-BOND by EBAA Iron, Inc.

D. Manufacturer:

1. EBAA Iron MegaLug Series 1100

2.11 FLANGE ADAPTORS:

A. Provide restrained flange adaptors for pipe consisting of multiple individual gripping wedges incorporated into a follower gland meeting requirements of AWWA A21.10.

1. Provide actuation of the gripping wedges ensured with torque limiting twist off nuts.

2. Provide restraint devices Listed by Underwriters Laboratories (3-inch (75 mm) through 12 inch (300 mm) size) and Designed by Factory Mutual (4-inch (100 mm) through 12-inch (300 mm) size).

3. Gland body, wedges and wedge actuating components must be domestic manufactured in the USA.

B. Joint Deflection capability:

1. 3-inch through 8-inch (30 mm through 200 mm): 5 degrees

2. 10-inch and 12-inch (250 mm and 300 mm): 3 degrees

3. 14-inch and 16-inch (350 mm and 400 mm): 2 degrees

4. 18-inch and 20-inch (450 mm and 500 mm): 1.5 degrees

5. 20-inch, 42-inch and 48-inch (500 mm, 1050 mm and 1200 mm): 1 degrees

6. 30-inch and 36-inch (750 mm and 900 mm): 3 degrees

C. Provide flange adaptor to maintain seal with and 0.6 inch (15 mm) gap between end of pipe and mating flange

D. Working Pressure Rating:

1. 16-inch (400 mm) and Smaller: 350 psi (2450 kPa)

2. 18-inch (450 mm): 300 psi (2100 kPa)

3. 20-inch (500 mm): 250 psi (1750 kPa)

4. 24-inch (600 mm): 200 psi (1400 kPa)

5. 30-inch through 48-inch (750 mm through 1200 mm): 150 psi (1050 kPa)

6. Minimum safety factor of 2 to 1.

E. Materials:

1. Gland body, wedges and wedge actuating components: Grade 65-45-12 ductile iron in accordance with ASTM A536.

2. Ductile iron gripping wedges: Heat treated, 370 to 470 BHN.

3. Provide three (3) test bars incrementally poured per production shift as per Underwriter's Laboratory (U.L.) specifications and ASTM A536. Testing for tensile, yield and elongation in accordance with ASTM E8.

4. Provide chemical and nodularity tests performed as recommended by the Ductile Iron Society, on a per ladle basis.

5. Provide an identification number consisting of year, day, plant and shift (YYDDD)(plant designation)(Shift number) cast into each gland body.

6. Record all physical and chemical test results such that they can be accessed via the identification number on the casting. Provide the Material Traceability Records (MTRs) available, in hard copy.

7. Provide coating for restraint devices consisting of the following:

   a. Process all wedge assemblies and related parts through a phosphate wash, rinse and drying operation prior to coating application.

   b. Coating: A minimum of two coats of liquid thermoset epoxy coating with heat cure to follow each coat.

   c. Surface pretreat all casting bodies with a phosphate wash, rinse and sealer before drying. The coating shall be electrostatically applied and heat cured. Coating: Polyester based powder to provide corrosion, impact and UV resistance.

   d. Coating system: MEGA-BOND by EBAA Iron, Inc.

F. Manufacturer:

1. EBAA Iron MegaFlange Series 2100

2.12 FLEXIBLE CONNECTIONS:

A. Use as specified or indicated:

1. Bolted split sleeve couplings

2. Grooved couplings

3. Expansion joints

2.13 BOLTED SPLIT SLEEVE COUPLINGS:

A. Provide in accordance with Section 15101.

B. Pressure rating at least equal to that of related pipeline.

C. Provide with gaskets of composition designed for exposure to liquid within pipe.

D. Provide gaskets with copper tips for electrical continuity through joints.

2.14 GROOVED COUPLINGS:

A. Conform to AWWA C606.

B. Minimum pipe wall thickness specified under "Pipe For Use With Couplings."

C. Where grooved couplings are indicated to provide for expansion or flexibility, cut pipe grooves to provide necessary expansion or flexibility.

D. Where grooved couplings are used instead of flanged joints, joint to be of rigid type with pipe grooves cut to bring pipe ends together. Beam strength of joint shall be equal to or greater than that of flanged joint.

2.15 EXPANSION JOINTS:

A. Provide in accordance with Section 15105.

B. Pressure rating at least equal to that of related pipeline.

2.16 FILLING RINGS:

A. Provide where necessary.

B. Materials, workmanship, facing, and drilling, conforming to 125-lb. ANSI (Class 125).

C. Suitable length with nonparallel faces and corresponding drilling, if necessary, for correct assembly of adjoining piping or equipment.

2.17 WATER SERVICE MATERIALS

A. All water service materials, which shall include but is not limited to corporation cocks, curb stops, couplings, adapters, and fittings shall have compression type connections. Castings shall be sufficiently heavy to meet all service conditions without springing or leaking and be clean and free from roughness both inside and out. Waterways shall be smooth, full size and free from obstruction. All threads shall be cut sharp, clean and true.

1. Service Pipe 1-in ASTM B 88, Type K, annealed.

2. Fittings: ASME B16.18, cast copper, or ASME B16.22, wrought copper.

3. Joints: Compression connection or AWS A5.8, BCuP silver braze.

4. Only lead-free solder shall be used.

5. Working Pressure: Minimum of 55 psi .

6. Bronze curb stop with compression CTS connections and

7. Cast Iron Curb Box with SS operating rod.

8. Full Port Corporation Stop; MuellerH-15008 or Ford F-100G AWWA

2.18 PVC PIPE:

1. PVC Material: ASTM D1784, Type 1, Grade 1.

   a. PVC: ASTM D1784, Cell classification 12454-B.

2. PVC Pipe 2-4 inches in diameter:

   a. Pipe: ASTM D1785, Schedule 40/80 or ASTM D2441, SDR 17 (unless noted otherwise

   b. Fittings: ASTM D2467 for solvent welded joints; ASTMD 2464 for threaded joints. Match schedule and pressure rating of adjacent pipe.

   c. Joints: Solvent welded or Push-on in accordance with ASTM D3139. Drilled in accordance with ANSI/ASME B16.1, Class 125 with full-face teflon or natural rubber gaskets.

   d. Trace Wire: Wire: Magnetic detectable conductor, clear plastic covering, imprinted with "Drain" in large letters.

3. Solvent Cements: Use fast-drying solvent for 1-1/2 inch sizes and smaller. Use heavy slow-drying type for sizes 2 inches and larger. Solvent as furnished by manufacturer of pipe used. Cement shall be compatible with piped fluid.

   a. PVC: ASTM D2564.

4. Thread Lubricant:

   a. Liquid: Teflon base liquid in plastic squeeze bottles. Use liquid lubricant on permanent joints.

   b. Tape: Teflon base tape. Use tape on joints for valves or joints that may be disconnected often.

2.19 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

A. For Tank underdrain, 6 inches diameter perforated to face down.

B. SDR 11

C. Trace Wire: Magnetic detectable conductor, clear plastic covering, imprinted with "Water Service" in large letters.

2.20 VALVES

A. Resilient Seated Gate Valves (buried service) as specified in Section 15101:

1. 3 Inches and Over: AWWA C500, iron body, bronze trim, non-rising stem with square nut, single wedge, [flanged] [mechanical joint] ends, control rod, [post indicator,] extension box [and valve key 3 feet longer than depth of valve nut. AWWA C509 or C515, Iron body, bronze trim, non-rising stem with square nut, single wedge, resilient seat, flanged or mechanical joint ends, control rod, post indicator, extension box and valve key 3 feet longer than depth of valve nut. Protective interior coating per AWWA C550. Gate valves 16 inches and larger to be equipped with spur or beveled gears enclosed in a seal grease case, in the horizontal position to be equipped with rollers, tracks, and scrappers.

2. Provide one operating wrench of length to operate deepest valve.

B. Manual Air Release Valve Assembly

1. 1-inch Wedge Air Release Valve

2. 1-inch Mueller H-15015 Corporation Stop (AWWA Taper Thread x FIP Thread)

3. Valve Box as specified.

C. Butterfly Valves (buried service)

1. Manufacturers: Mueller, Pratt, Valmatic

2. Conform to AWWA C504, Class 150B and NSF 61

3. Class 150B for cast iron body, Class 250B for ductile iron body, mechanical joint connections, fusion bonded epoxy coating inside and out, 250 psi rated working pressure, gear operator with 2-inch operating nut.

4. Type 316 stainless steel mating surfaces, seat placement, shaft, fasteners/screws, retaining ring.

5. Valve body: ASTM A126 Class B cast iron or ASTM A536 GR65/45/12 ductile iron

6. Valve bearings: Self-lubricating, non-metallic material to isolate disc shaft assembly from valve body.

7. Valve seats: Molded new natural or synthetic rubber suitable for potable water service

2.21 VALVE BOXES:

A. General: Provide cast-iron valve boxes for all buried valves, rated for vehicular traffic.

B. Cast-Iron Boxes: Extension type with slide-type adjustment, flared base and 3/16-inch minimum thickness of metal.

C. Cast the word "WATER" in cover. Adapt box length, without full extension, to depth of cover required over pipe at valve location.

D. Bell end of lower section shall in all cases be sufficiently large to fit over the stuffing boxes of the valves. Minimum inside dimension shall be 5 ¼ inches.

E. Valve box extensions, if required, shall be supplied at no additional cost.

2.22 FIRE HYDRANTS:

A. AWWA C502, UL 246, dry barrel type compression hydrant with double O-ring seals; rotation to open as required by local Water Utility and as indicated. Protective interior coating per AWWA C550.

B. In City of Middletown:

1. Mueller Super Centurion 250 Model No. A-421.

2. 4 ½-in Main valve opening

3. Opening Direction: Left (counterclockwise)

4. Provide One (1) 4 ½-in pumper nozzle and Two (2) 2 ½-in hose nozzles

5. Bonnet and cap factory coated John Deer Green and remainder of hydrant painted John Deer Yellow.

C. In Town of Durham:

1. Mueller Super Centurion 250 Model No. A-423.

2. 5 ½-in Main valve opening

3. Opening Direction: Right (clockwise)

4. Provide One (1) 4 ½-in pumper nozzle and Two (2) 2 ½-in hose nozzles

5. Hydrant to be factory coated with a White Reflective Bonnet and Yellow Barrel.

6. Provide a stenciled identification label in accordance with Connecticut Water Company requirements (Operator).

D. Provide threads on nozzles in conformance with Local fire-hose coupling screw-thread dimensions. Nozzles shall be replaceable.

E. Fabricate extensions in multiples of 6 inches with rod and coupling to increase barrel length.

F. Working Pressure: 150 psi (1050 kPa) minimum.

G. Provide 1 safety flange repair kit.

H. UL Listed/FM Approved.

2.23 BEDDING AND COVER MATERIALS:

A. As specified in Section 02210.

2.24 THRUST RESTRAINT:

A. Mechanical Joint Restraint: Wedge action restrained joint retainer gland devices. Mechanical joint restraint incorporated into the design of the follower gland.

B. Thrust Blocks: Only where restrained joint pipe cannot be used as directed by the Contracting Officer. Restrained Joint Pipe is specified for all pipe and fittings. Concrete type for thrust restraints is specified under Section 03300.

C. Pipe Clamps and Tie Rods: ANSI/NFPA 24.

D. Push-On Restrained Joint Pipe: Provide joint restraint and conforming joint to AWWA C111/21.11, fabricated to be easily disassembled. Provide assembly and disassembly kits.

E. Wall Pipes: Cast or ductile iron with an intermediate wall collar, unless noted otherwise. End connections as indicated.

2.25 COUPLINGS:

A. Mechanical Couplings: Dresser Style 38, long sleeve unless shown otherwise; equivalent by Smith-Blair or Baker. Harness when required for thrust restraint.

B. Flanged Coupling Adapters: Dresser Style 127 (2-12 inches), Dresser Style 128 (14-96 inches), equivalent by Smith Blair or equal.

2.26 ACCESSORIES:

A. Backflow Preventer: 1-in RPZ Lead Free backflow preventer with strainer and air gap fitting (Watts LF type with isolation valves and testing connections).

B. Exterior Backflow Preventer: Installation arrangement per drawing detail 6 on Sheet C-503; including precast concrete base slab, Hot Rok insulated fiberglass enclosure and appurtenances, complete as specified and indicated on the drawings.

C. Meter: To be obtained by the Contractor from the Municipality.

D. Water Meter Pit (For 1-in meters): 18-inch DIA x 54-inch SDR 35 PVC (0.485 in. minimum wall thickness) for 5/8-in or 3/4- in meters. Cast Iron Frame and 15-inch DIA locking Lid labeled "WATER" with hole and plug for touch pad reader.

E. Water Meter Pit (For 4-in meters): Per drawing detail 7 on Sheet C-503; including vault, piping and all appurtenances, complete as specified and indicated on the drawings.

F. Tapping Sleeves: Ductile- or cast-iron, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of sleeve suitable for maximum working pressure of 150 psi**.** Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets shall be as recommended by manufacturer of sleeve.

G. Tapping Valves: Provide tapping valves that conform to gate valves, specified herein. Provide tapping valves suitable for installation with tapping sleeves and pipe used, designed for minimum water working pressure of 150 psi, and have clear waterway equal to full nominal diameter of valve.

H. Service Clamp: Pressure rating not less than connecting pipe; either single or double flattened strap type. Clamps shall have rubber gasket cemented to galvanized malleable-iron body. Straps and nuts shall be cadmium-plated.

I. Service Boxes: Cast iron or concrete and shall be extension service boxes of length required for depth of line, with either screw or slide-type adjustment. Boxes shall have housings of sufficient size to completely cover service stop or valve and shall be complete with identifying covers.

2.27 DISINFECTION CHEMICALS:

A. Refer to Section 02515.

2.28 APPURTENANCES:

A. Provide appurtenances for a complete piping system suitable for operation, and in conformance with Project Documents.

2.29 SHOP PAINTING/COATINGS:

A. Unless noted otherwise, provide standard manufacturer paint and coatings for piping, valves, hydrants, and accessories to prevent corrosion for the life of the component in accordance with 09941.

2.30 SHOP TESTING:

A. Test pipes, valves, hydrants, and applicable accessories per manufacturer requirements, and as required by referenced Standards.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Verify existing conditions.

B. Coordinate all private property work with Contracting Officer.

3.02 PREPARATION:

A. Ream pipe and tube ends and remove burrs.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare pipe connections to equipment with flanges or unions.

D. Excavate pipe trench in accordance with Section 02210 for work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated.

3.03 WATER PIPE INSTALLATION:

A. Maintain separation of water main from sewer as follows:

1. Parallel Installation

a. Under normal conditions water mains shall be laid at least 10 feet horizontally from a sewer or sewer manhole. The distance shall be measured edge-to-edge.

b. Under unusual conditions when local conditions prevent a horizontal separation of 10 feet the water main may be laid closer to a sewer or sewer manhole provided that:

c. The bottom (invert) of the water main shall be at least 18 inches above the top (crown) of the sewer;

d. Where this vertical separation cannot be obtained, the sewer shall be constructed of AWWA approved water pipe, pressure tested in place without leakage prior to backfilling; and

e. The sewer manhole shall be of watertight construction and tested in place.

2. Crossing

a. Where necessary water lines crossing sewers shall be laid to provide a separation of at least 18 inches between the bottom of the water line and the top of the sewer whenever possible.

B. Install pipes and structures to within tolerance of 1/2-inch of indicated elevations.

C. Install ductile iron piping and fittings to AWWA C600.

F. Install joint restraint per manufacturer's instructions. Submit instruction to the Contracting Officer for review.

G. Form and place concrete for thrust blocks at each elbow or change of direction of pipe main [and as indicated.

H. Establish elevations of buried piping to ensure not less than 4 feet of cover and as indicated.

I. Install trace wire continuous over top of pipe buried 12 inches above pipe line or as directed by the Contracting Officer. Extend wire into valve boxes and adjacent to hydrants for connection to location equipment.

J. Backfill trench in accordance with Section 02210.

3.04 VALVES AND HYDRANTS INSTALLATION:

A. Set valves on solid bearing.

B. Center and plumb valve box over valve. Set box cover flush with finished grade.

C. Set hydrants plumb and locate pumper nozzle perpendicular to roadway.

D. Provide drainage pit as indicated and as approved by the Contracting Officer. Wrap drainage pit and gravel with filter fabric. Do not connect drain opening to sewer.

E. Paint fire hydrants in accordance with local water utility requirements.

F. Install tapping sleeves and tapping valves in accordance with manufacturer's recommendations.

G. Install valves and hydrants according to applicable AWWA Standards.

3.05 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM:

A. Refer to Section 02515 and Section 15400.

3.06 SERVICE CONNECTIONS:

A. Provide water service including corporation stop, copper pipe, curb stop, meter setter, and water meter pit as indicated and specified.

3.07 REPAIR/RESTORATION:

A. Repair any existing utilities/structures, or features damaged during installation of water utilities to s's satisfaction, and at no cost to Contracting Officer.

3.08 FIELD TESTING:

A. Perform field-testing under provisions of AWWA C600 and Section 02515.

3.09 FIELD PAINTING/COATINGS:

A. Repair any shop painting/coatings damaged during storage or installation to Contracting Officer's satisfaction.

3.10 ADJUSTING:

A. Coordinate with Contracting Officer for any field adjustments. The Contracting Officer reserves the right to reject any field adjustments.

3.11 PROTECTION:

A. Protect installed water utilities from damage throughout storage, installation, testing, and final approval.

3.12 CLOSEOUT ACTIVITIES:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 02515

DISINFECTING WATER DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide disinfection of water utility distribution system as indicated and in compliance with Contract Documents.

1. Coordinate with City of Middletown regarding testing and disinfection of Storage tank and pipelines in Middletown.

2. Coordinate with Town of Durham and its water system operator Connecticut Water Company (CWC) regarding testing and disinfection of water main facilities in Durham including specific procedures, schedule, and use of water.

B. Section Includes:

1. Disinfection of water mains in accordance with AWWA C651 and water storage facility in accordance with AWWA C652, except as modified below.

2. Refer to Section 13225 for additional tank disinfection requirements.

1.02 REFERENCES:

A. American Water Works Association (AWWA):

1. C651: Disinfecting Water Mains.

2. C652: Disinfection of Water-Storage Facilities.

1.03 SEQUENCING:

A. Basic procedure for disinfecting water mains:

1. Testing and disinfection of water mains shall be limited to 1,000 ft sections or as approved by the Contracting Officer.

2. Inspecting materials to be used to ensure their integrity.

3. Preventing contaminating materials from entering the water main during storage, construction, or repair and noting potential contamination at the construction site.

4. Removing, by flushing or other means, those materials that may have entered the water main.

5. Chlorinating any residual contamination that may remain, and flushing the chlorinated water from the main.

6. Protecting the existing distribution system from backflow caused by hydrostatic pressure test and disinfection procedures.

7. Documenting that an adequate level of chlorine contacted each pipe to provide disinfection.

8. Determining the bacteriological quality by laboratory test after disinfection.

9. Final connection of the accepted new water main to the active distribution system.

1.04 SUBMITTALS:

A. Submit the following in accordance with Section 01300.

1. Supervisor qualifications.

2. Equipment list.

1.05 QUALITY ASSURANCE:

A. Comply with the requirements specified in Section 01400.

B. Regulatory Requirements:

1. Disinfection work shall be acceptable to the water system operators of Durham and Middletown. If requirements of this section are in conflict with requirements of regulatory agencies, the latter shall govern.

C. Source Quality Assurance:

1. Perform Work in connection with disinfection under direction of experienced supervisor.

2. Use equipment in proper working condition and adequate for specified Work.

D. Prior to starting disinfection work, furnish detailed outline of proposed sequence of operation, manner of filling and flushing units, source and quality of water to be used, and disposal of wasted water.

E. Perform work in connection with disinfection under direction of experienced supervisor.

F. Use equipment in proper working condition and adequate for specified work.

1.06 DELIVERY STORAGE AND HANDLING:

A. Comply with the requirements specified in Section 01610.

1.07 PROJECT CONDITIONS:

A. Discharge of chlorinated water into watercourses or surface waters is regulated by the National Pollutant Discharge Elimination System (NPDES). Disposal of the chlorinated disinfection water and the flushing water is the Contractor's responsibility.

B. Schedule the rate of flow and locations of discharges in advance to permit review and coordination with Contracting Officer and regulatory authorities

PART 2 - PRODUCTS

2.01 CONTRACTING OFFICER-SUPPLIED PRODUCTS:

A. In coordination with the Contracting Officer, the City of Middletown will provide potable water for the first disinfection effort. Submit request for use of water from waterlines of Middletown and Durham 48 hours in advance. If bacteriological testing shows that the first disinfection effort was not successful, the Contractor will be charged, at Middletown's current rates, the cost of additional water for subsequent disinfection efforts.

2.02 MATERIALS:

A. Water: Use potable water for cleaning and disinfection.

B. Chlorine: Provide in accordance with AWWA C652.

1. Liquid Chlorine: Inject with a solution feed chlorinator and a water booster pump. Follow the instructions of the chlorinator manufacturer.

2. Calcium Hypochlorite (Dry): Dissolve in water to a known concentration in a drum and pump into the pipeline at a metered rate. Tablet form calcium hypochlorite may be used only for water mains up to 12 inches in diameter and less than 2,500 feet in length.

3. Sodium Hypochlorite (Solution): Further dilute in water to desired concentration and pump into the pipeline at a metered rate.

2.03 EQUIPMENT:

A. Submit list of equipment used for disinfecting work.

2.04 ACCESSORIES:

A. Chlorine Residual Test Kit: For measuring chlorine concentration, supply and use a medium range, drop count, DPD drop dilution method kit per AWWA C651, Appendix A.1. Maintain kits in good working order available for immediate test of residuals at point of sampling.

PART 3 - EXECUTION

3.01 PREPARATION:

A. Isolate new work being disinfected from system to avoid possibility of contaminating materials entering distribution system.

B. Water Storage Facilities:

1. Remove debris and material not part of structural or operating facilities of tank.

2. Clean using high pressure water jet or other equally effective means to remove dirt and foreign material.

3. Cleaning shall:

a. Remove deposits of foreign nature.

b. Remove growths.

c. Broom walls, floor, and ceiling.

d. Avoid damage to structure.

e. Avoid contamination by workers and equipment.

4. Remove water, dirt, and foreign material and dispose.

5. Water used in cleaning reservoir shall be wasted before adding chlorinating agent to reservoir.

C. Method of disinfection for water containment devices and piping systems shall conform to AWWA C651 and AWWA C652.

3.02 CHLORINE PREPARATION:

A. Liquid Chlorine:

1. Apply chlorine gas-water solution by means of solution feed chlorinating device or, if accepted by the Contracting Officer dry gas may be fed directly through proper devices for regulating rate of flow and providing effective diffusion of gas into water within unit being treated.

2. Provide chlorinating devices for feeding solutions of chlorine gas that prevent backflow of water into chlorine cylinder.

B. Calcium Hypochlorite:

1. Prepare granular calcium hypochlorite as water mixture before introduction into unit. Make dry powder into paste and thin to approximately 1 percent chlorine solution.

3.03 PIPELINE PREPARATION:

A. After pressure and leakage tests complete, flush units thoroughly to remove foreign material.

B. Release entrapped air at high points and fill units with disinfecting agent and water to allow disinfecting agent to come in contact with interior surfaces.

C. If complete venting cannot be accomplished through available outlets, provide necessary corporation cocks and vent piping.

3.04 APPLICATION OF DISINFECTANT:

A. Point of Application:

1. Apply chlorinating agent at supply end of unit being disinfected.

2. For pipes, apply disinfectant through corporation cock installed in top of pipe.

3. Place tablets in accordance with AWWA C651.

B. Rate of Application:

1. Introduce water at controlled rate in order to regulate chlorine dosage.

2. Proportion rate of chlorine mixture flow to rate of water entering unit so chlorine dose applied produces at least 25 mg/L chlorine residual after period of 24 hours.

3. Method of determining rate of flow of water into unit being disinfected shall be accepted by the Contracting Officer.

C. Isolating Systems:

1. Keep chlorine gas-water disinfecting solution and contaminated water from flowing into units previously chlorinated and flushed.

D. Quality:

1. Retain chlorinated water in unit long enough to destroy non-spore forming bacteria.

2. Minimum retention period shall be 24 hours with chlorine residual at end of this period of not less than 25 mg/L (ppm).

E. Disinfecting Valves:

1. Operate valves and appurtenances while line or unit is being disinfected to ensure surfaces of valves are disinfected.

F. Swabbing:

1. Flush and swab pipe, fittings or valves that must be placed in service immediately with 5 percent solution of calcium hypochlorite immediately prior to assembly.

2. Secure acceptance from the Contracting Officer before using this method of disinfection.

G. Valve Operation: Performed by Operator.

3.05 DISINFECTING METHODS:

A. Continuous Feed Method:

1. Introduce potable water into the pipeline at a constant measured rate. Feed the chlorine solution into the same water at a measured rate. Proportion the two rates so that the chlorine concentration in the pipeline is maintained at a minimum concentration of 25 mg/L. Check the concentration at points downstream during the filling to ascertain that sufficient chlorine is being added.

B. Slug Method:

1. Introduce the water in the pipeline at a constant measured rate. At the start of the test section, feed the chlorine solution into the pipeline at a measured rate so that the chlorine concentration created in the pipeline is 100 mg/L. Feed the chlorine for a sufficient period to develop a solid column or "slug" of chlorinated water that will, as it passes along the line, expose all interior surfaces to a concentration of at least 100 mg/L for at least three hours.

C. Disinfection of Valves, Blind Flanges, and Appurtenances:

1. During the period that the chlorine solution or slug is in the section of pipeline, open and close valves to obtain a chlorine residual at hydrants and other pipeline appurtenances. Swab exposed faces of valves and blind flanges prior to bolting flanges in place with a 1 percent sodium hypochlorite solution.

D. Disinfection of Connections to Existing Pipelines

1. Disinfect isolation valves, pipe, and appurtenances in accordance with AWWA C651, Section 4.7. Flush with potable water until discolored water, mud, and debris are eliminated. Swab interior of pipe and fittings with a 1 percent sodium hypochlorite solution. After disinfection, flush with potable water again until water is free of chlorine odor.

E. Confirmation of Residual:

1. After the chlorine solution applied by the continuous feed method has been retained in the pipeline for 24 hours, confirm that a chlorine residual of 10 mg/L minimum exists along the pipeline by sampling at air valves and other points of access.

2. With the slug method, confirm by sampling as the slug passes each access point and as it leaves the pipeline that the chlorine concentration in the slug is at least 50 mg/L.

3.06 FINAL FLUSHING AND TEST:

A. Following chlorination, flush unit or system until replacement water in system is proven to be comparable in quality to water which will enter unit or system.

B. Above acceptable condition of water delivered by each unit or system shall continue for at least 2 days, as demonstrated by laboratory examination of samples. Laboratory tests shall show chlorine residual, after final flushing, of less than 1 mg/L (ppm).

C. Repetition of Flushing and Testing:

1. If initial treatment results in unsatisfactory bacterial test, repeat disinfection until satisfactory results obtained.

D. Prevent entry of contaminated water into previously disinfected units or systems.

3.07 DISINFECTING TANK:

A. Disinfect in accordance with AWWA C652 and as specified in 13225.

B. Place water containing 50 ppm chlorine in reservoir to depth that, when reservoir is filled, resultant chlorine concentration shall be no less than 2 ppm, 24 hours before filling reservoir.

C. Fill reservoir.

D. Full reservoir shall stand for 24 hours, after which reservoir may be put into service without draining water used to disinfect it, providing safe samples obtained by Contracting Officer.

E. If safe samples are not obtained using above procedure, add additional chlorine to full reservoir in amounts necessary to obtain safe sample. After obtaining safe sample, drain prior to placing in service.

F. Cost of water and chlorine for re-chlorination of reservoir if first attempt does not test safely shall be Contractor’s responsibility.

3.08 BACTERIOLOGIC TESTS:

A. Collect two sets of samples per AWWA C651, Section 5.1, deliver to a certified laboratory within six hours of obtaining the samples, and obtain a bacteriologic quality test to demonstrate the absence of coliform organisms in each separate section of the pipeline after chlorination and refilling. Collect at least one set of samples from every 1,200 feet of the new water main, plus one set from the end of the line and at least one set from each branch.

B. Repetition of Procedure: If the initial chlorination fails to produce required residuals and bacteriologic tests, repeat the chlorination and retesting until satisfactory results are obtained.

C. Test Facility Removal: After satisfactory disinfection, disinfect and replace air valves, restore the pipe coating, and complete the pipeline where temporary disinfection or test facilities were installed.

3.09 FIELD QUALITY CONTROL:

A. Contracting Officer will obtain samples for and submit to laboratory for analysis before reservoir placed in service.

B. If safe samples not obtained using above procedure, Contractor shall add additional chlorine in amounts necessary to obtain safe samples.

3.10 CLOSEOUT ACTIVITIES:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 02521

WELL ABANDONMENT

PART 1 – GENERAL

1.01 DESCRIPTION

A. Furnish labor, materials, tools and equipment for fully abandoning up to125 water supply wells in accordance with the specifications and drawings. The full abandonment procedure, which is described in detail in this specification, generally includes removing all existing equipment from the well, filling the wells with appropriate backfill for abandonment, restoring any areas that were affected by the well abandonment to the pre-work condition, and submitting records of abandonment.

B. Furnish labor, materials, tools and equipment for partially abandoning six water supply wells, which are proposed to be used as long-term monitoring wells. The six wells are the two Fairgrounds public water supply wells; the Regional school supply well; one of the Hill Hollow Condo supply wells (the others will be fully abandoned); Durham Manufacturing (DMC) Well #1, and DMC Well #2. The partial abandonment procedure, which is described in detail in this specification, generally includes removing all existing equipment from the well, removing and replacing the upper portion of the well casing, restoring any areas that were affected by the well abandonment to the pre-work condition, and submitting records.

1.02 RELATED SECTIONS

A. Section 01120 - Health & Safety

B. Section 01063 – Miscellaneous Requirements

C. Section 01300 – Submittals

D. Section 01400 – Quality Assurance

E. Section 01710 – Cleaning Up

F. Section 02241 – Construction Water Management

G. Section 02900 – Planting

H. Section 2922 – Hydroseeding

1.03 REFERENCES

A. Connecticut Well Drilling Code

B. Letter from Connecticut DCP to Connecticut DEEP, dated July 23, 2014, explaining permitted deviation from well abandonment procedures in Connecticut Well Drilling Code (attached at end of section).

1.04 SUBMITTALS

A. Well Abandonment, Verification of Work Completed forms, attached and available for download at http://www.ct.gov/dcp/cwp/view.asp?a=1622&q=446490 completed for all wells abandoned, with additional information as specified below.

1.05 PERFORMANCE REQUIREMENTS

A. Work shall be performed in accordance with the Connecticut Well Drilling Code requirements for well abandonment, except that 1) deviations as described in the letter from Connecticut DCP to Connecticut DEEP, dated July 23, 2014 (attached), may be used in lieu of the Code requirements, and 2) permits will not be required in accordance with Superfund NCP Section 300.400 (e)(1).

PART 2 - PRODUCTS

2.01 MATERIALS

A. Bentonite Chips - raw mined sodium montmorillonite in chip form, with chips sized between ¼ and ½-inch.

B. Fine Sand – A poorly graded (SP) sand in which 100% passes the #40 sieve and no more than 10% passes the #200 sieve.

PART 3 – EXECUTION

3.01 ABANDONMENT OF WELLS

A. Prior to well abandonment work being done, all residences and businesses must have been permanently connected to the new municipal water supply such that the wells are no longer needed to supply potable water. Also, in accordance with other specification sections, the water service pipe from the well to the pressure tank and the well pump power duct shall have been cut off and capped or plugged watertight at the interior basement wall.

B. Locate the well and gain access to its interior by removing any materials, equipment, or appurtenances (e.g., well caps, concrete well covers, soil, decorative well covers) that cover or seal the well. If a decorative well cover is removed, place it on the ground at a distance from the well where it will not be damaged or impede the abandonment process.

C. Remove all materials and equipment that are within the well including, but not limited to, the well pump; all wire, pipe, and conduit; and any other downhole appurtenances. The

well pump, wire, and/or piping shall be placed at a location on the property as directed by the owner if he/she wants to retain it. Any materials and equipment removed from the well that are not wanted by the property owner shall become the property of the Contractor, to be recycled (to the maximum extent possible) or disposed. Water that is present in the piping and pump as they are raised in the well shall not be released onto the ground and must be either collected in a container or poured back down the well.

D. Record all requested information on the Well Abandonment, Verification of Work Completed form, and make actual measurements of the well diameter, the depth of the well below ground surface (bgs), and the depth to water in the well (include this on the form even though it is not listed as a requested measurement). Also include a sketch of the well location so that the property owner will have a record of it with the well abandonment form.

E. Calculate the volume of standing water in the well and add enough chlorine to create a solution with 50 ppm available chlorine throughout the well. Chlorine shall be added throughout the length of well, or shall be circulated in the well, to ensure distribution throughout the water column.

F. In the case of a drilled well in bedrock:

1. Add fine sand to the well, at a rate not exceeding 50 lbs every 30 seconds. Sound the well continuously, or at least every time enough sand has been added to fill 10 ft of the borehole, to assure that bridging is not occurring. If bridging occurs, use appropriate means to collapse bridge(s) so that voids in sand are eliminated.

2. The addition of the sand will cause the water level in the well to rise. The rate of rise will depend on the permeability and depth of water-bearing fracture zones and rate at which sand is added. No water shall be released onto the ground. If the water level rises close to the top of the well, the rate of sand placement shall be slowed, or water shall be pumped from the well to a storage container, so that no water overflows onto the ground. Any water that is collected during well abandonment shall be transported to a location designated by the Contracting Officer for treatment and disposal in accordance with Section 02241 Construction Water Management.

3. When the level of the sand is 40 feet below ground surface, stop adding sand. The portion of the well above a depth of 40 feet bgs shall be filled with bentonite chips (1/4-inch to 1/2-inch size) so that the final level of bentonite after swelling is 4 feet bgs. The chips shall be poured into the well at a rate of 20 pounds per minute or less. If the chlorine in the water interferes with expansion of the bentonite, the water shall be removed and replaced with non-chlorinated water, and the removed water shall be captured and handled as described above. Sound the well continuously, or at least every time enough bentonite has been added to fill 6 ft of the borehole, to assure that bridging is not occurring. If bridging occurs, use appropriate means to collapse bridge(s) so that voids are eliminated. Since smaller pieces of bentonite or bentonite dust can contribute to bridging, the chips will be screened as they are placed in the

well such that any particles of bentonite smaller than ¼-inch are removed. The small pieces and dust that are screened out shall be collected on a ground cover and may be added to the well in the final stages of filling (when level is less than 8 ft bgs).

4. The addition of the bentonite chips will cause the water level in the well to rise. The rate of rise will depend on the permeability and depth of water-bearing fracture zones and rate at which chips are added. No water shall be released onto the ground. If the water level rises close to the top of the well, the rate of chip placement shall be slowed, or water shall be pumped from the well to a storage container, so that no water overflows onto the ground. Any water that is collected during well abandonment shall be transported to a location designated by the Contracting Officer for treatment and disposal in accordance with Section 02241 Construction Water Management. If necessary to keep the chips submerged and achieve full swelling, add water to the well.

5. When the chips have fully swelled, cut the well casing off below the pitless adapter or at a depth of at least 4 feet bgs (whichever is deeper) and recycle or dispose of it. Cut off the water service pipe and the well power conduit (if present) at or below the 4 ft depth and cap or plug each watertight. Backfill the hole with any excess soil from excavations only on that property, supplemented with fine sand if necessary, from 4 feet bgs to the depth at which landscaping materials will be placed.

6. Landscape in accordance with Sections 02900 and 02922. With the exception of any decorative well cover that may have been present over the well and any materials that are being retained by the property owner, all well materials, equipment, and appurtenances that were removed for the abandonment, plus all excess materials (sand, chips, water), should be removed from the property and, after recycling to the extent possible, disposed of by the Contractor.

G. In the case of dug wells, or wells whose dimensions preclude abandonment in accordance with the above procedures:

1. Fill the portion of the well that is more than 4 feet bgs with a sealant per the Connecticut Well Drilling Code or with bentonite chips. If bridging occurs, use appropriate means to collapse bridge(s) so that voids in the sealant are eliminated.

2. The addition of the sealant will cause the water level in the well to rise. The rate of rise will depend on the permeability of the soil and rate at which sealant is added. No water shall be released onto the ground. If the water level rises close to the top of the well, the rate of sealant placement shall be slowed, or water shall be pumped from the well to a storage container, so that no water overflows onto the ground. Any water that is collected during well abandonment shall be transported to a location designated by the Contracting Officer for treatment and disposal in accordance with Section 02241 Construction Water Management. When the level of the sealant is 4 feet bgs, stop adding sealant.

3. Remove well casing to a depth of 4 feet bgs. Recycle or dispose of the removed casing. Backfill the hole with any excess soil from excavations only on that property, supplemented with fine sand as necessary, from 4 feet bgs to the depth at which landscaping materials will be placed.

4. Landscape in accordance with Sections 02900 and 02922. With the exception of any decorative well cover that may have been present over the well and any materials that are being retained by the property owner, all well materials, equipment, and appurtenances that were removed for the abandonment, plus all excess materials (sand, chips, water), should be removed from the property and, after recycling to the extent possible, disposed of by the Contractor.

H. Submit well abandonment records.

1. All blank spaces on the Well Abandonment, Verification of Work Completed form shall be completed with the possible exception of the casing length, if unknown and undeterminable. In addition to filling in all the blank spaces on the form, the depth to static water level (bgs) shall be noted, and a sketch map of the well location on the property shall be provided.

3.02 PARTIAL ABANDONMENT OF WELLS TO BE USED AS LONG-TERM MONITORING WELLS

A. Prior to well conversion work being done, the residence or business must have been permanently connected to the new municipal water supply such that the well is no longer needed to supply potable water. The water service pipe from the well to the pressure tank and the well pump power duct shall have been cut off and capped or plugged watertight at the interior basement wall, in accordance with other specification sections (note that the two Fairgrounds public water supply wells may require additional or alternate treatment, to be coordinated with the Contracting Officer and the well owner).

B. Locate the well and gain access to its interior by removing any materials, equipment, or appurtenances (e.g., well caps, concrete well covers, soil, decorative well covers) that cover or seal the well (note that the two Fairgrounds public water supply wells may require additional or alternate treatment, to be coordinated with the Contracting Officer and the well owner). If a decorative well cover is removed, place it on the ground at a distance from the well where it will not be damaged or impede the abandonment process.

C. Remove the well pump, piping, and all wire. The well pump, piping, and wire shall be placed at a location on the property directed by the owner if he/she wants to retain it. Any materials and equipment removed from the well that is not wanted by the owner shall become the property of the Contractor, to be recycled (to the maximum extent possible) or disposed. For the Durham Manufacturing Well #1 (DMC#1) and Well #2 (DMC #2), which are highly contaminated, and for the Regional school supply well and the Hill Hollow Supply well, which are contaminated to a lesser degree, water that is present in the pump or piping as it is raised in the well shall not be released onto the ground and must be

either be collected in a container or poured back down the well. Any water that is collected shall be transported to a location designated by the Contracting Officer for treatment and disposal in accordance with Section 02241 Construction Water Management.

D. After removing the contents of the well (excluding the water), remove the well casing to a depth below any casing perforation (e.g., pitless adapter) or to a depth of at least 4 feet bgs, whichever is deeper. Recycle or dispose of the removed casing. The section of well casing removed shall be replaced by a section of pipe matching the dimensions of the existing well casing. The new pipe shall be joined to the existing casing by a welded watertight connection. The top of casing shall be 2 feet above finish grade (post soil removal and backfill). A locking well cap shall be placed on the top of the new casing, such that the well can be easily accessed for monitoring.

END OF SECTION

STATE OF CONNECTICUT
DEPARTMENT OF PUBLIC HEALTH

Jewel Mullen, M.D., M.P.H., M.P.A.
Commissioner

Dannel P. Malloy
Governor
Nancy Wyman
Lt. Governor

April 1, 2014

Anni Loughlin
US Environmental Protection Agency
5 Post Office Square, Suite 100
Mail Code: OSRR07-1
Boston, MA 02109-3912

SUBJECT: Durham Water Line Project- Comments to CT DEEP letter dated January 22, 2014

Dear Ms. Loughlin:

This correspondence is provided in response to your verbal request on March 13, 2014 for the Connecticut Department of Public Health (CT DPH) to submit written comments on the Connecticut Department of Energy and Environment's request for an exception to the Connecticut Well Drilling Board Rules and Regulations (copy attached). The CT DPH has reviewed the exemption request letter and offers the following:

1. Public Well Abandonment Procedures

   - The alternate abandonment method is acceptable as long as it is equivalent to the method currently in the Well Drilling Code in preventing surface water intrusion.
   - For public water supply wells in the impacted area of Durham, CT, there should be some level of chlorination. DPH suggests a dose of 50 ppm which is consistent with the disinfection guidance document which can be found at this link: http://www.ct.gov/dph/lib/dph/drinking_water/pdf/Well_Disinfection.pdf
   - Source Abandonment Application – source abandonment permits are required pursuant to Connecticut General Statute 25-33k for each public water system well abandonment. The DPH plans to reach out to system owners to review the requirements and streamline the process. Are there any requirements that we are waiving? Or do we need to clarify what type of public systems need to supply this?

2. Private Well Abandonment Procedures

   - The permitting of private wells is under the jurisdiction of the Local Health Department. All private well abandonment procedures should be reviewed and approved by the Durham Director of Health.

Connecticut Department of Public Health

Phone: (860) 509-8171 • Fax: (860) 509-7541 • VP: (860) 899-1611
410 Capitol Avenue, MS#12RSV, P.O. Box 340308
Hartford, Connecticut 06134-0308
www.ct.gov/dph

CT DPH broadly supports the disinfection of abandoned wells because nearby drinking water wells that may not connect immediately need to be protected from potential contamination. DPH further believes that any exemption that the Plumbing and Piping Board choses to grant should be applicable only to the area covered by the Durham water line.

If you have any questions, please contact me at (860) 509-8171.

Sincerely,

Ellen Blaschinski
Public Health Branch Chief
Regulatory Services Branch

EB/sm
attachment

c: Laura L. Francis, First Selectman, Town of Durham
Aimee Eberly, Director of Health, Durham Health Department
William Milardo, Assistant Director of Health, Durham Health Department
Chuck Appleby Sr, Chairman, Plumbing and Piping Board, 165 Capitol Ave, Hartford, CT 06106
Patrick Bowe, Director, CT DEEP

Connecticut Department of
ENERGY &
ENVIRONMENTAL
PROTECTION

79 Elm Street • Hartford, CT 06106-5127 www.ct.gov/deep

January 22, 2014

Mr. Charles E. Appleby, Sr., Chairman
Plumbing and Piping Work Examining Board
Department of Consumer Protection
165 Capitol Avenue
Hartford, Connecticut 06106-1630

RE: Request for Exemption
Pursuant to Sec. 25-133 of Title 25 of the State Well
Drilling Board Rules and Regulations

Dear Mr. Appleby:

This letter is being sent to the Department of Consumer Protection's Plumbing and Piping Work Examining Board for its consideration of granting the Connecticut Department of Energy & Environmental Protection (CT DEEP) and the U.S. Environmental Protection Agency (EPA) an exemption pursuant to Section 25-133 of Title 25 of the Regulations of Connecticut State Agencies to disinfect drinking water wells by chlorination and to use an alternative grout method and material as part of a proposed widespread well abandonment project in Durham center.

The CT DEEP and EPA are currently working to design and subsequently contract the extension of an alternate water supply from the City of Middletown into the Town of Durham to address an expansive area of groundwater contamination at the Durham Meadows Superfund Site in Durham, Connecticut. This water line will service over 100 properties, including mostly residential homes and some businesses, in the Town of Durham.

The groundwater in this area is contaminated with volatile organic compounds (VOCs), and many of the potable wells have been on carbon filters since 1982. Some properties are also provided with bottled water for drinking. The agencies determined that it is technically impracticable to clean up the contamination in bedrock groundwater in the area. As part of the water line remedy, it is the agencies' expectation that when properties are connected to the water line, virtually all potable wells will be permanently abandoned, and a Town Ordinance will be passed to prohibit the use of groundwater for drinking water within the Superfund site area except maybe for agricultural purposes.

In light of the preceding discussion, CT DEEP, in conjunction with EPA and its contractor AECOM, hereby requests pursuant to Section 25-133 of Title 25 of the Regulations of Connecticut State Agencies, an exemption to the Department of Consumer Protection's regulations requiring chlorination of wells prior to abandonment. Based on the number of wells that will require abandonment (100+) in the area and the average depth of each well, it is estimated that approximately 500 gallons of chlorine laden water per well (or more than 50,000 gallons total) will be generated and have to be properly disposed of in accordance with applicable regulations.

Locally recharging groundwater with the chlorinated water in an area that is already contaminated would be unwise as it may cause the existing pollution to expand into areas that are not presently impacted and possibly pollute drinking water wells that are currently unaffected. In addition, overloading the bedrock aquifer in such a concentrated area via the abandonment of more than one hundred drinking water wells will not allow sufficient dilution of the chlorine and thus possibly creates a pollution problem of its own. Furthermore, there is also a possibility that extracted water may adversely impact the properties and neighboring surface water bodies (nearby Ball Brook, Allyn Brook, and the Durham Meadows conservation area including the Coginchaug River).

Cost is also a concern to the agencies. The cost to disinfect each well and properly dispose of the wastewater for these 100+ properties will be exorbitant. The added cost of properly handling and disposing of such a large volume of chlorinated water could potentially be so costly that it would significantly delay the project until additional funds become available to cover the costs of the work or prevent the project from being done at all.

Based on these issues and the long-standing historic pollution in the groundwater, the agencies believe that the chlorination will not provide any added benefit to this project especially if the ordinance prohibiting the use of ground water in the federal Superfund site area is passed by the Town.

At this time, the agencies are also requesting approval for an alternative grouting method based on the proposed well abandonments. In accordance with Sec. 25-128-57 of Title 25 of the Regulations of Connecticut State Agencies, the agencies propose to fill drilled wells that are constructed in bedrock with fine sand to a depth of about 40 feet. The sand will be placed slowly enough that the standing water in the well will seep back into the rock as it is displaced by the sand, rather than rising to the top of the well. This alternative method will limit the potential for contaminated water to spill onto the surface of the ground.

Above the sand, the agencies' preference is to fill the wells with bentonite chips, with a specification in place to detect and eliminate any potential bridging problems. The bentonite will also be placed slowly enough that the standing water either seeps back into the rock or is absorbed by the bentonite as it swells. Using bentonite chips rather than traditional grouting will negate the significant work and cost associated with collection and disposal of displaced water in each of the 100+ wells and the possibility of accidental releases of contaminated water to the surface of the ground.

The agencies will only begin widespread well abandonment in the Superfund site area after the water line is constructed and properties are hooked up to public water. Because of funding considerations, it is unclear when the construction will occur, but the agencies currently anticipate this work will commence in 2015. Regardless, DEEP will provide the Board a list of wells coincided with street addresses that are subject to abandonment once the well abandonment work is complete.

Thank you for the Board's consideration of the proposed exemption from chlorination and of the alternative grouting methods for the abandonment of drinking wells in the Superfund site area of Durham based on the prospective extension of public water. The agencies look forward to your decision, so that the Superfund project may seek appropriate state and federal funds to move forward.

If you have any questions regarding this letter, please do not hesitate to contact Jing Chen or Bill Warzecha of my staff at (860) 424-3391 and (860) 424-3776, respectively.

Sincerely,

Patrick F. Bowe
Director
Remediation Division

cc: Laura L. Francis, First Selectman
Aimee Eberly, Director of Health
Bill Milardo, Sanitarian
Richard Hurlburt, Department of Consumer Protection
Anni Loughlin, US EPA

SECTION 02630

STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.01 SUMMARY:

A. This section specifies storm drainage systems and excludes interceptors, storm separators, or subdrainage.

1.02 DESCRIPTION:

A. Provide storm drainage utilities as indicated and in compliance with Contract Documents.

B. Section includes:

1. Furnishing and installing (or resetting existing) storm drainage piping, fittings, and accessories.

2. Furnishing and installing storm drainage catch basins, inlets, manholes or other structures.

1.03 REFERENCES:

A. American Association of State Highway and Transportation Officials (AASHTO):

1. M198: Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.

B. Connecticut Department of Transportation (ConnDOT):

1. ConnDOT Specifications: State of Connecticut Department of Transportation, Form 817, Standard Specifications for Roads, Bridges, and Incidental Construction, 2016 Edition, as amended and supplemented.

C. American Society of Testing and Materials International (ASTM):

1. A123/A123M: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

2. A536: Standard Specification for Ductile Iron Castings.

3. A716: Standard Specification for Ductile Iron Culvert Pipe.

4. C76: Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

5. C139: Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.

6. C150: Standard Specification for Portland Cement.

7. C207: Standard Specification for Hydrated Lime for Masonry Purposes.

8. C361: Standard Specification for Reinforced Concrete Low-Head Pressure Pipe.

9. C443: Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

10. C478: Standard Specification for Precast Reinforced Concrete Manhole Sections.

11. C890: Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures.

13. C923: Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.

14. C990: Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.

15. D1785: Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

16. D2729: Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

17. D3034: Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

18. D3212: Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

1.04 DEFINITIONS:

A. Catch Basin or Catchbasin: A special type of inlet structure designed to retain sediment and debris transported by stormwater into the storm drainage system.

1.05 SUBMITTALS:

A. Submit the following in accordance with Section 01300.

1. Shop Drawings:

a. Precast Concrete Structures: Indicate locations, dimensions, configuration, thicknesses, elevations, sizes, and penetration elevations.

2. Product Data:

a. Pipe: Material, pipe accessories, and manufacturer's installation instructions.

3. Certificates: Manufacturer's certificate stating that product meets or exceeds specified requirements.

4. Project Record Documents: Provide record drawings of actual pipe run locations, connections, structures, and invert elevations.

5. Testing Results.

1.06 QUALITY ASSURANCE:

A. Comply with the requirements specified in Section 01400.

B. Conform to referenced ConnDOT Form 817 for materials and installation of work specified in this section.

1.07 DELIVERY STORAGE AND HANDLING:

A. Comply with the requirements specified in Section 01610.

PART 2 - PRODUCTS

2.01 PIPE MATERIALS:

A. Ductile Iron Culvert Pipe: ASTM A716; nominal inside diameter as indicated.

C. Reinforced Concrete Pipe (RCP):

1. Culvert (drain) pipe and joint sealant; per ConnDOT Form 817, Article M.08.01

2. End Joints: Bell and spigot for drain pipes in under roadway.

D. Plastic Pipe (PVC):

1. Pipe: ASTM D2729, Polyvinyl Chloride (PVC) material; nominal inside diameter as indicated.

2. End Joints: Bell and spigot.

3. Joint Device: Solvent sealed joint.

E. Plastic Pipe (PVC):

1. Pipe: ASTM D1785, Schedule 40, PVC material; nominal inside diameter as indicated.

2. End Joints: Bell and spigot.

3. Joint Device: Solvent sealed joint.

F. Plastic Pipe (HDPE): AASHTO M294, Type S; high density polyethylene (HDPE) material; smooth interior and annular-corrugated exterior; bell shall be an integral part of the pipe and shall be watertight in accordance with ASTM D3212. Pipe gaskets shall be manufacturer installed. Joints shall remain watertight when subjected to a 1.5 degree misalignment.

2.02 CATCHBASINS:

A. Type C, or CL as specified on the drawings.

C. Minimum sump depth is 12 inches, unless noted otherwise.

D. Materials for construction to Conform to ConnDOT Form 817, Article M.08.02.

E. Protective compound shal conform to ConnDOT Form 817, Article M.03.09.

F. Galvanizing shall conform to ConnDOT Form 817, Article M.02.05.

G. Geotextile shall conform to ConnDOT Form 817, Subarticle rticle M.08.01-19.

2.03 PRECAST STRUCTURES:

A. Manhole Sections: Reinforced precast concrete in accordance with ASTM C478/C478M), with resilient connectors complying with ASTM C923/C923M.

B. Pipe Connections: Grout pipe at manhole to form a watertight connection. Storm drains 42 inches and smaller, ASTM C923. Storm drains larger than 42 inches, grout 4 feet spool piece into place on manhole. Connect pipe to spool piece using flexible connection.

C. Joints: ASTM C443/C443M, watertight.

2.04 CAST-IN-PLACE STRUCTURES:

A. Materials:

1. Concrete: Section 03300, minimum compressive strength of 4,000 psi.

2. Portland Cement: ASTM C150, Type II.

3. Hydrated Lime: ASTM C207, Type S.

4. Sand: ASTM C33, Fine Aggregate, except all passes No. 8 sieve.

5. Water: Potable, not detrimental to concrete.

6. Brick: ASTM C32, Grade MS, maximum 8 percent absorption computed from average of 5 cycles.

7. Precast Concrete Masonry Units: ASTM C139, precast machine-made solid segments with the following:

   a. Use Type II cement except as otherwise permitted.

   b. Width of units as indicated.

   c. Inside and outside surfaces of units curved to necessary radius; interior surfaces of structures cylindrical, except top batter courses to reduce inside section of structure uniformly to required size and shape at top.

   d. Only full-length units required to lay any one course.

   e. Accept units on basis of material tests and inspection of completed product.

B. Components:

1. Bases: Cast-in-place concrete, one piece, precast concrete sumps or precast segmental plates, as indicated.

2. Walls: Precast Concrete Masonry Units.

3. Top of Cone: Brickwork for adjusting frame to meet finished surface shall not exceed 6 inches.

4. Frames and Grates: As indicated and specified.

C. Precast Concrete Sumps: ASTM C478/C478M base section, Type 2; minimum wall thickness of 6 inches and meeting the following requirements:

1. ASTM C150, Type II cement, unless noted otherwise.

2. Cure by saturated steam between temperatures of 100 and 130 degrees F for minimum of 12 hours. Continue curing process until the minimum compressive strength is achieved.

3. Maximum of 2 lift holes in each sump, cast or drilled.

4. Acceptance of sump is on basis of material tests and inspection of completed work.

D. Mixes:

1. Concrete: Section 03300.

2. Mortar for Brickwork: Mix Portland cement, hydrated lime and sand. Volume of sand not to exceed three times sum of volumes of cement and lime. Proportion cement and lime as directed. Cement to lime proportions may vary between 1 part cement to 1/4 part lime for dense hard burned brick, and 1 part cement to 3/4 part lime for softer brick. Generally mix mortar in proportion of 1 part cement to 1/2 part lime to 4-1/2 parts sand. Use sufficient water to form a workable mixture.

3. Mortar for Masonry Units: Mix 1 part Portland cement and 2 parts of sand by volume with sufficient water to form a workable mixture.

2.05 MIXES:

A. Mortar for Plugging Lift Holes: Mix Portland cement and sand, 1 part cement to 1/2 part sand with sufficient water to make mortar damp without "balling".

2.06 COMPONENTS:

A. Frame and Cover: ASTM A48/A48M, Class 30B cast iron construction or ASTM A536, Grade 60-40-18 ductile iron construction. Machined flat bearing surface, removable lid; rated for AASHTO HS20-44 loading, unless noted otherwise. Castings shall be as follows:

1. Free from scale, lumps, blisters, and sandholes.

2. Machine contact surfaces to prevent rocking.

3. Thoroughly clean and hammer inspect.

B. Manhole Steps: ASTM C478.

PART 3 - EXECUTION

3.01 TRENCHING:

A. Per Conn DOT Form 817, Article M.08.03 for bedding and Article M.02.01 for Granular Fill.

1. Pipes less than 48-in diameter shall be installed in a Type I installation.

2. Pipes 48-in diameter or greater shall be installed in a Type II installation.

B. Refer to Section 02210 for additional requirements.

C. Hand trim excavation for accurate placement of pipe to indicated elevations.

3.03 CATCHBASINS AND CLEANOUTS:

A. Form bottom of excavation, clean and smooth and to correct elevation.

B. Provide bedding in accordance with Section 02210 and ConnDOT Form 817.

C. Place structure plumb and level on prepared bedding.

D. Orient structure for pipe connections.

E. Form and place cast-in-place concrete base pad.

F. Level the top surface of base pad and sleeve concrete shaft sections to receive storm drainage pipe sections.

G. Establish elevations and pipe inverts as indicated.

H. Establish top elevation and mount frame and cover.

I. Mount frame level in grout, secured to top cone section.

3.04 PRECAST STRUCTURES:

A. Provide bedding according to Section 02210 as indicated.

B. Place manhole sections plumb and level on prepared bedding. Orient manhole to allow for connection with pipe. Trim to correct elevation.

3.05 CAST-IN-PLACE STRUCTURES:

A. Brickwork and Masonry Units:

1. Use clean units.

2. Bricks:

a. Moisten bricks to prevent absorption of water from mortar. Limit moisture to prevent bricks from becoming slippery during placement.

b. Lay each brick in full bed and joint of mortar without requiring subsequent grouting, flushing or filling; bond thoroughly.

3. Concrete Masonry Units:

a. Do not moisten concrete masonry units.

b. Lay each masonry unit in full bed of mortar; bond thoroughly. Fill vertical keyways, completely, with mortar.

B. Plastering and Curing Brick Masonry:

1. Plaster outside faces with mortar 1/4- to 3/8-inch thick.

2. Moisten brick masonry before application of mortar, if required.

3. Spread and trowel plaster carefully.

4. Check for bond and soundness after hardening, by tapping.

5. Remove and replace unbonded and unsound plaster.

6. Protect from too rapid drying by use of moist burlap or other accepted means.

7. Protect from weather and frost.

C. Setting Frames, Grates, and Curb Inlets:

1. Set inlets and frames with tops conforming accurately to finished ground or pavement surface as indicated and directed.

2. Set circular frames concentric with top of masonry.

3. Set frames in full bed of mortar to fill and make watertight completely the space between top of masonry and bottom flange of the frame.

4. Place a thick ring of mortar extending to the outer edge of masonry, around bottom flange. Finish mortar smoothly and give a slight slope to shed water away from the frame.

5. Place grates in the frames after completing all other work at the structure.

3.06 FIELD QUALITY CONTROL:

A. Remove work that does pass tests; replace and retest until successful installation is achieved.

B. Displacement Test:

1. Contracting Officer will test pipe for displacement after trench has been backfilled and compacted, and after pipe has been cleaned of silt and debris.

2. Contracting Officer will visually inspect pipe. Pipes that do not present a uniform bore due to displacement and misalignment shall be replaced.

C. Deflection Test:

1. Test pipes for vertical ring deflection within 15 days after completion of backfill at least 4 months after installation but not later than 30 days before estimated substantial completion.

2. Maximum allowable ring deflection is 5 percent of vertical internal pipe diameter.

3. Replace pipe exceeding this allowable deflection.

4. Make deflection tests with deflectometer which produces a continuous record of pipe deflection by pulling mandrel, sphere, or pin-type go/no-go device through pipe. Make the diameter of go/no-go device to be 95 percent of the undeflected inside pipe diameter.

3.07 PROTECTION:

A. Protect pipe and bedding from damage or displacement until backfilling operation is completed.

3.08 CLOSEOUT ACTIVITIES:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 02740

FLEXIBLE PAVING

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide flexible paving as indicated and in compliance with Contract Documents.

1. Scope includes:

a. Aggregate base course.

b. Asphalt concrete pavement.

1.02 REFERENCES:

A. Connecticut Department of Transportation (ConnDOT):

1. ConnDOT Specifications: State of Connecticut Department of Transportation, Form 817, Standard Specifications for Roads, Bridges, and Incidental Construction, 2016 Edition, as amended and supplemented.

B. American Association of State Highway and Transportation Officials (AASHTO):

1. M147: Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base, and Surface Courses.

2. M226: Standard Specification for Viscosity-Graded Asphalt Cement.

3. M320: Standard Specification for Performance-Graded Asphalt Binder.

4. T89: Standard Method of Test for Determining the Liquid Limit of Soils.

5. T90: Standard Method of Test for Determining the Plastic Limit and Plasticity Index of Soils.

6. T99: Standard Method of Test for Moisture-Density Relations of Soils Using a 5.5-lb Rammer and a 12-in. Drop.

7. T104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate.

C. American Society for Testing and Materials International (ASTM):

1. C125: Standard Terminology Relating to Concrete and Concrete Aggregates.

2. D242: Standard Specification for Mineral Filler For Bituminous Paving Mixtures.

3. D946: Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction

4. D977: Standard Specification for Emulsified Asphalt.

5. D2027: Standard Specification for Cutback Asphalt (Medium-Curing Type).

6. D3381/D3381M: Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction.

7. D6373: Standard Specification for Performance Graded Asphalt Binder.

1.03 DEFINITIONS:

A. Gravel: Coarse aggregate resulting from natural disintegration and abrasion of rock or processing of weakly bound conglomerate.

B. Crushed Gravel: The product resulting from the artificial crushing of gravel with substantially all fragments having at least one face resulting from fracture.

C. Crushed Stone: The product resulting from the artificial crushing of rocks, boulders, or large cobblestones, substantially all faces of which have resulted from the crushing operation.

1.04 SUBMITTALS:

A. Submit the following shop drawings in accordance with Section 01300.

1. Base course testing results.

2. Submit haul route, procedures, and schedule of operation times.

1.05 QUALITY ASSURANCE:

A. Comply with the requirements specified in Section 01400.

B. Codes and Standards: Comply with CTDOT Specifications, Form 817, 2016 Edition as amended.

1.06 DELIVERY STORAGE AND HANDLING:

A. Comply with the requirements specified in Section 01610.

B. Transport bituminous mixtures in covered trucks whenever:

1. Rainy weather, or

2. Air temperature is less than 60 degrees F.

C. Adjust weight, type, capacity, haul routes, and method of operation of hauling vehicles so that:

1. No damage results to existing streets, subgrade or base course, and

2. Noise and air pollution levels are not noticeably increased along selected haul route.

D. Haul routes through residential areas shall be avoided.

E. Submit haul route, procedures for transport, and schedule of operation times to the Contracting Officer for acceptance.

1.07 PROJECT CONDITIONS:

A. Weather Limitations: Apply prime and tack coats when ambient temperature is above 50 degrees F, and when temperature has not been below 35 degrees F for 12 hours immediately prior to application. Do not apply when base is wet or contains an excess of moisture.

B. Place asphalt concrete surface course when atmospheric temperature is above 40 degrees F, and when base is dry. Place binder course when air temperature is above 30 degrees F, and rising.

PART 2 - PRODUCTS

2.01 GENERAL:

A. All materials shall conform to the requirements of "State of Connecticut Department of Transportation Standard Specification for Roads, Bridges and Incidental Construction Form 817", including supplemental specifications (hereinafter referred to as the "State Specifications") and as specified herein.

2.02 CALCIUM CHLORIDE

A. Calcium Chloride shall conform to the requirements of Section 9.42 of the State Specifications.

2.03 BASE COURSE:

A. Gravel base course shall conform to the requirements of Section M.02.06, Grading "B" of the State Specifications. The maximum size of stone in the gravel shall be 3 inches.

B. Processed aggregate base course shall conform to the requirements of Section M.05.01 of the State Specifications except that recycled or reclaimed materials shall not be utilized.

2.04 BITUMINOUS CONCRETE PAVEMENT

A. The base, binder, and top courses for bituminous concrete pavement shall conform to the requirements of Section M.04 of the State Specifications as shown in the drawings.

B. No bituminous concrete pavement shall be placed until the Contracting Officer approves the job mix formula.

2.05 TACK COAT

A. Tack Coat shall conform to the requirements of Section M.05.02 of the State Specifications.

2.06 CONCRETE SIDEWALKS

A. Cement concrete for walks shall be of 4,000 psi compressive strength at 28 days, and shall conform to Section M.03.01 (class "C" concrete) of the State Specifications and to the Concrete sections of the specifications contained herein.

B. Welded steel wire fabric shall meet AASHTO-M55 and shall have a minimum end-lap of six inches except where expansion joints occur. Mesh shall be 6 inches by 6 inches, W2.9 by W2.9 welded wire fabric.

C. Pre-molded expansion joint filler shall meet AASHTO-M153 thickness and widths required for the expansion joint widths.

2.07 PARKING AND ROADWAY MARKINGS

A. Paint for parking and roadway markings shall be a white and/or yellow reflectorized, fast drying paint, conforming to Section M.07.22 of the State Specifications.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Check subgrade as to soundness, outline, and contour.

3.02 DUST CONTROL

A. Calcium chloride shall be applied to control dust. No calcium chloride will be allowed where runoff will enter water bodies or wetlands.

B. Calcium chloride shall be uniformly applied at the rate of 1-1/2 pounds per square yard.

3.03 SUBGRADE PREPARATION:

A. Scrape down subgrade bumps and irregularities to obtain smooth, even surface.

B. Proof roll as specified in Section 02210.

C. Remove and replace soft or spongy areas as specified in Section 02210.

D. The Contractor shall raise all drain and sewer manhole frames and covers, catch basin frames and grates and gate boxes to the established grades before paving is applied.

E. Prior to submitting his bid, the Contractor shall contact the other utilities so as to gain their requirements concerning any possible adjustment of gate boxes and other such structures. If the utility wishes the Contractor to raise these boxes it shall be in accordance with the utilities requirements. If the utility wishes to adjust their own gate boxes the Contractor shall give the utility adequate notice of his paving schedule.

F. If the gravel base course is disturbed by the adjustment of utilities, the disturbed base material shall be carefully removed and replaced with Portland cement concrete. (For additional requirements see DIVISION 3 – CONCRETE).

3.04 PAVEMENT PREPARATION:

A. Remove loose material from compacted base course immediately before applying herbicide treatment or prime coat.

B. If base course becomes rutted, loose or uneven due delays in placing subsequent courses then proof roll prepared surface to check for unstable areas. Provide additional compaction or remove unstable areas, backfill and compact. Do not begin paving work until deficient areas have been re-graded and corrected and are ready to receive paving.

3.05 DRIVEWAYS

A. Where trenches are dug through existing bituminous concrete paved driveways, the trench shall be resurfaced with a 2-1/2 inch binder course of bituminous concrete followed by a 1-1/2 inch top course over the full width of the existing paved driveway. The limits of the overlay course shall be as defined by the Contracting Officer.

3.06 LEVELING COURSE

A. Where specified or directed by the Contracting Officer, the Contractor shall install a leveling course of bituminous concrete to the depths as required and as approved by the Contracting Officer. The leveling course shall be installed utilizing bituminous material as specified above for a top course.

3.07 TEMPOARY SURFACNG

A. Temporary surfacing shall be placed over trenches in hard surfaced streets and roads, and other areas where directed and shall be of bituminous concrete base course as specified herein before, laid in one course, 2 inches thick. Backfill at top of trench shall be removed to allow for placing temporary surfacing.

B. Contractor shall maintain temporary surfacing in good condition. Trenches shall be inspected at least once a week and also immediately after each storm. Holes and settlements shall be promptly refilled with bituminous mixture.

3.08 PERMANENT SURFACING

A. Permanent resurfacing shall not be started before May 15th for trenching completed by January 15th. If the trenching is completed after January 15th, permanent resurfacing cannot be completed until May 15th of the next calendar year.

B. Overlay Pavement Method

1. After the trenches have been completely consolidated and when directed by the Contracting Officer, the Contractor shall carefully remove the temporary surfacing and foundation gravel base to such a depth as required to receive the permanent bituminous concrete and overlay. The existing pavement shall be saw cut back a minimum of 12" on each side of the trench. The pavement surrounding and including the excavation shall be milled to a depth of 2-in. and shall extend a minimum of 10 ft. beyond the edges of the original trench line, from the centerline to the curb as specified. The edges of abutting bituminous concrete surfacing shall be painted with an emulsion to ensure a satisfactory, watertight bond between the two materials.

2. After placement of a tack coat, permanent bituminous concrete pavement shall then be laid in a top or finished course as indicated on the Contract Drawings. Each course shall be completely rolled and compacted to form a smooth dense surface. The finished surface elevation of the top course shall allow for the overlay pavement. Construction requirements for placement of bituminous concrete surfacing shall conform to the applicable requirements of Section 4.06 of the State Specifications and as herein specified.

3. Permanent bituminous concrete pavement overlay surfacing shall be applied in locations indicated on the Contract Drawings. Milling shall be provided around existing catch basins to provide smooth transition of new bituminous overlay to existing catch basin frame grades. Milling shall be performed as required to maintain a 6" curb reveal. The placement of bituminous concrete surfacing shall conform to the applicable requirements of Section 4.06 of the State Specifications and as herein specified. Permanent bituminous overlay pavement shall be laid in one course with a depth as shown on the Contract Drawings. The bituminous concrete shall be thoroughly rolled and compacted to form a smooth dense surface. The limits of the wearing (top) course shall be as defined by the Contracting Officer.

C. Permanent Bituminous Concrete Pavement

1. After the trenches have been completely consolidated and when directed by the Contracting Officer, the Contractor shall carefully remove the temporary surfacing and foundation gravel base to such a depth as required to receive the permanent

bituminous concrete. The existing pavement shall be saw cut back a minimum of 12" on each side of the trench. The edges of abutting bituminous concrete surfacing shall be painted with an emulsion to ensure a satisfactory, watertight bond between the two materials.

2. Permanent bituminous concrete surfacing shall then be laid in 2 courses consisting of a base or binder course and a top or finished course. The depth of each course shall be as indicated on the Contract Drawings. Each course shall be completely rolled and compacted to form a smooth dense surface. The finished surface elevation of the top course shall match those adjoining undisturbed existing paved surfaces. Construction requirements for placement of bituminous concrete surfacing shall conform to the applicable requirements of Section 4.06 of the State Specifications and as herein specified.

D. The Contractor shall furnish and install the materials of the type necessary to reshape the road shoulders so that the new pavement meets the elevation of the existing ground surface.

3.09 GRAVEL BASE COURSE

A. Construction requirements for gravel base course shall conform to the requirements for gravel fill in SECTION 02230, SITE CLEARING.

B. Material as previously specified shall be placed and compacted to the required thickness for the particular application. The moisture content of material may have to be adjusted to obtain the specified compaction. Refer to the SECTION 02230, SITE CLEARING for specific compaction requirements. After compaction, all base course placement for pavements shall be as indicated on the drawings.

3.10 BITUMINOUS CONCRETE PAVEMENT

A. Construction requirements for bituminous concrete pavement shall conform to Section 4.06.03 of the State Specifications.

B. Material for proposed bituminous concrete roadway shall be spread on the prepared gravel base course to the compacted thickness indicated on the drawings. If there has been an appreciable lag in time between installing bituminous concrete courses, or if the binder course has been used extensively during construction, the Contracting Officer shall determine whether tack coat and/or cleaning will be required.

C. In areas indicated for proposed bituminous concrete resurfacing, the Contractor shall thoroughly clean and repair the existing pavement to the satisfaction of the Contracting Officer. Upon securing approval, the Contractor shall apply a tack coat as specified and shall place a bituminous concrete mix to a minimum depth as shown on the Contract Drawings in an approved manner.

3.11 CEMENT CONCRETE SIDEWALKS

A. Construction requirements for cement concrete walks shall conform to the requirement of Section 9.21.03 of the State Specifications, and meet special color requirements in the Durham Center Historic District. Where possible, new utilities shall be installed by soil piercing method to avoid disturbance of concrete walks in the Durham Center Historic District.

B. Walks shall be sloped as indicated on drawings and slightly adjust grades at intersections.

C. Concrete walk sections shall be one-course construction and of thickness, widths, and lengths shown on drawings.

D. The concrete shall be tamped and screened true to grade and section.

E. Expansion joints shall be 1/2 inch expansion joints, with pre-molded fillers here shown on the drawings and at walk junctions and intersections, at top and bottom of steps, and where walks abut building, platforms, or other fixed structures. Expansion joints shall extend full depth of concrete. Pre-molded filler shall extend to within 3/8 inch of the walk surfaces.

F. Control joints shall be located as shown on the drawings; depth and width as required.

G. Finish cement concrete walks shall be finished according to Section 9.21 of the State Specifications. A final medium broom finish shall be applied as indicated on the drawings.

3.12 BITUMINOUS CONCRETE CURBING

A. Construction requirements for bituminous concrete curing shall conform to the requirement of Section 8.15.03 of the State Specifications.

3.13 PARKING STALL LINES AND ROADWAY MARKINGS

A. Parking stall lines and roadway markings shall be painted on non-windy days using whatever methods are necessary to prevent overspray from discoloring pavement. Lines shall be white, 4 inches in width. Painting, in general, shall conform to Section 12.10.03 of the State Specifications.

3.14 REPLACEMENT OF REMOVED CURBS, WALKS, FENCES, STONE WALLS AND OTHER SIMILAR ITEMS

A. All existing curbs, walks, fences, stone walls and other similar items removed for the construction of the sanitary sewer, services, connections, water and/or storm drain lines shall be replaced in a manner equal or better than their original condition.

3.15 ROLLING:

A. General: Begin rolling when mixture will bear roller weight without excessive displacement. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.

B. Breakdown Rolling: Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling, and repair displaced areas by loosening and filling, if required, with hot material.

C. Second Rolling: Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been thoroughly compacted.

D. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained maximum density.

E. Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut-out such areas and fill with fresh, hot asphalt concrete. Compact by rolling to maximum surface density and smoothness.

3.16 FIELD QUALITY CONTROL:

A. Base Course Testing:

1. Optimum Moisture Content and Maximum Density: Comply with AASHTO T99, Method C, with replacement of fraction of aggregate retained on 3/4 inch sieve. Replace with No. 4 to 3/4 inch material.

B. Pavement Testing:

1. General: Test in-place asphalt concrete courses for compliance with requirements for thickness and surface smoothness. Repair or remove and replace unacceptable paving.

2. Thickness Tolerances: In-place compacted thickness will not be acceptable if exceeding following allowable variation from required thickness:

a. Base Course Thickness: Less than 1/4-inches, plus or minus.

b. Surface Course Thickness: Less than 1/4-inches, plus or minus.

3. Surface Smoothness Tolerances: Test finished surface of each asphalt concrete course for smoothness, using 10-foot straightedge applied parallel with, and at right angles to centerline of paved area. Surfaces will not be acceptable if exceeding following tolerances for smoothness.

a. Binder Course: 1/4-inches.

b. Surface Course: 1/8-inches.

c. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template, 1/4 inches.

d. Profile and Section: Variation from true shall not exceed +/- 3/8-inches.

3.17 PROTECTION:

A. After final rolling:

1. Do not permit vehicular traffic on pavement until it has cooled and hardened.

2. Protect paving from traffic until mixture has cooled enough not to become marked.

3.18 CLOSEOUT ACTIVITIES:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 02820

CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Section includes:

1. Chain link fence framework, fabric, and accessories.

2. Excavation for post bases.

3. Manual gates and related hardware.

1.02 REFERENCES:

A. American Association of State Highway and Transportation Officials (AASHTO):

1. M181: Standard Specification for Chain-Link Fence.

B. American Society for Testing and Materials (ASTM):

1. A53/A53M: Standard Specification for Pipe, Steel, Black, and Hot-Dipped, Zinc-Coated, Welded and Seamless.

2. A121: Standard Specification for Metallic-Coated Carbon Steel Barbed Wire.

3. A392: Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.

4. F567: Standard Practice for Installation of Chain-Link Fence.

5. F654: Standard Specification for Residential Chain Link Fence Gates.

6. F900: Standard Specification for Industrial and Commercial Swing Gates.

7. F1184: Standard Specification for Industrial and Commercial Horizontal Slide Gates.

C. Chain Link Fence Manufacturers Institute (CLFMI):

1. PM 2445: Chain Link Fence Manufacturers Institute Product Manual.

1.03 SUBMITTALS:

A. Submit the following in accordance with Section 01300.

1. Submit Manufacturer's specifications, drawings, details and fence layout with appurtenances.

2. Submit two samples of fencing materials. Mark or tag each sample and submit 30 days prior to erection of fence.

3. Submit certified test reports with results of tests for fence finish.

4. Submit shop drawings, samples, and certificates simultaneously as one complete package.

1.04 SPARE PARTS:

A. Comply with the requirements specified in Section 01600.

1.05 QUALITY ASSURANCE:

A. Comply with the requirements specified in Section 01400.

B. Sustainability Standards Certifications.

1.06 DELIVERY STORAGE AND HANDLING:

A. Comply with the requirements specified in Section 01610.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION:

A. Provide framework, fabric, accessories, and gates in accordance with ASTM F567.

D. Fence heights as indicated with top rail, bottom tension wire, and three strands of barbed wire projecting outward at top.

E. Gates:

1. Residential: Provide gates in accordance with ASTM F654.

2. Industrial and Commercial:

a. Provide swing gates in accordance with ASTM F900.

b. Provide horizontal slide gates in accordance with ASTM F1184.

2.02 FENCE FABRIC:

A. Colored PVC-coated steel fabric with galvanized and factory-painted steel posts, hardware, and fittings. Color of vinyl coating shall be selected by the Contracting Officer.

B. Fabric woven in 2-inch mesh from PVC coated wire in an 8 feet height with barbed selvages top and bottom. PVC coating thermally fused and bonded over galvanized plastic primed commercial quality steel wire with minimum coating thickness of 7 mils. Coated wire 9-gage with minimum breaking strength of 1,200 lbs. Color to be selected to match total fence system (0.40 oz. of zinc per sq. ft. of surface).

2.03 BARBED WIRE AND SUPPORT ARMS:

A. Galvanized-steel barbed wire consisting of two strands of twisted No. 12-1/2 gage wires with 4-point barbs spaced 3 inches apart and conforming to ASTM A121, with Class 3 zinc coating (minimum of 0.8 oz of zinc coating over each square foot of uncoated wire surface for No. 12-1/2 gage wire).

B. Support arms projecting outward, from top of posts, at 45 degrees and capable of withstanding 200 lb. downward pull on outermost end of arm, without failure. Arms with provision for attachment of three strands of evenly spaced barbed wire and integral with post top weather caps with holes for passage of top rail at intermediate posts.

2.04 TENSION WIRE:

A. No. 7-gage coil spring steel wire with galvanized finish having minimum of 0.8 oz of zinc coating over each square foot of uncoated wire surface.

2.05 TIE WIRES:

A. Tie wires, for fastening fence fabric to line posts and rails, not less than 9 gage (outside diameter) color matched PVC coated galvanized steel wire.

2.06 LINE POSTS:

A. 2-3/8 inches outside diameter steel pipe weighing not less than 3.65 lb/ft, or 1-7/8 inch high carbon steel H-beams weighing not less than 2.70 lb/ft.

2.07 END, CORNER, AND PULL POSTS:

A. 2-7/8 inch outside diameter steel pipe weighing not less than 5.79 lb/ft, or 2-1/2 inch square steel tube weighing not less than 5.14 lb/ft, or 3-1/2 inch by 3-1/2 inch roll-formed, steel corner section weighing not less than 5.14 lb/ft.

2.08 GATE POSTS:

A. 2-7/8 inches outside diameter steel pipe and gate posts, for gate leaves up to and including 6 feet wide, weighing not less than 5.79 lb. per ft., or 2-1/2 inch square steel tube weighing not less than 5.14 lb. per ft., or 3-1/2 inch by 3-1/2 inch roll-formed, steel corner section weighing not less than 5.14 lb/ft.

B. 4 inch outside diameter steel pipe, gate posts for gate leaves over 6 feet wide and up to and including 13 feet wide and weighing not less than 9.10 lb/ft.

C. 6-5/8 inch outside diameter steel pipe, gate posts for gate leaves over 13 feet wide and up to and including 18 feet weighing not less than 18.97 lb/ft.

2.09 RAILINGS:

A. 1-5/8 inch outside diameter steel pipe with minimum weight of 2.27 lb/ft or 1-5/8 inch by 1-1/4 inch, 14-gage roll-form section, for top railing and railings for top middle and bottom braces between terminal posts and adjacent line posts.

2.10 TRUSS:

A. 3/8 inch diameter steel rod diagonal truss braces between terminal and adjacent line posts and for gate framework.

2.11 FITTINGS:

A. Heavy-duty malleable iron or pressed steel fittings of suitable size to produce strong construction.

2.12 STRETCHER BARS:

A. Flat bars with minimum cross section dimensions of 1/4-inch by 3/4 inch, full height of fabric, secured with bar bands of minimum 11-gage sheet steel, spaced approximately 15 inches on centers and bolted with 3/8-inch diameter bolts, for attaching fabric to terminal posts.

2.13 GATE LEAF FRAMEWORK:

A. 1-7/8 inch outside diameter steel pipe weighing 2.72 lb/ft, minimum.

2.14 GATE HINGES:

A. Heavy pattern of adequate strength for gate size, with large bearing surfaces for clamping or bolting in position.

2.15 LATCH:

A. Gates with suitable latch, accessible from both sides and with provision for padlocking.

2.16 GATE PADLOCKS:

A. Manufacturers:

1. Eaton Corp. Lock & Hardware Div., Yale Marketing Dept., Charlotte, NC.

2. P&F Corbin, Div. of Emhart Corp., Berlin, CT.

3. Best Universal Lock Co., Inc., Indianapolis, IN.Solid brass cases hardened steel shackles, removable core cylinders, and galvanized steel chains attached to shackle by a clevis.

2.17 CONCRETE FOOTINGS:

A. Section 03300 Cast-In-Place Concrete, Class A concrete.

2.18 GROUT:

A. One part Portland cement and three parts of clean, sharp, well-graded sand with minimum water for proper workability for posts set in solid rock.

2.19 ACCESSORIES:

A. Steel pipe dimensions and weights: ASTM A53/A53M, Schedule 40. Dimensions specified are nominal pipe sizes.

B. Dimensions and weight tolerances: Plus or minus 5 percent.

C. Zinc Coating: Minimum 2.0 ounces per square foot.

D. Provide posts with tops of same material, and designed to fit securely over post and carry top rail. Carry apron around outside of post at base of top fitting.

E. Ferrous metal fittings, posts, fence, gate framework, and accessories galvanized with heavy coating of 2.0 oz/ft2 pure zinc spelter per square foot or surface area to be coated. Use hot-dip process. Thinner zinc coatings, electro-galvanizing, zinc paint or cold galvanizing compounds not used as substitute for hot-dipped galvanized finish not acceptable.

F. Fabricate and weld before hot-dip galvanizing. Weld conforming to American Welding Society standards.

G. Hot-dip galvanized gate frame, after welding, if bolted or riveted corner fittings not used.

H. Galvanize fittings, posts, fence and gate framework, and accessories, then epoxy phenolic primed and top coated with matching PVC, using thermal bond process.

I. Single and double leaf swing gates with center bolt, center stop, and automatic backstops.

J. Cantilever sliding (rolling type) gate complete with latch, stop, keeper, rollers, heavy duty roller track, and 3 strands of barbed wire installed vertically above fabric.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Examine conditions under which fence and gates are to be installed. Notify the Contracting Officer, in writing, of improper conditions of work.

B. Do not proceed with work until unsatisfactory conditions have been corrected.

C. Verify measurements at site.

D. Check location of underground work to make sure fence footings clear utilities and drainage work.

E. Do not install fence until final grading is complete and finish elevations are established.

F. Do not drive equipment on areas to be landscaped, except as accepted by the Contracting Officer. Areas not accessible from roads shall be protected with heavy wood planking. Remove barricades and protection at completion of project. Repair damaged landscape surfaces.

3.02 INSTALLATION:

A. Footings:

1. Vertical sides to minimize up-lift. Dispose of excavated material in accordance with Section 01710.

2. Rod and compact concrete around posts. Slope top of footings above level of adjacent grade, and trowel finish.

3. Size:

a. 6 inches minimum diameter, plus outside dimension of post.

b. Set corner, end, pull, and gate posts 42 inches into concrete.

c. Set line posts set 36 inches into concrete.

d. Total depth of concrete 6 inches greater than required for post embedment.

4. Time of Set: 48 hours before rails are erected or before fabric is applied or stretched.

B. Framing:

1. Install line posts not more than 10 feet apart.

2. Install pull posts not more than 600 feet apart where a straight run of fence exceeds 600 feet and where fence line changes direction by more than 15 degrees but less than 30 degrees.

3. Install corner posts where the fence line changes direction by more than 30 degrees.

4. Set posts in concrete footings, plumb and true to line.

5. Brace and truss end, pull, corner, and gate posts to adjacent line posts. Provide brace to match top rail spaced midway between top rail and tension wire and extending to adjacent line posts. Provide brace to match top rail spaced midway between top rail and tension wire and extending to adjacent line post. Truss diagonally with 5/16-inch diameter tension rod with turnbuckle.

6. Fasten top rail to end, pull, gate and corner posts. Pass top rail through fittings of line posts.

7. Provide expansion and contraction joints in top rail for each 100 linear feet of fence.

8. Fasten bottom tension wire to end, pull, gate, corner, and line posts.

9. Maximum area of unbraced fence shall not exceed 1,500 square feet.

10. When rock is encountered, set posts into rock a minimum depth of 12 inches for line posts and 18 inches for terminal posts. If solid ledge is encountered without overburden of soil. Provide post holes at least 1 inch greater in diameter than post, fill post holes with concrete work post into hole taking care not to cause voids, remove excess concrete and crown remainder at top to shed water. Where solid rock is covered by overburden, do not exceed total setting depth required for setting in earth, grout posts into rock as described.

C. Fabric:

1. Place fabric on outside of posts and stretch to avoid bulging or buckling.

2. Fasten at line posts, top rail, and bottom tension wire with aluminum or zinc PVC coated ties. Space ties not more than 15 inches apart on line posts and not more than 24 inches apart on rail and tension wire.

3. Fasten at terminal posts at intervals not exceeding 15 inches using flat or beveled galvanized steel bands with 5/16-inch x 1-1/4 inch galvanized carriage bolts and nuts.

4. Make tie connections on interior side of fence.

5. Provide steel angle metal closures where finished ground surface is more than two inches below bottom tension wire. Bolt steel angle to fence posts, and install reinforcing rods and bracing members as accepted. Install rods of accepted length vertically. Where drainage ditches cross fence line, provide concrete ditch lining and steel reinforcing bar grill.

6. Install three strands of barbed wire on each extension arm of line fence and at top of each gate. Pull wires taut and fasten at each support.

7. Install barbed wire on extension arms as indicated. Pull each wire taut, and make entire assembly secure Attach wire to end, corner, pull, and gate posts with wire stretching bands.

8. Install gates plumb, level, and secure for full width of opening and hardware adjusted for smooth operation.

3.03 REPAIR:

A. Remove and replace fencing which is improperly located or is not true to line, grade and plumb within tolerances as indicated.

B. Repair damaged vinyl-coated components as recommended by manufacturer.

3.04 CLOSEOUT ACTIVITIES:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 02900

PLANTING

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide for establishment of permanent vegetation to restore unpaved areas disturbed by the Contractor's operations and work to pre-existing conditions.

B. Provide topsoiling, fertilizing, seeding, planting and related work as indicated and as required for restoration and as indicated and specified.

C. Trees, shrubs, ground cover, and perennials.

D. Repairing existing areas damaged by Work.

1.02 REFERENCES:

A. Standard Specification for Roads, Bridges and Incidental Construction, State of Connecticut Department of Transportation, Form 817, 2004 as amended and supplemented.

B. Comply with American National Standards Institute (ANSI) Z60.1-2004 American Standard for Nursery Stock.

C. American Society for Testing and Materials International (ASTM):

1. D5268: Standard Specification for Topsoil Used for Landscaping Purposes.

2. D5435: Standard Test Method for Plant Growth and Food Chain Protection.

1.03 SUBMITTALS:

A. Product Data:List indicating source of plant material to be provided, at least 4 weeks prior to digging. Include see list naming seeds, pounds per acre, and supplier's name, address and phone number.

2. Product Data, rates of application, and anticipated uses of pesticides, herbicides, and fumigants.

3. Certificates concerning seed mixture, purity, germinating value, and crop year identification.

B. Samples:

1. When specified, submit samples and certified analyses by recognized laboratory approved by Contracting Officer for topsoil, humus, fertilizer, fungicide, insecticide, tree paint, and anti-desiccant before delivery. Manufacturer's analysis for standard products will be acceptable.

2. When specified submit samples of soil separation matting, erosion control matting, natural fiber material, and/or geosynthetic liners.

3. Approval shall not be construed as final acceptance. Contracting Officer may take samples of materials delivered to site and analyze them for compliance with Specifications.

C. Miscellaneous:

1. Prior to end of maintenance period, furnish 2 copies of typed maintenance instructions recommending procedures to be established for maintenance of landscape Work for one year.

2. Inspection certificates required by federal, state or other governing agency shall accompany each shipment.

3. Shop drawings showing locations and depths of agronomic soil samples collected.

D. Submit in accordance with Section 01300.

1.04 QUALITY ASSURANCE:

A. Qualifications:

1. Subcontractor shall have specialized equipment and experience for hydroseeding. Hydroseeding will be warranted by the Contractor for a period of 1 year. Maintenance will occur every 6 months at a minimum.

B. Planting Plan

1. Follow planting plan in accordance with Contracting Officer's drawings and as required for restoration as specified.

C. Inspection:

1. The Contracting Officer may inspect plant material at nursery. Such inspection shall be in addition to inspection at Site.

2. Upon delivery and before planting, the Contracting Officer will inspect plants. Plants must not be dried out and must be free of mold, fungus, and other pests.

3. Inspection and approval is for quality, size, and variety only, and in no way impairs right of rejection for failure to meet other requirements during progress of Work.

4. Contractor shall be present during required inspections or as may be required by the Contracting Officer.

D. Source Quality Control:

1. Certification: Landscape materials shall be from stock inspected and certified by authorized governmental agencies. Material shall comply with governmental regulations prevailing at supply source and project. Investigate sources of supply and make assurances that plants will be supplied as indicated in the Planting Plan in sizes, variety and quality noted and specified before submitting bid. Substitution of species must be approved in writing prior to bidding. Ensure that materials can be procured depending on the time of year. Failure to take this precaution will not relieve responsibility for furnishing and installing plant material in accordance with Contract requirements and without additional expense to Contracting Officer.

2. Plant material shall comply with State of Connecticut and federal laws with respect to inspection for plant diseases and insect infestation.

3. When specified, provide analyses and tests of topsoil, fertilizer and humus in accordance with requirements of Association of Official Agricultural Chemists. USDA Service Center Locator. Analyze appropriate soil samples for nutrients (nitrogen, phosphorous, potassium), pH, and appropriate parameters as recommended by the local USDA NRCS extension office. Apply soil amendments in accordance with agronomic soil results, experience, and local conditions. Report shall include a fertility and plant suitability analysis with written recommendations for organic soil amendments, fertilizers, soil conditioners, and their respective application rates for soil treatment and plant maintenance. The soils report recommendations shall take precedence over the minimum amendment, fertilizer, and conditioner application rates specified herein only when they exceed specified minimums. Agronomic test results shall include nitrogen, phosphorous, potassium, pH, or other soil mineral content as applicable.

4. Plant names used in plant list are in accordance with “Standardized Plant Names,” published by American Joint Committee on Horticulture Nomenclature (current edition). Plants will be referred to by common name and genus and species.

5. Size and grading standards of plant materials shall be in accordance with American Association of Nurserymen, Inc. (AAN) Standard: American Standard for Nursery Stock (ANSI Z60.1).

6. Contractor will furnish two copies of written maintenance, instructions for maintenance and care of installed plants and lawn areas.

7. Provide only nursery grown plants having been transplanted at least once and growing in a nursery for at least two years.

8. Provide container grown stock in containers long enough for root system to develop sufficiently to hold soil together firm and whole when removed from container. Use no plants loose in the container.

9. Notify the Contracting Officer at least 48 hours in advance of all planned planting operations and identify specific material and its location. Plant material must not be dried out and must free of mold, fungus, or other pests.

10. Furnish suitable quantities of water, hose and appurtenances.

11. Provide topsoil that complies with ASTM 5268 – Standard Specification for Topsoil Used for Landscaping Purposes.

12. Begin maintenance immediately after planting. Continue maintenance for 2 years.

13. Repair or replace seeded areas, plants, shrubs, and trees, which in judgment of the Contracting Officer, have not survived and grown in a satisfactory manner, for a period of 1 year after date of acceptance.

14. Provide as specified seedings or plantings replacements of the same type and size as approved by the Contracting Officer.

1.05 DELIVERY STORAGE AND HANDLING:

A. Preparation for Delivery:

1. Balled and Burlapped (B&B) Plants:

2. Dig and prepare for shipment in manner that will not damage roots, branches, shape, and future development of plant.

3. Originate from soil which will hold good ball and be wrapped with burlap or similar material, bound with twine or cord to hold balls firm and intact.

4. Ball Sizes: Not less than standard established by AAN for B&B stock.

B. Potted or Container Plants:

1. Provide container to hold ball shape protecting root mass during delivery and handling.

C. Delivery:

1. Schedule shipping to minimize on-site storage of materials.

2. Plant Material: Take precautions in accordance with best trade practices to ensure arrival of plant material at Site in good condition and without injury. Cover plants to prevent freezing, drying, transit injury, or other exposure that may be harmful.

During shipment, plants shall not be bent, stacked, or bound in manner that damages bark, breaks branches, deforms root balls, or destroys natural shape.

3. Fertilizer: Deliver fertilizer to site in original, unopened containers bearing weight, manufacturer's guaranteed chemical analysis, name, trade name, trademark, and conformance to state law.

4. Notify the Contracting Officer 48 hrs before delivery of plant material.

5. Each shipment shall be accompanied by invoice showing sizes and varieties included.

    a. Provide copy of invoice to the Contracting Officer upon delivery of plant material.

6. Deliver topsoil in an unfrozen and non-muddy condition

D. Temporary Storage:

1. Storage of Plant Material:

    a. Set plants which are not to be planted within 4 hrs, on ground and heal in with peat, soil, mulch or other approved media.

    b. Protect roots of plant material from drying or other possible injury.

    c. Water plants until planted.

    d. Plants shall not remain unplanted for longer than 3 days.

1.06 PROJECT/SITE CONDITIONS:

A. Inspection:

1. Prior to beginning Work, Contractor shall examine and verify acceptability of Site for conditions under which Work will be performed. Do not proceed with Work until unsatisfactory conditions have been corrected.

2. Starting Work constitutes acceptance of conditions under which Work is to be performed. After such acceptances, Contractor shall be responsible for correcting unsatisfactory and defective Work resulting from such unsatisfactory conditions.

3. It is the intent of this specification that existing trees within grading and seeding limits, not be disturbed by Contractor's operations and be saved and protected, except where specified to be removed. Clear trees required to be removed only after approval by the Contracting Officer. Contracting Officer directs variations required in grading on the job. Trees to be saved shall be clearly marked with caution tape. Jurisdictional wetland and/or stream banks will be flagged and protected in accordance with local, state, and federal Clean Water Act (CWA)

permits; Use of native local species is encouraged, including transplanting from impacted areas, if practicable.

4. Remove invasive species, if applicable, in accordance with scope of work, water permits, and/or wetland/stream restoration plans

B. Utilities:

1. Locate underground utilities by servicing agencies.

2. On-site sources of water will be provided by Contracting Officer.

C. Planting Seasons:

1. Spring Planting: Deciduous material shall be planted between March 1 and June 1. Plant bare root materials only during this season, but no later than June 1. Consider current and forecasted weather conditions.

2. Fall Planting: August 15 to October 1. Plant deciduous materials no later than October 15.

3. Summer Season: Planting shall be considered unseasonable and requires approval by the Contracting Officer.

4. Container Plants: Planting season designated above may be extended for container grown plants when approved by the Contracting Officer.

5. If special conditions exist which warrant installation outside normal planting seasons, Contractor shall submit written request to the Contracting Officer describing conditions and stating proposed variance. Approval to plant under such conditions shall in no way relieve Contractor from warranty.

D. Plant when weather and soil conditions are suitable in accordance with industry practices.

E. Protection:

1. Protect seeded and planted areas against damage by trespass and other Work (for example heavy equipment) until substantial completion.

2. Protect plants from nuisance species such as deer or beaver as necessary.

3. Replace, repair, re-stake or replant lawn or plantings which are damaged.

4. If planting after lawn installation, protect lawn areas, and repair damage resulting from planting operations.

5. Where planting occurs in close proximity to other site improvements, protect features prior to commencing Work. Any items damaged due to planting operations shall be repaired to their original condition.

1.07 WARRANTY:

A. During 1 year correction period replace plants which have died, or are in dying condition, or which has failed to flourish so its usefulness or appearance has been impaired. Replace trees with dead main leader or crown which is 25 percent or more dead.

1. Replacement and Damages:

a. Decisions of the Contracting Officer for required replacements are final and binding upon Contractor.

b. Contractor is responsible for repairing damage to property caused by defective workmanship and materials.

2. Exclusions:

a. Contractor is not liable for replacement cost of plants damaged by deicing compounds, fertilizers, pesticides or other materials not specified in Contract Documents or not applied by Contractor, by relocating or removal by others, by acts of God, or by vandalism, and losses due to curtailment of water by local authorities.

3. Inspection of Maintenance:

a. During correction period, Contractor shall, periodically (once a week), inspect watering, cultivation, and other maintenance operations by Contracting Officer, and notify Contracting Officer of methods, practices or operations considered unsatisfactory and not in accordance with good horticultural practices.

b. Failure of Contractor to inspect or report shall be construed as acceptance of Contracting Officer's maintenance operations, and Contractor shall not claim or assert defects which may later develop are result of such methods or practices or operations.

c. Contracting Officer will notify Contractor when maintenance is to be performed so Contractor may observe maintenance procedures.

PART 2 - PRODUCTS

2.01 PLANTS:

A. General:

1. Provide plants in accordance with ANSI Standard for Nursery Stock, Designation Z60.1-2004.

2. Plant material shall be nursery grown unless otherwise specified or approved in writing by the Contracting Officer. Plants shall have been grown within same hardiness zone as Project site or acclimated to conditions of same hardiness zone for minimum of 2 growing seasons. Hardiness zones shall conform to "Zones of Plant Hardiness" as provided by U.S. Department of Agriculture.

3. Unless specifically noted otherwise, plants shall be of selected specimen quality; have normal habit of growth; and be sound, healthy, vigorous plants with well developed root systems. Plants shall be free of disease, insect pests, their eggs or larvae, and injuries.

4. Do not prune before delivery. Prune at time of planting. Trees with damaged, crooked leader or multiple leaders, unless specifically specified, will be rejected. Trees with abrasion of bark, sun scalds, disfiguring knots or fresh cuts of limbs over 1-1/4 inch which have not completely calloused, will be rejected. Prune in accordance with American Association of Nurserymen standards to preserve natural form and character of the plant. Plants shall be freshly dug or container grown. Heeled-in plants or plants for cold storage are not acceptable unless Contractor makes such request in writing and plants are inspected and approved.

5. Plant Name and Size:

a. Measure plants when branches are in normal position. Height and spread refer to plant's main body and not from tip to branch tip.

b. Take caliper measurement at specified distance above root collar as described in ANSI Z60.1.

c. If range of size is given, no plant shall be less than minimum size and not less than 50 percent of plants shall be as large as upper half of range specified.

d. Measurements specified are minimum size acceptable and are measurements after pruning, where pruning is required. Plants meeting measurements specified, but not producing normal balance between height and spread, will be rejected.

e. Shrubs shall be matched specimens from single block source.

f. Plants shall be true to species and variety and conform to measurement specified in Plant Schedule, except plants larger than specified may be used if approved by the Contracting Officer. Use of such plants will not result in increase in Contract Price. If larger plants are approved, increase ball of earth in proportion to size of plant.

g. Where plants larger than specified have been submitted in writing for approval and approved in writing by the Contracting Officer, Contractor shall assume responsibility of guarantee for plant in size as planted.

B. Balled and Burlapped Plants (B&B):

1. Dig plants with firm natural balls of earth of sufficient diameter and depth to encompass fibrous and feeding root system necessary for full recovery of plant.

2. Plants having balls broken or cracked during delivery or at time of planting will be rejected.

3. Ball sizes shall meet or exceed requirements of ANSI Z60.1.

4. The Contracting Officer may reject plants specified as B&B which, in the Contracting Officer's opinion, fails to conform to balling requirements.

C. Bare Roots Plants (BR):

1. Dig shrubs marked BR at nursery without injury to fibrous root system necessary for full recovery of plant.

2. Cover root with thick coating of mud by puddling or wrap in wet straw, moss or other suitable packing material immediately after they are dug for protection until delivery and installation.

3. Root Spread:

Height of Plant	**Minimum Spread of Root (in.)**
18 - 24 inches	10
2 - 3 feet	11
3 - 4 feet	14
4 - 5 feet	16
5 - 6 feet	18
6 - 8 feet	20

4. Maintain bare root plants in cold storage at approximately 30 degrees F prior to being delivered to Site.

D. Container or Pot Grown Plants (Cont. or Pot):

1. Container grown plants shall have heavy fibrous root system, or well developed tap root, developed by proper horticultural practice including transplanting and root pruning, and shall have grown in container for at least 1 growing season.

2. Root system shall have developed sufficiently long for new fibrous roots to develop so root mass will retain its shape and hold together when removed from container.

3. Container shall not strangle or girdle natural growth of plant. Plants, other than groundcovers, over-established in container as evidenced by pot-bound root ends, will be rejected.

E. Bulbs, Corms, or Tubers:

1. Healthy and viable, free from fungus and disease; and not dried out, desiccated or damaged by digging or handling. Provide proper period of rest.

2. Bulbs and corms shall meet diameter or circumference as set forth in ANSI Z60.1.

3. Tubers shall have minimum of 2 “eyes” or buds.

F. Perennials, Biennials, Prairie Forbes, and Grasses:

1. Perennials, biennials, prairie forbes, and grasses specified as “container” or “pot” shall be provided as container-grown plants, or provided with firm natural balls of earth with diameter and depth in accordance with ANSI Z60.1 for size specified on Plant List.

2. Ship balled plants in open air boxes or crates to minimize handling of each plant prior to installation. Do not plant balled plants if ball is cracked or broken before or during process of planting.

G. Collected Plants:

1. Plant material collected from native stands or established plantings shall be designated as such. Spread of roots, bare root or root balled trees shall be a minimum of 1/3 greater in size than recommended for nursery grown stock in accordance with ANSI Z60.1.

2. Plant material collected from wild or native stands may be considered nursery grown when successfully re-established in nursery row and grown under regular nursery cultural practices for minimum of 2 growing seasons and attained adequate root and top growth to indicate full recovery from transplanting into nursery row.

H. Grass

1. Provide seed mixes in accordance with Planting Plan clean, high in germinating value and latest year's crop mixture as follows:

Name	Minimum Proportion by Weight	Percent Purity	Percent Germination
Kentucky bluegrass	20 percent	87 percent	85 percent
Merion Kentucky bluegrass	20 percent	87 percent	85 percent
Red Chewings Fescue	45 percent	98 percent	85 percent
Manhattan Rye	15 percent	98 percent	90 percent

2. Turf grass seed, outside perimeter fence, clean, high in germinating value and of the latest year's crop mixed as follows:

Name	Minimum Proportion by Weight
Creeping Red Fescue	50 percent
Domestic Ryegrass	20 percent
Redtop	5 percent
Kentucky Bluegrass	25 percent

3. Weeds shall not exceed 0.25 percent.

2.02 SOD:

A. Established, nursery grown Kentucky or Merion Bluegrass sod, vigorous, well rooted, healthy turf, free from disease, insect pests, weeds, other grasses, stones, and any other harmful or deleterious matter.

B. Sod harvested by machine at uniform soil thickness of approximately 1 inch but not less than 3/4-inch. Measurement for thickness excludes top growth and thatch. Prevent tearing, breaking, drying or any other damage.

2.03 CRUSHED STONE:

A. Crushed stone made from light colored granite. Stone screened to insure uniformity of size. No flat, elongated stone used. Size of stone in mowing strips and other areas as indicated on drawings, conforming to following requirements:

Size of Square Screen	Percent Passing
1-1/4-inch	95 maximum
3/4-inch	15 maximum

2.04 PLANTING MATERIALS:

A. Topsoil:

1. Obtained from natural well drained areas, and be fertile, friable soil, clean of undesirable materials such as plants, weeds, roots, stalks, stones, and other debris.

2. Existing topsoil may be used if the Contracting Officer determines soil is suitable and of sufficient quantity. Topsoil must meet ASTM standard 5268 Standard Specification for Topsoil Used for Landscaping Purposes.

3. Acidity range of pH 5.0 and pH 7.0 and shall contain no less than 4 percent organic matter as determined by loss on ignition of moisture free samples dried at 212 degrees F.

B. Soil Amendments:

1. Peat:

a. Natural, domestic, or Canadian product, free of stones, taken from freshwater site.

b. Not less than 80 percent decomposed organic matter by weight on oven-dried basis.

c. Deliver peat in workable condition, free from lumps.

2. Manure:

a. 2 to 3 yrs old, well rotted stable or cattle manure, free from shavings, sawdust, refuse, and other materials harmful to plant growth.

3. Super-phosphate: Finely ground phosphate rock, agricultural grade, containing not less than 20 percent available phosphoric acid.

4. Granular Fertilizer:

a. Commercial type, uniform in composition, free flowing, conforming to state and federal laws, and suitable for application with equipment designed for that purpose.

b. Contain minimum basis percentage by weight:

(1) Nitrogen: 6 percent, 1/4 of nitrogen shall be in the form of nitrates, 1/4 in the form of ammonia salts, and 1/2 in the form of organic nitrogen.

(2) Phosphorus: 24 percent, available phosphoric acid shall be derived from super phosphate having minimum analysis of 20 percent available phosphate.

(3) Potash: 24 percent, potash shall be in form of sulphate or potash.

(4) Balance of fertilizer shall be materials usually present in such products, free from dust, sticks, sand, stone, and other debris.

(5) Ground agricultural limestone containing not less than 85 percent total carbonates.

c. Coordinate N-P-K requirements with agronomic soil testing lab recommendations.

5. pH Adjusters:

a. Lime: Ground dolomite limestone, containing not less than 85 percent calcium and magnesium carbonates, 50 percent passing through 100 mesh screen, 98 percent passing 20 mesh screen.

b. Elemental sulphur: Finely ground horticultural grade material containing at least 95 percent purity.

C. Mulch:

1. Processed Hardwood Bark:

a. From mixed hardwood species and free of sticks and leaves, 60 percent shall range between 1 and 3 inches in length; remaining 40 percent shall not exceed 1-1/2 inches.

b. Maximum of 5 percent content by weight of shredded wood particles.

2. Mushroom Manure:

a. Well rotted cattle or stable manure with admixture of 15 percent to 30 percent topsoil.

b. Used for commercial growing of at least one corp of mushrooms.

D. Water:

1. Obtain from fresh water sources and free from injurious chemical or other toxic substances harmful to plant life.

2. No water which is brackish may be used.

E. Herbicide:

1. Shrub Beds: "Casoron" as manufactured by Thompson-Haywood Chemical Company, "Snapshot" as manufactured by Dow Elanco Products Company, or equal.

2. Ground Cover Beds: "Treflan" as manufactured by Elanco Products Company, Division of Eli Lilly and Company, or equal.

3. Do not apply herbicides for wetlands or stream restoration projects unless the water permit and planting plan specifically allow for application to invasive and/or nuisance species.

F. Tree Wrap:

1. Two thicknesses of waterproof crepe paper 6 to10 inches wide, cemented together with bituminous material wrapped from bottom with minimum 2 inch overlap.

2. Twine: Minimum of 2-ply jute materials.

3. Protect woody plants from deer, beaver, and other nuisance species as necessary.

G. Staking and Guying Materials:

1. Hose:

a. Tree guy hose: New 2-ply fiber-bearing garden hose, not less than 1/2-inch inside diameter.

b. Seconds rejected by factory are acceptable if approved by the Contracting Officer.

c. Use one color throughout project.

2. Wire: Tree guy wire shall be pliable No. 12 ga, galvanized wire.

3. Stakes: For guying trees, shall be 2 by 4 inches nominal construction grade lumber, 30 inches long and sharpened on one end.

H. Tree Paint:

1. Waterproof, adhesive, and elastic, free from kerosene, coal tar, creosote or other material injurious to life of tree.

2. Contain an antiseptic.

I. Planting Mixture for Plant Pits:

1. 6 parts topsoil or suitable existing soil thoroughly mixed with 2 parts peat and 1 part manure, plus 1 pound 6-24-24 fertilizer/cu yd of mixture.

PART 3 - EXECUTION

3.01 PREPARATION:

A. Do not install plantings where depth of soil over underground construction, obstructions or rock is insufficient to accommodate roots or where pockets in rock or impervious soil require drainage.

1. Where such conditions are encountered in excavation planting areas and where stone, boulders or other obstruction cannot be broken or removed by hand methods and where trees to be planted are under overhead wires, alternate locations for planting may be designated by the Contracting Officer.

2. Where locations cannot be changed as determined by the Contracting Officer, submit cost required to remove obstructions to depth of not less than 6 inches below required pit depth. Proceed with Work after approval of the Contracting Officer.

3. Dispose of excavated material not suitable for backfilling off-site.

4. If drainage problems are encountered detrimental to growth of specified plant material, notify the Contracting Officer of conditions before proceeding with Work.

B. Remove rock or other underground construction and drain planting areas only when approved by the Contracting Officer. Payment for extra work shall be based on in-place volume required to provide normal requirements for plantings.

3.02 INSTALLATION:

A. Topsoil/Finish Grading:

1. Do not place or work topsoil in frozen or muddy condition.

2. Finish grade is established final grade. Grades not otherwise indicated are uniform levels or slopes between points where elevations given or between such points and existing finished grades.

3. Where Drawings show existing grades of landscaped areas are not to be changed or if new grade is less than 4 inches above existing grades, remove enough material to allow placement of 4 inches new topsoil, unless existing topsoil to required depth is undisturbed and of equal or better quality than topsoil specified. In latter case, existing topsoil may be left in-place, using enough new topsoil to bring these areas up to grade.

B. Preparation:

1. Planting Season: Conform to planting seasons.

2. Preparation of Planting Areas: Cover surrounding turf (if existing) to protect turfed areas that are to be trucked or hauled over and upon which soil is to be temporarily stocked.

3. Stake or paint locations of plants and outlines of bed. The Contracting Officer will approve locations before excavation starts. Make adjustments in locations and outlines as required. If pits or areas for planting are prepared and backfilled with topsoil to grade prior to commencement of lawn operations, mark so they can be readily located when planting proceeds.

C. Excavation for Planting:

1. Planting Pits:

a. Circular pits with vertical sides and flat bottoms.

b. Depth of pits for trees shall be suitable to accommodate ball, container or bare roots when plant is set to finished grade allowing for 6 inches. of compacted, prepared soil in bottom of pit.

c. If rotating augers or other mechanical diggers are used to excavate holes, scarify vertical sides of pits to eliminate impervious surfaces.

d. Continuous trench may be utilized instead of separate round pits for hedge plantings.

2. Shrub bed preparation:

a. Excavated existing soil in shrub beds and replace with planting bed soil mixture.

b. Planting beds shall be brought to smooth and even surface conforming to established grades.

D. Preparation for Planting:

1. Preparation of Planting Pits:

a. Loosen soil at bottom of pit to minimum depth of 4 inches by spading or other effective methods.

b. Backfill pit with 6 inches layer of compacted, prepared soil.

2. Preparation of Groundcover, Annual, and Perennial Beds:

a. Cover areas specified for ground cover, annuals, and perennials with 2-inch layer of mushroom manure.

b. Work into soil to minimum depth of 9 inches by use of rototiller or other cultivating mechanism.

c. After completion, mulch bed throughout with additional 3-inch layer of mushroom manure prior to planting of plants.

d. Mix herbicide directly into prepared planting soils in conformance with manufacturer's recommendations.

E. Planting:

1. B&B Plants:

a. Cut away burlap, rope, wire or other wrapping materials from top of ball and remove from pit. Do not remove burlap or ties from sides and bottom of root ball. If plastic wrap or other non-degradable materials are used in lieu of burlap, remove them before placing of backfill.

b. Backfill planting pits approximately 2/3 full with prepared soil, add water and allow settling. After water has been absorbed, fill planting pit with planting mixture and tamp to match finish grade. Form shallow saucer around each isolated plant pit with prepared soil.

2. Container-Grown Plants:

a. Open and remove potted plants from containers.

b. If growing medium is comprised of 75 percent or more of peat, perlite, sand or like material other than soil, pull visible roots away from container medium so as to leave roots partially exposed.

c. Place plants in plant pit or trench and backfill with prepared soil among exposed roots. Continue backfilling and tamping in 6-inch layers until planting mixture is at final grade.

3. Bare Root Plants:

a. Place plants which have been puddled in mud or peat and water solution in center of pit or trench.

b. Cut off broken or frayed roots.

c. Spread roots in natural position and backfill moist prepared soil among roots in 6-inch layers until planting mixture is at final grade.

d. Form shallow saucer around each isolated plant pit with prepared soil.

e. Water plants immediately after planting.

4. Bulbs, Corms, Tubers and Grass sprigs:

a. Plant at time and depth in accordance with best horticultural practice.

F. Pruning:

1. Prune new trees and shrubs at time of or after planting. Prune and repair existing trees designated to remain. Prune in accordance with American Association of Nurserymen standards.

2. Prune in accordance with standard horticultural practices to retain natural form and character of plant.

3. Prune and remove dead wood, suckers, injured twigs and branches, badly formed or interfering limbs, and sufficient other growth to insure health and symmetrical growth of new wood. Up to one third (1/3) of branches may be removed.

4. Use clean, sharp tools.

5. Make cuts flush and clean, leaving no stubs.

6. For cuts greater than 3/4-inch in diameter and bruises or scars on bark, trace injured cambium back to living tissue and remove. Smooth and shape wounds so as not to retain water.

7. Paint pruning cuts greater than 3/4-inch with tree paint.

8. Prune flowering trees only to remove dead or damaged branches. Do not remove main leader. In case of multiple leaders, preserve one that will best promote symmetry of tree, and remove or cut back rest.

9. Prune shrubs by removing broken branches, thinning out canes, and cutting back or removing unsymmetrical branches. Pruning shall result in loose outline conforming to general shape of shrub type. Do not use hedge shears.

G. Wrapping:

1. Wrap deciduous trees with tree wrap immediately after planting.

2. Wrap spirally from base of trunk to first lateral branches, overlapping preceding wrap by one-half width of paper.

3. Trunks may be inspected by the Contracting Officer prior to wrapping for injury to bark, improper pruning, and evidence of insect or disease infestation.

4. Tie wrap securely in place at top, bottom, and 18 inches maximum intervals with twine.

H. Fertilizer:

1. First Application (Ratio 1-4-4): Prior to installation of mulch to plant beds and saucers, apply commercial fertilizer to plant bed or saucer area at rate of 1/2 pound active ingredient per 100 square feet.

2. Second Application (Ratio 5-3-2): Applied in 60 days after planting at rate of 1/2 pound active ingredient per 100 square feet..

I. Herbicide Application:

1. Comply with manufacturer's recommendations before mulching.

2. Place herbicide in direct contact with soil.

3. Plant leaf surfaces shall be dry during herbicide application.

J. Mulching:

1. Mulch shade trees, ornamental trees, singularly planted shrubs, hedge plantings, and massed shrub plantings. Cover entire planting pit or bed with uniform 4 inch depth of shredded hardwood bark.

2. Mulch within 5 days after installation.

3. Keep mulch out of crowns of shrubs and off buildings, walks, and pavements, light standards, and other structures.

K. Staking and Guying:

1. Stake and guy trees.

2. Stake and guy immediately after wrapping. Plants shall stand plumb after staking.

L. Watering:

1. Water immediately after installation.

2. Water during period of temporary maintenance.

3. Provide hose and other equipment for watering.

3.03 CLEAN UP AND PROTECTION

A. Remove excess and waste material daily.

B. Remove soil or similar material brought onto paved areas, keeping areas broom clean.

C. Upon completion of planting, remove excess soil, stones, and debris and dispose of off-site.

D. Damage to existing landscape, pavements, or other site features as result of Work shall be repaired to its original condition.

E. Protect landscape Work and materials from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods.

3.04 MAINTENANCE

A. Temporary Maintenance:

1. Maintain plant material until substantial completion as defined in section 3.06. Acceptance of this specification.

2. Temporary maintenance begins immediately after each plant is installed and shall include watering, necessary cultivation, weeding, pruning, disease and insect pest control, protective spraying, resetting of plants to proper grades or upright position, restoration of damaged planting saucers, and other procedures consistent with good horticultural practice necessary to ensure normal, vigorous, and healthy growth of plantings.

3. Remove and replace dead and unacceptable plants as their condition becomes apparent.

4. Upon substantial completion, Contractor assumes responsibility for plant maintenance, except as below.

a. For duration of one year correction period, Contractor is responsible for resetting of settled plants, straightening of plants which are not plumb, and tightening of tree guys.

b. Contractor shall remove and dispose of tree wrap, stakes, tublings, and guys at end of 1 yr period.

3.05 REPLACEMENTS:

A. Replace plants which have died prior to substantial completion.

B. Plants which die or require replacement for other reasons during one-year correction period shall be replaced as soon as possible during acceptable planting seasons.

1. Spring Replacement Season: All plants-when ground becomes workable to June 1.

2. Fall Replacement Season:

a. Deciduous plants: October 15 until the ground freezes.

b. Evergreen plants: August 15 to October 1.

C. Procedure:

1. Dispose of removed plants off-site.

2. Replacements shall be of same size and species as original plant unless otherwise approved by the Contracting Officer.

3. Replacements shall be supplied and installed in accordance with Specifications.

4. Restore areas damaged by replacement operations to original condition.

5. Notify the Contracting Officer at conclusion of replacement program.

6. The Contracting Officer will conduct inspection of replacements for determining final acceptance.

3.06 ACCEPTANCE:

A. Preliminary Planting Acceptance:

1. Notify the Contracting Officer at conclusion of planting operations so the Contracting Officer can determine substantial completion by field inspection.

2. Substantial completion requires:

a. Plant material conforms to Contract Documents with respect to quantity, quality, size, species, and location, except those items accepted or revised in field by the Contracting Officer.

b. Plant material shall be in healthy condition as defined under warranty.

c. Vegetation density (for herb species) and/or woody species stems/acre shall be in accordance with water permit and/or wetlands/stream restoration criteria.

B. Final Planting Acceptance:

1. Final planting acceptance shall be granted after completion of replacement operations required to fulfill guarantee.

2. Final inspection of planting will be made by Contractor and Contracting Officer.

3. On or about expiration of 1 yr correction period, follow-up inspection will be made to determine replacements required to be made by Contractor in accordance with provisions of these Specifications. The Contracting Officer will document

findings in field report, and forward copies to Contractor. Items identified for replacement will be tagged during inspection with plastic flagging.

4. Upon completion of replacement program, the Contracting Officer will inspect to determine acceptability of required replacements. If acceptable, the Contracting Officer shall notify Contractor in writing, of final acceptance of Work.

5. Complete vegetative monitoring and reporting in accordance with water permit, scope of work, and/or EEP criteria.

3.07 CLOSEOUT ACTIVITIES:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 02922

HYDROSEEDING

PART 1 - GENERAL

1.01 DESCRIPTION:

A. This section describes hydroseeding, hydromulching, and seed mix establishment and maintenance for erosion control and revegetation.

1.02 REFERENCES:

A. Standard Specification for Roads, Bridges and Incidental Construction, State of Connecticut Department of Transportation, Form 817, 2004 as amended and supplemented.

B. American National Standards Institute (ANSI):

1. Z60.1-2004: American Standard for Nursery Stock.

C. American Society for Testing and Materials International (ASTM):

1. ASTM D5268, Standard Specification for Topsoil Used for Landscaping Purposes.

2. ASTM D5435, Standard Test Method for Plant Growth and Food Chain Protection.

1.03 SUBMITTALS:

A. Submit the following shop drawings in accordance with Section 01300.

1. After completion of grading and prior to soil preparation, obtain soil samples for a representative sampling of planting areas. Submit a location map showing proposed soil sample locations for review prior to collecting samples. Collect two soil samples at each sample location. Collect samples at depths of 0-6 inches and 6-12 inches. Submit soil samples for agronomic soils test report. Tests shall be performed by an agronomic soils testing laboratory. USDA Service Center Locator Report shall include a fertility and plant suitability analysis with written recommendations for organic soil amendments, fertilizers, soil conditioners, and their respective application rates for soil treatment and plant maintenance. The soils report recommendations shall take precedence over the minimum amendment, fertilizer, and conditioner application rates specified herein only when they exceed specified minimums.

2. Submit materials list noting product (generic) name and manufacturer or supplier. List shall include fertilizers, organic amendments, soil conditioners, soil binder, herbicides, fiber mulch, etc.

3. Submit seed list naming seeds, application rate in pounds per acre, and supplier's name, address, and phone number.

4. Submit laboratory analysis of fertilizers, organic amendments, soil conditioners, soil binder, herbicides, etc.

5. Submit the above submittals to the Contracting Officer no later than 30 days prior to performing the work, giving evidence that Contractor has a source for specified hydrospray materials and seed mix and that they conform to these specifications.

1.04 QUALITY ASSURANCE:

A. Qualifications:

1. Subcontractor shall have specialized equipment and experience for hydroseeding.

B. Planting Plan:

1. Follow planting plan in accordance with Contracting Officerdrawings and apply hydroseeding as required for site restoration.

C. Inspection:

1. The Contracting Officer may inspect hydroseeded area. Such inspection shall be in addition to inspection at Site.

2. Contractor shall be present during required inspections or as may be required by the Contracting Officer.

1.05 WARRANTY:

1. During 1 year correction period replace bare spots, or areas that have failed to flourish so its usefulness or appearance has been impaired.

2. Replacement and Damages:

a. Decisions of the Contracting Officer for required replacements is final and binding upon Contractor.

b. Contractor is responsible for repairing damage to property caused by defective workmanship and materials.

3. Exclusions:

a. Contractor is not liable for replacement cost of grass damaged by deicing compounds, fertilizers, pesticides or other materials not specified in Contract Documents or not applied by Contractor, by relocating or removal by others, by acts of God, or by vandalism, and losses due to curtailment of water by local authorities.

1.06 OBSERVATIONS:

A. Request observation by the Contracting Officer at least 48 hours in advance of required observation time.

B. Observation will be required for the following parts of the work:

1. Review landscape final grading and weed control prior to hydroseeding.

2. When hydroseeding work is ready to begin, a review of slurry materials and seed mixes shall be performed prior to slurry preparation.

3. During and upon completion of maintenance and seed mix establishment.

PART 2 - PRODUCTS

2.01 SEED MIX:

A. Deliver seeds to the site in sealed bags with certification tags, including weight, seed type, seed purity, germination percent, and date seed tested. Give seed certification tags to Contracting Officer.

B. Seed shall be fresh, clean, new crop seed. Seed shall be delivered to the work site with each container bearing the dealer's guaranteed analysis. Seed mixes shall be composed substantially as follows with less than 1.5 percent inert matter, not more than one percent crop seed content, and no noxious weed seeds. Seed shall be spread at rates indicated after each mixture.

C. Mowable Grass Seed Mixture (4 pounds/1,000 square feet)

1. Mowable grass seed mixture shall conform to seed mixture of State of Connecticut Department of Transportation Standard Specifications Section M13.04.

2.02 FIBER MULCH:

Fiber mulch shall be derived from wood chips or recycled paper products. The mulch shall be free of chemicals and growth inhibitors. Mulch shall contain a green dye to assist in metering the application.

A. Cellulose fiber mulch shall be Conwed 2000 (wood fiber), Conwed Corp. 612/631-5700; Cellin-K (cellulose fiber), Cellin Manuf. Inc. 703/690-1195; or equal.

2.03 HYDRO MULCH:

A. Material for hydromulching shall consist of the fiber mulch material.

2.04 STRAW:

A. Materials for straw tack shall consist of the straw from oats, barley, wheat, or rye and shall be seed free or fumigated to prevent introduction of weeds. At least 50 percent of the mulch by weight shall be 10 inches or more in length. Do not use old, dry straw that breaks and does not bend.

2.05 WOVEN JUTE MESH NETTING

A. Woven jute mesh netting shall be "Ludlow Soil Saver", as manufactured by the Ludlow Corp., Needham Heights, Massachusetts, or an equal manufactured by Advance Netting Company, Lodi, New Jersey, or "Jute - Net" by Bemis, Inc., St. Louis, Missouri, and shall be placed on all slopes greater than 3 to 1, and all slopes 3 to 1 which are higher than 10 feet. Woven Jute Mesh Netting will only be required for the protection of mowable grassed areas or in any other areas where erosion is a problem.

2.06 TOPSOIL:

A. Fertile, friable, natural topsoil typical of locality, without admixture of subsoil, refuse or other foreign materials, and obtained from well-drained arable site. Mixture of sand, silt and clay particles in equal proportions. Free of stumps, roots, heavy or stiff clay, stones larger than 1 inch in diameter, lumps, coarse sand, noxious weeds, sticks, brush or other deleterious matter. Topsoil shall be in accordance with ASTM 5268 Standard Specification for Topsoil Used for Landscaping Purposes.

2.07 FERTILIZERS, SOIL CONDITIONERS, SOIL BINDER, AND HERBICIDES:

A. Provide slow-release fertilizer with an analysis of 20-10-5.

B. Provide superphosphate fertilizer with an analysis of 0-18-0.

C. Agricultural gypsum shall be an agricultural calcium sulfate and shall contain 19 percent combined sulfur.

D. Soil sulfur shall contain 99 percent combined sulfur.

E. Soil Binder:

1. Soil binder shall be a physllium based, organic compound derived from natural plant sources. Binder shall consist of an active hydrophilic colloid, which will hydrate with water and, upon drying after application, will tack hydrospray mix to soil surface.

2. Binder shall be nontoxic and contain no growth or germination inhibitors.

3. Binder shall be R-2400 by Reclamare Co. 206/824-2385, Sentinel from Albright Seed Co. 805/484-0551, Ecology M-Binder, or equal.

F. Herbicide shall be Roundup® by Monsanto Company or equal.

G. Fertilizer application rates shall be based on results of agronomic soil testing section 104.A.1.

PART 3 - EXECUTION

3.01 DELIVERY OF AMENDMENTS AND FERTILIZERS:

A. Deliver amendments and fertilizers in sacks with manufacturer's label showing weight and analysis attached to each sack. The Contracting Officer will review amendments and fertilizers prior to hydroseeding.

3.02 LANDSCAPE GRADING:

A. Bring planting areas to grade by filling or removing surplus dirt. Final grades shall be uniform and smooth in nonturf areas. Topsoil shall be a minimum of 4 inches below adjacent hardscape. Areas shall slope to drain.

B. Remove rock debris over 1 inch in diameter.

C. Topsoil shall be scarified to a depth of 4 inches inches prior to seeding.

3.03 IRRIGATION:

A. Irrigation system shall be installed per Section 02813,

3.04 WEED AND INVASIVE SPECIES ABATEMENT:

A. After establishment of grades and installation of irrigation system and prior to hydroseeding, cut weeds and grasses to ground. Remove from site. Do not drag cut materials.

B. Apply 150 pounds per acre of urea fertilizer and irrigate several times per day for a minimum of two weeks to germinate weed seeds.

C. Following germination, a licensed pest control applicator shall spray a postemergent weed killer, Roundup® or equal, per manufacturer's directions in hydroseed areas.

D. Wait a minimum of one week for dissipation. Remove residual foliage.

3.05 HYDROSEEDING:

A. Hydroseed the locations indicated in the drawings and where the native vegetation has been destroyed by construction or grading operations. Hydroseed excavation and fill areas.

B. Prior to hydroseeding, all other work in areas to be hydroseeded shall be complete (i.e., grading, irrigation, other plant installations, etc.).

C. Application:

1. Measure the site and stake to identify the areas to be sprayed by each truckload of mix.

2. Water the area to be hydroseeded for three consecutive days prior to or until the upper 2 inches of soil are wet. Let the top 1/4-inch of soil dry out, leaving some residual moisture in the soil below.

3. Apply the hydroseed in the form of a slurry consisting of fiber mulch, seed, soil binder, soil conditioners, fertilizer, and water. When hydraulically sprayed on the soil surface, the mix shall form a blotter-like ground cover impregnated uniformly with seed and fertilizer and shall allow moisture to percolate to the underlying soil.

4. Hydroseed in the time period between March 15 to June 15 and August 15 to October 15. Repeat in accordance with warranty, water permit, local and/or state regulations, State of Connecticut Department of Transportation criteria, and/or warranty as required.

D. Hydroseed Slurry Mixture:

Seed Mix:	
Fiber mulch	2,000 lbs per acre
Slow-release fertilizer:	
20-10-5	200 lbs per acre
0-18-0 single super-phosphate	150 lbs per acre
Agricultural gypsum	500 lbs per acre
Soil sulfur	100 lbs per acre
Soil binder	100 lbs per acre

E. Mix the soil binder at the rate of 60 pounds of concentrate mixed with 1,500 gallons of water.

F. Equipment:

1. Use an agitator mixer for the application of the slurry. This equipment shall have a built-in agitation system and operating capacity sufficient to agitate, suspend, and homogeneously mix a slurry containing not less than 82 pounds pounds of cellulose fiber mulch, plus a combined total of 15 pounds pounds of fertilizer solids for each 100 gallons of water.

2. The slurry distribution hose lines shall be large enough to prevent stoppage and shall be equipped with a set of hydraulic spray nozzles that will provide a continuous nonfluctuating discharge. Mount slurry tank on a traveling unit.

3.06 GEOTEXTILE AND STABILIZATION FABRIC

A. Install as specified in accordance with water permit, design plans, and/or wetland/stream restoration plan.

3.07 STRAW TACK:

A. After the hydroseed application, spread straw uniformly over the hydroseed area at the rate of 3 tons per acre.

B. Apply hydromulch over straw.

3.08 HYDROMULCHING:

A. Hydromulching application shall be similar to hydroseeding as far as equipment and procedures.

B. Apply hydromulch over hydroseed or straw.

C. Hydromulch slurry mix shall be as follows:

1. Fiber Mulch: 200 lbs per acre.

2. Soil Binder: 50 lbs per acre.

D. Mix soil binder at the rate of 30 pounds of concentrate mixed with 1,500 gallons of water.

3.09 MAINTENANCE:

A. Maintenance work shall include the following plant establishment work:

1. Maintain the entire project for a minimum period of 90 calendar days**,** commencing from the time all contract work items have been completed to the satisfaction of the Contracting Officer and evidence of such satisfaction has been received in writing.

2. Rehydroseed planting areas that do not show a prompt establishment of plant material at 10-day intervals.

B. Repair damage to hydroseeded areas immediately and throughout the maintenance period. Rehydroseed immediately after repairs are finished.

1. Fill and level depressions caused by vehicles or foot traffic.

2. Exterminate gophers and moles and repair damage as above.

3. Fill rills and gullies caused by erosion.

C. Remove obvious undesirable and/or invasive plants (such as noxious weeds, thistle, etc.) that have grown in with the hydroseed mix.

D. Keep watering basins of container stock planted in hydroseed area free of hydroseeded plants that overgrow container stock.

E. Maintain site in a neat and clean condition. Remove debris and trash from the site weekly.

END OF SECTION

DIVISION 3

CONCRETE

SECTION 03100

CONCRETE FORMWORK

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide design and furnish materials for fabricating, erecting and removing formwork, false work and shoring for cast-in-place concrete as shown on the contract drawings and specified herein for a complete installation.

B. Use formwork to cast all cast-in-place concrete structures.

C. Provide and remove all formwork for electrical work as shown on the drawings or specified under electrical work.

1.02 REFERENCES:

A. American Concrete Institute (ACI):

1. 117/117R: Standard Tolerances for Concrete Construction and Materials.

2. 309.2R: Identification and Control of Visible Effects of Consolidation on Formed Concrete Surfaces.

3. 318/318R: Building Code Requirements for Structural Concrete and Commentary.

4. 347: Guide to Formwork for Concrete.

5. 350/350R: Code Requirements for Environmental Concrete Structures and Commentary.

B. National Sanitation Foundation (NSF):

1. 61: Drinking Water System Components – Health Effects

C. Engineered Wood Association (APA)

D. National Institute of. Product Standards and Technology

1. Voluntary Product Standard PS 1 Structural Plywood

1.03 DESIGN REQUIREMENTS:

A. Design formwork in conformance with methodology of ACI 347R for anticipated loads, lateral pressures, depth of concrete placement and rate of concrete placement. Design shall consider any special requirements due to the use of self-consolidating, plasticized

and/or retarded set concrete. All forms and shoring shall be designed at the contractor's expense.

1.04 QUALIFICATIONS:

A. Formwork Designer: Formwork, false work, and shoring design shall be by an engineer licensed in the state where the Project is located.

1.05 SUBMITTALS:

A. Submit product data for form ties, spreaders, chamfer strips, rustication strips, form liners, form coatings, and bond breakers.

B. Submit following shop drawings in accordance with 01300.

1. Layout of panel joints and tie hole pattern for architectural formwork.

2. Form Ties: Submit data sheets for form ties proposed for use.

3. Form Ties-Tapered Through-Bolts: Proposed method of sealing and patching form tie holes.

4. ANSI/NSF 61 Certification that form release agents proposed for use in structures to contain potable water are non-toxic and have no adverse effect on the quality or appearance of potable water.

1.06 QUALITY ASSURANCE:

A. Comply with requirements in section 01400 and as specified.

B. Design of Formwork:

1. The Contractor shall assume responsibility for the design, engineering and construction of formwork. Forms shall be designed to produce concrete members identical in shape, lines and dimensions to members shown on the Contract Documents.

2. When high range water reducer (superplasticizer) is used in concrete mix or when self-consolidated concrete is specified, forms shall be designed for full hydrostatic pressure per ACI 347.

3. The formwork shall be designed for the loads and lateral pressures in accordance with ACI 347 and wind loads as specified by the local building code.

4. Construction and contraction joints, openings, offsets, keyways, recesses, moldings, chamfers, blocking, screeds, bulkheads, waterstops, anchorages, inserts, and other features shall be provided.

5. Formwork shall be designed to be readily removable without impact, shock, or damage to 'green' concrete surfaces and adjacent materials.

6. The maximum panel deflection shall be 1/360 of the span between structural members.

C. Unless otherwise specified herein, formwork shall be constructed so that the concrete surfaces will conform to the tolerance limits as given in ACI 117.

D. Materials, fabrications and workmanship found defective shall be promptly removed and replaced and new acceptable work shall be provided in accordance with Contract requirements at no additional cost to the Contracting Officer.

1.07 DELIVERY, STORAGE AND HANDLING:

A. Comply with the requirements in section 01610.

B. Materials shall be delivered to the site in an undamaged condition and at such intervals as will avoid delay in the work.

C. Material shall be stored and protected in a clean, properly drained location. Material shall be kept off the ground under a weather-tight covering permitting good air circulation. Formwork materials shall be stored on dry wood sleepers, pallets, platforms or other appropriate supports which have slope for positive drainage. Materials shall be protected from distortion, excessive stresses, corrosion and other damage. Materials shall not be stored on the structure in a manner that might cause distortion or damage to the supporting structure.

PART 2 - PRODUCTS

2.01 LUMBER:

A. Lumber used in form construction shall be Douglas fir, No. 2 grade, S4S, Standard Grading and Dressing Rules No. 16, West Coast Lumber Inspection Bureau; or Southern Yellow Pine, No. 2, S4S, Standard Grade Rules Southern Pine Inspection Bureau. Boards shall be 6 inches or more in width.

2.02 PLYWOOD:

A. Only grade-marked plywood conforming to APA shall be provided.

B. Plywood used in form construction shall be Grade B-B, Class 1 plyform, mill-oiled, and sanded on both sides in conformance with U.S. Product Standard PS 1 Structural Plywood.

C. Thickness shall be sized to maintain alignment and surface smoothness, but not less than 5/8-inch (16 mm) thick.

2.03 STEEL FORMS:

A. Commercial grade sheets not less than 16 gage shall be provided.

B. Stock material that is free from warps, bends, kinks, cracks, and rust or other matter that could stain the concrete shall be provided.

2.04 FORM MATERIAL LOCATIONS:

A. Wall Forms and Underside of Slabs and Beams:

1. Materials: Plywood, hard plastic finished plywood or steel in new and undamaged condition, of sufficient strength and surface smoothness to produce specified finish.

B. Column Forms:

1. Rectangular Columns: As specified for walls.

2. Circular Columns: Fabricated steel or fiber reinforced plastic with bolted together sections or spirally wound laminated fiber form internally treated with release agent for height of column.

C. All Other Forms: Materials as specified for wall forms.

D. Rustication Grooves and Chamfer Strips: Nonabsorbent material, compatible with form surface, fully sealed on all sides prohibiting loss of paste or water between the two surfaces.

2.05 FORM TIES:

A. Locate form ties on exposed surfaces in a uniform pattern. Place form ties so they remain embedded in the concrete except for a removable portion at each end. Form ties shall have conical or spherical type inserts with a maximum diameter of 1 inch (25.4 mm). Construct form ties so that no metal is within 1-1/2 inch (38.1 mm) of the concrete surface when the forms, inserts, and tie ends are removed. Do not use wire ties. Ties shall withstand all pressures and maintain forms within acceptable deflection limits.

B. Flat bar ties shall not be used.

C. Tapered form ties shall be tapered through-bolts or through-bolts that utilize a removable tapered sleeve.

D. Water Stop Ties: For water-holding structures, basements, pipe galleries, and accessible spaces below finish grade, furnish one of the following:

1. Integral steel water stop 0.103 inch (2.6 mm) thick and 0.625 inch (16 mm) in diameter tightly and continuously welded to tie.

2. Neoprene water stop 3/16-inch (4.8 mm) thick and 15/16 inch (23.8 mm) diameter whose center hole is one-half diameter of tie, or molded plastic water stop of comparable size.

E. Elastic Vinyl Plug:

1. Design and size of plug shall allow insertion with tool to enable plug to elongate and return to original length and diameter upon removal forming watertight seal.

2. Manufacturer:

a. Dayton Superior; A58 Sure Plug.

b. Or acceptable equivalent product.

E. Mechanical EPDM Rubber Plug:

3. Mechanical plug for taper tie

4. Manufacturers:

a. Sika Greenstreak, St. Louis, MO; X-Plug

b. Or acceptable equivalent product.

5. Friction fit plugs will not be allowed.

2.06 BOND BREAKER:

A. Bond breaker shall be a V.O.C.-compliant nonstaining type that will provide positive bond prevention.

B. Manufacturers:

1. Edoco Burke; Clean Lift 90 W.B..

2. Nox-Crete, Inc.; Silcoseal 97EC.

3. Or acceptable equivalent product.

2.07 CHAMFER STRIPS:

A. Provide 3/4 inch by 3/4-inch (19.1 mm by 19.1 mm) chamfer strips milled from clear, straight-grain pine, surfaced each side or extruded vinyl type with or without nailing flange unless otherwise shown on the Contract Documents.

2.08 INSERTS:

A. Provide galvanized cast steel or galvanized welded steel inserts, complete with anchors to concrete and fittings such as bolts, wedges and straps.

2.09 FORM RELEASE AGENT:

A. Form release agent shall not bond with, stain, or adversely affect concrete surfaces and shall not impair subsequent treatments of concrete surfaces. Form release agent shall be a ready-to-use water-based material formulated to reduce or eliminate surface imperfections and containing no mineral oil or organic solvents.

B. Certified as meeting the requirement of ANSI/NSF 61 for contact with potable water.

C. Manufacturers and Products:

1. BASF; MBT, Rheofinish 211.

2. Cresset Chemical Company; Crete-Lease 20-VOC.

3. Unitex Chemicals; Farm Fresh.

4. Symons Corporation: Magic Kote

5. Or acceptable equivalent product.

PART 3 - EXECUTION

3.01 FORM TOLERANCES:

A. Comply with the requirements of ACI 117 for tolerances for formed surfaces except as specified in Table 03100-1.

Table 03100-1	
Vertical alignment (plumbness)	1/4-inch (6 mm) in any 10 feet (3 meters) and 1-inch (25 mm) maximum for entire length
Variation in the lines and surfaces of foundation mats, base slabs and walls	1/4-inch (6 mm) in any 10 feet (3 meters) and 1-inch (25 mm) max. for entire length
Variation from the level or from the grades indicated on the drawings	1/4-inch (6 mm) in any 10 feet (3 meters)
Variation of the linear building lines from established position in plan	1/2-inch (13 mm) in any 20 feet (6 meters) and 1-inch (25 mm) maximum for entire length
Variation of distance between walls	1/4-inch (6 mm) in any 10 feet (3 meters) and 1-inch (25 mm) maximum for entire

	length and height
Variation in the sizes and locations of sleeves, floor openings and wall openings	Minus 1/4-inch (6 mm) . Plus 1/2-inch (13 mm) .
Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls	Minus 1/4-inch (6 mm) . Plus 1/2-inch (13 mm) .
Offset between adjacent panels of formwork facing material	1/2-inch (13 mm) (ACI 117 Class C finish).
Offset between adjacent panels of formwork facing material for exposed surfaces where appearance is of importance	1/8-inch (3 mm) (ACI 117 Class A finish).

B. Tolerances are not cumulative

C. Where equipment is to be installed, comply with manufacturer's tolerances if more restrictive than above.

D. Failure of the forms to produce the specified concrete surface and surface tolerance shall be grounds for rejection of the concrete work. Rejected work shall be repaired or replaced at no additional cost to the Contracting Officer.

3.02 PREPARATION:

A. Clean form surfaces to be in contact with concrete of foreign material prior to installation. Tape, gasket, plug, and/or caulk joints, gaps, and apertures in forms so that the joint will remain watertight and withstand placing pressures without bulging outward or creating surface irregularities.

B. Coat form surfaces in contact with concrete with a form release agent prior to form installation.

C. Keep form coatings off steel reinforcement, items to be embedded, and previously placed concrete.

D. Steel Forms: Apply form release agent to steel forms as soon as they are cleaned to prevent discoloration of concrete from rust.

E. Form liners for architectural concrete finish shall be installed in accordance with the manufacturer’s recommendations.

3.03 ERECTION AND INSTALLATION:

A. Forms shall be constructed in accordance with ACI 347 to required dimensions, plumb, straight and mortar tight. Forms shall be substantial, properly braced, and tied together to maintain position and shape and to resist all pressures to which they may be subject. Unless otherwise indicated on the Contract Documents, formwork shall be constructed

so that the concrete surfaces will conform to the tolerance limits in ACI 117 and herein specified.

B. Provide means for holding adjacent edges and ends of form panels tight and in accurate alignment to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete.

C. Provide one cleanout and inspection opening 12 inches wide by 18 inches high (305 mm wide by 450 mm high) every 7 feet (2130 mm) at the bottom of each lift of forms.

D. Provide exterior corners of concrete members with chamfers as specified.

E. Provide means for removing forms without injury to the surface of finished concrete.

F. Do not embed any form-tying device or part thereof other than metal in the concrete.

G. Locate large end of taper tie on the "wet" side of the wall.

H. Use only form or form-tying methods that do not cause spalling of the concrete upon form stripping or tie removal.

I. Form surfaces of concrete members except where placement of the concrete against the ground is shown in the drawings or as indicated below. The dimensions of concrete members shown in the drawings apply to formed surfaces, except where otherwise indicated. Add 2 inches (50.8 mm) of concrete where concrete is placed against trimmed undisturbed ground in lieu of forms. Placement of concrete against the ground shall be limited to footings and other nonexposed concrete and only where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing.

J. Provide openings with continuous keyways and water stops. Provide a slight flare to facilitate grouting and the escape of entrained air during grouting. Provide formed openings with additional reinforcement as shown in the typical structural details. Reinforcing shall be at least 2 inches (50.8 mm) clear from the opening surfaces and encased items.

K. Set anchor bolts and other embedded items accurately before placing concrete and hold securely in position until the concrete is placed and set. Check special castings, channels, or other metal parts that are to be embedded in the concrete prior to and again after placing concrete. Check nailing blocks, plugs, and strips necessary for the attachment of trim, finish, and similar work prior to placing concrete.

3.04 PROTECTION:

A. During installation, the forms shall not be used as a storage platform nor as a working platform until the forms have been permanently fastened in position.

3.05 PIPES AND WALL CASTINGS CAST IN CONCRETE:

A. Install wall castings, wall flanges, and wall anchors before placing concrete. Do not weld, tie, or otherwise connect the wall castings or anchors to the reinforcing steel.

B. Pipes or wall castings located below operating water level shall have water stop ring collars and shall be cast in place. Do not block out such piping and grout after the concrete section is cast unless permitted, authorized or directed by the Contracting Officer. Pipes fitted with thrust rings shall be cast in place.

3.06 REMOVAL OF FORMS:

A. Forms shall be removed in accordance with ACI 347 recommendations without damage to concrete and in a manner to ensure complete safety to the structure. Forms, form ties and bracing shall not be removed without specific permission of the Contractor's Registered Professional Contracting Officer.

B. The following table indicates the minimum allowable time after the last cast concrete is placed before forms, shoring, or wall bracing may be removed; during which the air surrounding the concrete is above 50 degrees F (10 degrees C).

Table 03100-2	
Sides of footings and encasements, walls, vertical sides of slabs, beams, girders, columns, and similar members not supporting loads	24 hours
Bottom forms of slabs, beams, and girders and shoring for slabs, beams, and girders with immediate reshoring	10 days or until concrete strength reaches 70 percent specified 28-day strength

C. Removal times will be increased if the concrete temperature following placement is permitted to drop below 50 degrees F (10 degrees C).

D. Do not remove supports and reshore.

3.07 PATCHING OF TAPERED TIE HOLES:

A. Clear tie hole of all loose debris with a taper tie void brush and flush debris from tie hole with air or water.

B. Install plug from larger tie hole end in accordance with manufacturer’s instructions using an insertion tool as recommended by the manufacturer.

C. Fill each side of hole with mortar. Apply mortar to the "wet" side of the wall first. Consolidate mortar solidly into the hole.

3.08 CLOSEOUT:ACTIVITIES:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 03200

REINFORCEMENT BARS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide concrete reinforcement as indicated and in compliance with Contract Documents:

1. Section Includes:

a. Reinforcement bars.

b. Welded wire reinforcement.

c. Reinforcement accessories.

1.02 REFERENCES:

A. ASTM International (ASTM):

1. A82: Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

2. A184: Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.

3. A185/A185M: Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.

4. A370: Standard Test Methods and Definitions for Mechanical Testing of Steel Products

5. A496: Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.

6. A497: Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete Reinforcement.

7. A555: Standard Specification for General Requirements for Stainless Steel Wire and Wire Rods.

8. A615: Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

9. A616: Standard Specification for Rail-Steel Deformed and Plain Bars for Concrete Reinforcement.

10. A617: Standard Specification for Axle-Steel Deformed and Plain Bars for Concrete Reinforcement.

11. A704/A704M: Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement

12. A706: Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.

13. A767: Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.

14. A775: Standard Specification for Epoxy-Coated Reinforcement Steel Bars.

15. A884: Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.

16. A955/A955M: Standard Specification for Deformed and Plain Stainless Steel Bars for Concrete Reinforcement.

B. American Concrete Institute (ACI):

1. 301: Standard Specification for Structural Concrete.

2. 315: Details and Detailing of Concrete Reinforcement.

3. 318: Building Code Requirements for Structural Concrete.

4. 350: Building Code Requirements for Environmental Engineering Concrete Structures

5. SP-66: ACI Detailing Manual.

C. Concrete Reinforcing Steel Institute (CRSI):

1. Manual of Standard Practice.

2. Placing Reinforcing Bars.

D. American Welding Society (AWS):

1. D1.4: Structural Welding Code, Reinforcement Steel.

E. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

1.03 SUBMITTALS:

A. Unless otherwise acceptable to the Contracting Officer, each submittal shall include reinforcement only for the individual structure to which it pertains.

B. Shop Drawings:

1. Submit bar lists and placing drawings for all reinforced concrete and masonry structures in accordance with Section 01300.

2. Detail reinforcement in conformance with ACI SP-66.

3. Clearly indicate bar sizes, spacings, locations and quantities of reinforcement steel and wire reinforcement, bending schedules, and supporting and spacing devices. Show joints, with applicable joint reinforcement.

4. Coordinate bar splicing and placement with Contractor’s concrete placing schedule and joint locations. Do not add or delete joints without permission from the Contracting Officer.

5. Show wall reinforcement in elevation.

6. Show slab reinforcement in plan view.

7. Show location and size of all penetrations greater than 12-inches (300 mm) in diameter or least dimension of the opening with the corresponding added reinforcement around the penetrations.

8. Clearly show marking for each reinforcement item.

9. Indicate locations of reinforcement bar cut-offs, splices and development lengths.

C. Where mechanical couplers are required or permitted to be used to splice reinforcement steel, submit Manufacturer's literature that contains instructions and recommendations for installation for each type of coupler used; certified test reports that verify the load capacity of each type and size of coupler used; and Shop Drawings that show the location of each coupler with details of how they are to be installed in the formwork.

1.04 QUALITY ASSURANCE:

A. Comply with requirements in Section 01600 and as specified.

B. Do not fabricate reinforcement until shop and placement drawings have been reviewed and accepted by the Contracting Officer.

C. Perform concrete reinforcement work in accordance with ACI 301, and ACI 350/350M.

D. An independent testing agency shall be retained by Contractor and accepted by Contracting Officer to visually inspect and test reinforcing steel welds in accordance with AWS D1.4/D1.4M.

1.05 QUALIFICATIONS:

A. Welders: AWS qualified within previous 12 months.

1.06 INSPECTION AND TESTING:

A. In no case shall any reinforcement steel be covered with concrete until the installation of the reinforcement has been observed by the Contracting Officer and local building inspector and the Contracting Officer's and local building inspector's authorization to proceed with the concreting has been obtained. The Contracting Officer and local building inspector shall be given 48 hours minimum prior notice of the readiness of placed reinforcement for observation. The forms shall be kept open until the Contracting Officer and local building inspector has finished observations of the reinforcement steel.

1.07 DELIVERY STORAGE AND HANDLING:

A. Comply with the requirements in Section 01610.

B. Keep reinforcement steel free from mill scale, rust, dirt, grease or other foreign matter.

C. Ship and store reinforcement steel with bars of the same size and shape fastened in bundles with durable tags, marked in a legible manner with waterproof markings showing the same "mark" designations as those shown on the submitted placing drawings.

D. Store reinforcement steel off the ground, protected from moisture and kept free from dirt, oil or other injurious contaminants.

E. Provide equipment for handling epoxy coated reinforcement steel with protected contact areas. Lift bundles of coated reinforcement at multiple pick-up points to minimize bar to bar abrasion from sags in bundles. Do not drop or drag coated reinforcement steel or bundles.

F. Store coated reinforcement steel on protective cribbing.

G. Coating damage due to handling, shipment and placing need not be repaired in cases where damaged area is 0.1 sq. inch (65 sq. mm) or smaller. Repair damaged areas larger than 0.1 sq. inch (65 sq. mm). Maximum amount of damage, including repaired and unrepaired areas, shall not exceed 2 percent of surface area of each bar.

1.08 EPOXY COATING REBARS:

A. Provide equipment for handling epoxy coated reinforcement steel with protected contact areas. Lift bundles of coated reinforcement at multiple pick-up points to minimize bar to

bar abrasion from sags in bundles. Do not drop or drag coated reinforcement steel or bundles.

B. Store coated reinforcement steel on protective cribbing.

C. Coating damage due to handling, shipment and placing need not be repaired in cases where damaged area is 0.1 sq. inch (65 sq. mm) or smaller. Repair damaged areas larger than 0.1 sq. inch (65 sq. mm). Maximum amount of damage, including repaired and unrepaired areas, shall not exceed 2 percent of surface area of each bar.

PART 2 - PRODUCTS

2.01 REINFORCEMENT STEEL:

A. Reinforcement Steel: ASTM A615/A615M, 60 ksi (420 MPa) yield grade; deformed billet steel bars, unfinished finish.

B. Welded Steel Wire Fabric: ASTM A185/A185M. Provide in flat sheets only. Rolls are not acceptable.

C. Epoxy Coated Reinforcement Steel: Deformed bars conforming to ASTM A615, Grade 60 (420 MPa), with epoxy coating in accordance with ASTM A775.

D. Reinforcement Steel Plain Bar and Rod Mats: ASTM A704/A704M, ASTM A615/A615M, Grade 60 (420MPa); steel bars or rods, unfinished.

E. Spiral reinforcement shall be cold-drawn steel wire conforming to the requirements of ASTM A82.

F. Welded Wire Reinforcement:

1. Provide welded wire reinforcement conforming to ASTM A185 in flat sheets.

2. Provide deformed welded wire reinforcement to ASTM A497 in flat sheets.

3. Provide support bars and reinforcement bar supports as specified herein to obtain the concrete cover indicated.

4. Provide welded wire reinforcement heavier than W2.9 in flat sheets.

2.02 ACCESSORY MATERIALS:

A. Tie Wire: Minimum 16 gage annealed type.

B. Chairs, Bolsters, Bar Supports, and Spacers: sized and shaped for strength and support of reinforcement during concrete placement including load bearing pad on bottom of base slabs and slabs on grade to prevent puncturing the vapor retarder.

C. Special Chairs, Bolsters, Bar Supports, and Spacers Adjacent to Weather Exposed Concrete Surfaces: plastic coated steel type; size and shape.

D. Use wire reinforcement supports coated with dielectric material including epoxy or other polymer for a minimum distance of 2 inches (51 mm) from the point of contact with epoxy-coated reinforcement.

E. Provide 3-inch (75 mm) by 3-inch (75 mm) plain precast concrete blocks, precast concrete doweled blocks or concrete brick for support of bottom reinforcement in foundation mats, base slabs, footings, pile caps, grade beams and slabs on grade. Provide block thickness to produce concrete cover of reinforcement as indicated.

F. Mechanical Couplers

1. Use of mechanical couplers is subject to the approval of the Contracting Officer.

2. Reinforcement Tension Bar Splicers:

a. Manufacturers: Cadweld or Lenton rebar splicers by Erico Products, Inc. and Dayton Barsplice, Inc.

b. Manufacturers: DB-SAE splicer system by Richmond Screw Anchor Company, Inc., C2D rebar flange coupler by Williams Form Engineering Corporation and Lenton Form Saver by Erico Products, Inc.

c. Develop minimum 125 percent of yield capacity of bars spliced in tension when tested as assembly in accordance with ASTM A370 and A615.

G. Reinforcement Compression Bar Splicers:

1. Manufacturers: G-Loc splicers by Gateway Building Products Division and Speed-Sleeve by Erico Products, Inc.

H. Provide epoxy for grouting reinforcement bars specifically formulated for such application for the moisture condition, application temperature, and orientation of the hole to be filled. Epoxy grout shall meet the requirements in Section 03600 Grout.

2.03 FABRICATION:

A. Fabricate concrete reinforcement in accordance with ACI 350.

B. Weld reinforcement in accordance with AWS D1.4 only when permitted by the Contracting Officer.

C. Epoxy Coated Reinforcement: Clean surfaces, weld and re-protect welded joint in accordance with Manufacturer's instructions.

D. Locate reinforcement splices not indicated on Drawings, at point of minimum stress. Review location of splices with Contracting Officer.

E. Cold bend bars. Do not straighten or rebend bars.

F. When bending, apply slow, steady pressure. Replace bars that develop cracks or splits.

G. Do not heat reinforcement steel to bend or straighten.

H. Bend bars around a revolving collar having a diameter of not less than that recommended by ACI 350.

I. Cut bar ends that are to be butt spliced, or threaded by saw cutting. Terminate such ends in flat surfaces within 1-1/2 degrees of a right angle to the axis of the bar.

J. Apply epoxy coating to the deformed reinforcement bars under the following guidelines:

1. Shop bend reinforcement before coating.

2. Maintain thickness of the coating at 7 mil +/- 2 mil (0.175 mm +/- 0.050 mm).

3. Blast clean bars to near white metal before coating.

4. Clean and coat cut ends.

5. Patch damaged areas immediately before visible rust has formed. Patch at the fabrication plant.

6. Provide coatings free from holes, voids, contamination, cracks and damaged areas. Check coatings visually after curing.

7. Not more than two "holidays" (pinholes not visible to the naked eye) per 12 inch (300 mm) of bar are allowed in the coatings. Test coatings with a 67.5 volt holiday detector in accordance with the Manufacturer's instructions.

8. Check each production lot and certify that all the coated bars are supplied in the fully cured condition.

9. Evaluate the flexibility of the coating by selecting bars from production lots bent 120 degrees (after rebound) around a 6 inch (150 mm) diameter mandrel. Make the bend at a uniform rate in not more than one minute. The longitudinal deformations may be placed in a plane perpendicular to the mandrel radius, and the test specimens shall be at a constant temperature between 70 degrees F (20 degrees C) and 85 degrees F (30 degrees C) throughout the bend test.

10. If no cracks in the coating of the bent specimen are visible to the naked eye the coating is satisfactory.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Place, support and secure reinforcement against displacement. Do not deviate from required position. Place reinforcement a minimum of 2 inches (51 mm) clear of any metal pipe or fittings.

B. Do not displace or damage vapor retarder.

C. Position dowels accurately. Rigidly support, align and securely tie dowels normal to the concrete surface before concrete placement. Setting dowels into wet concrete is prohibited.

D. Position wall dowels projecting from base slabs on grade with templates or guides held in place above the concrete placement line. Position the templates to obtain the required clearance between the dowels and the face of the walls.

E. Bars additional to those indicated that may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position shall be provided by the Contractor at no additional cost to the Contracting Officer.

F. Do not extend continuous reinforcement or other fixed metal items through expansion joints. Provide 2 inches (51 mm) clearance from each face of expansion joint.

G. Provide additional reinforcement bars to support top reinforcement in slabs. Do not shift reinforcement bars from positions in upper layers to positions in lower layers as a substitute for additional support bars.

H. Support and tie reinforcement steel in accordance with CRSI “Placing Reinforcement Bars” with maximum spacing of 4 feet-0 inches (1200 mm).

I. Tie reinforcement steel at intersections in accordance with CRSI “Placing Reinforcement Bars”:

1. Maximum tie spacing for footings, walls and columns: every third intersection or 3 feet-0 inches (1,000 mm).

2. Maximum spacing for slabs and other work: every fourth intersection or 3 feet-0 inches (1,000 mm).

3. Tie a minimum of 25 percent of all intersecting bars in foundation mats, base slabs, footings, pile caps, slabs on grade and elevated slabs.

4. Secure all dowels in place before placing concrete.

5. Tie wires shall be bent away from the forms and from finished concrete surfaces in order to provide the required concrete coverage.

J. Locate reinforcement to avoid interference with items drilled in later, such as concrete anchors.

3.02 WELDED WIRE REINFORCEMENT:Extend welded wire reinforcement to within 2 inches (50 mm) of edges of slab or section. Lap sheets at least 12 inches (300 mm) or two wire spaces, whichever is greater, at ends and edges and wire tightly together. Stagger end laps.

B. Unless shown otherwise on Drawings, place welded wire reinforcement in slabs on grade between the upper third point and mid-point of slab. Placing welded wire reinforcement on the subgrade and pulling it up during concrete placement is not permitted.

C. Support welded wire reinforcement placed over the ground on wired concrete blocks (dobies) spaced not more than 3 feet (900 mm) on centers in any direction.

D. Support welded wire reinforcement placed over horizontal forms on slab bolsters spaced not more than 30 inches (750 mm) on center.

E. Mechanical coupler systems may be substituted for dowels at Contractor's option when permitted by Contracting Officer.

F. Provide additional reinforcement bars to support ties and stirrups in beams where top reinforcement is not continuous.

G. Securely support and tie reinforcement steel to prevent movement during concrete placement.

H. Ship, handle and place stainless steel reinforcement bars such that they do not come into direct contact with carbon steel. Use stainless steel or non-metallic tie wires and bar chairs. Use nylon, PVC, or polyethylene spacers where stainless steel bar must be attached to carbon steel, to maintain a minimum 1 inch clearance.

I. Unless otherwise shown on the Drawings or permitted by the Contracting Officer, do not bend reinforcement bars that project from in-place concrete.

J. Do not weld reinforcement steel bars (including tack welded) either during fabrication or erection unless specifically shown on the Drawings or specified herein, or unless prior written permission has been obtained from the Contracting Officer. Immediately remove bars that have been welded, including tack welds, without such permission from the work. Comply with AWS D1.4 when welding of reinforcement is or called for.

K. Reinforcement steel interfering with the location of other reinforcement steel, conduits or embedded items may be moved within the specified tolerances or one bar diameter, whichever is greater. Make greater displacement of bars to avoid interference only with the permission of the Contracting Officer. Do not cut reinforcement to install inserts, conduits, mechanical openings or other items without the prior permission from the Contracting Officer.

L. Reinforcement shall be clean and free from loose mill scale, dirt, grease, oil, form release agent, dried concrete or any material reducing bond with concrete.

M. Setting bars and welded wire reinforcement on layers of fresh concrete as the work progresses or adjusting reinforcement during the placement of concrete is prohibited.

N. Provide and place safety caps on all exposed ends of vertical reinforcement that pose a danger to injury or life safety.

3.03 CONCRETE COVER OVER REINFORCEMENT BARS:

A. Conform to ACI 350 and drawings for concrete cover over reinforcement.

3.04 REINFORCEMENT AROUND OPENINGS AND PENETRATIONS:

A. Accommodate placement of formed openings and penetrations.

B. Unless specific additional reinforcement around openings and penetrations is shown on the Drawings, provide additional reinforcement steel on each side of opening or penetration equivalent to one half of the cross-sectional area of the reinforcement steel interrupted by an opening or penetration. The bars shall have sufficient length to be fully developed at each end beyond the opening or penetration.

C. Refer to details on Drawings for additional diagonal bars around openings or penetrations and bar extension length on each side of openings or penetrations.

D. Where welded wire fabric is used provide extra reinforcement using fabric or deformed bars around opening or penetration.

3.05 SPLICING OF REINFORCEMENT:

A. Splices may be used to provide continuity due to bar length limitations. Minimum length of bars spliced for this reason is 40 feet (12 m). Do not splice reinforcement that is detailed to be continuous in the Drawings.

B. Stagger bar splices.

C. Provide tension lap splices at all laps in compliance with ACI 350. Class A splices may be used when 50 percent or less of the bars are spliced within the required lap length. Use Class B splices at all other locations.

D. Except as otherwise indicated on the Drawings, stagger splices in circumferential reinforcement in circular walls using Class B tension splices. Do not splice adjacent bars within the required lap length.

E. Make splices for reinforcement in tension tie members, with a full mechanical or full welded splice and staggered at least 30 inches (762 mm).

F. Make splices in column spiral reinforcement, when necessary, by a lap of 1-1/2 turns.

G. Make reinforcement continuous through construction joints.

H. Reinforcement may be spliced at construction joints provided that entire lap is placed within only one concrete placement.

3.06 ACCESSORIES:

A. Provide accessories such as chairs, chair bars and the like in sufficient quantities and strength to adequately support the reinforcement and prevent its displacement during the erection of the reinforcement and the placement of concrete.

B. Use precast concrete blocks where the reinforcement steel is to be supported over soil.

C. Provide stainless steel bar supports or steel chairs with plastic tips where the chairs are set on forms for a concrete surface that will be exposed to weather, high humidity or liquid (including bottom of slabs over liquid containing areas) unless otherwise noted on contract documents.

D. Do not use metal chairs, ferrous clips, nails, etc. that extend to the surfaces of the concrete. Do not use stones, brick or wood block supports.

E. Do not use alternate methods of supporting top steel in slabs, such as steel channels supported on the bottom steel or vertical reinforcement steel fastened to the bottom and top mats unless permitted by the Contracting Officer.

F. Mechanical Couplers:

1. Couplers that are located at a joint face can be a type that can be set either flush or recessed from the face as indicated.

2. Seal couplers during concrete placement to completely eliminate concrete or cement paste from entering.

3. Recess couplers intended for future connections a minimum of 1/2 inch (12 mm) from the concrete surface. After the concrete is placed, plug the coupler with plastic plugs that have an O-ring seal and the recess filled with sealant to prevent any contact with water or other corrosive materials.

4. Unless indicated otherwise, provide mechanical coupler spacing and size to match the spacing and size of the reinforcement indicated for the adjacent section.

3.07 PLACEMENT OF EPOXY COATED REINFORCEMENT:

A. Pad bundling bands and lift with strong backs or a platform bridge to prevent abrasion of bars by sagging in the bundles.

B. Do not be drop or drag bars or bundles.

C. Patch and touch up coated bars after placing. Do not place concrete until patching is reviewed by the Contracting Officer.

D. In systems for lifting, transporting and storing coated bars, pad areas in contact with the bars.

3.08 FIELD QUALITY CONTROL:

A. Remove reinforcement with kinks or bends not shown on shop or placement drawings. Remove such reinforcement from job site and replace with new fabricated steel. Do not field bend of reinforcement unless reinforcement is indicated or specified to be field bent.

B. Protect reinforcement from rusting, deforming, bending, kinking and other injury. Clean in-place reinforcement that has rusted, or been splattered with concrete using sand or water blasting prior to incorporation into the Work.

3.09 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide cast-in-place concrete as indicated and in compliance with Contract Documents.

1.02 REFERENCES:

A. American Concrete Institute (ACI):

1. 211.1: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete

2. 214R: Recommended Practice for Evaluation of Strength Test Results of Concrete

3. 301: Standard Specifications for Structural Concrete

4. 304R: Guide for Measuring, Mixing, Transporting and Placing Concrete

5. 304.2R: Placing Concrete by Pumping Methods

6. 305R: Hot Weather Concreting

7. 306R: Cold Weather Concreting

8. 308: Standard Practice for Curing Concrete

9. 309R: Guide for Consolidation of Concrete

10. 311.4R: Guide for Concrete Inspection

11. 318: Building Code Requirements for Structural Concrete

12. 350: Code Requirements For Environmental Engineering Concrete Structures

B. ASTM International (ASTM):

1. A123: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

2. A153: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

3. C31: Standard Practice for Making and Curing Concrete Test Specimens in the Field

4. C33: Standard Specification for Concrete Aggregates

5. C39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

6. C40: Standard Test Method for Organic Impurities in Fine Aggregates for Concrete

7. C42: Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

8. C87: Standard Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar

9. C88: Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

10. C94: Standard Specification for Ready-Mixed Concrete

11. C109: Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in or [50-mm] Cube Specimens)

12. C123: Standard Test Method for Lightweight Particles in Aggregate

13. C136: Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

14. C138: Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete

15. C143: Standard Test Method for Slump of Hydraulic Cement Concrete

16. C150: Standard Specification for Portland Cement

17. C157: Standard Test Method for Length Change of Hardened Hydraulic Cement, Mortar and Concrete

18. C171: Standard Specification for Sheet Materials for Curing Concrete

19. C172: Standard Practice for Sampling Freshly Mixed Concrete

20. C192: Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory

21. C231: Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

22. C260: Standard Specification for Air-Entraining Admixtures for Concrete

23. C289: Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method)

24. C295: Standard Guide for Petrographic Examination of Aggregates for Concrete

25. C309: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

26. C311: Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete

27. C494: Standard Specification for Chemical Admixtures for Concrete

28. C595: Standard Specification for Blended Hydraulic Cements

29. C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete

30. C881: Standard Test Method for Epoxy Resin Base Bonding Systems for Concrete

31. C882: Standard Test Method for Bond Strength of Epoxy Resin Systems Used with Concrete by Slant Shear

32. C989: Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars

33. C1017: Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete

34. C1064: Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete

35. C1107: Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

36. C1116: Standard Specification for Fiber Reinforced Concrete

37. C1240: Standard Specification for Silica Fume for Use as a Mineral Admixture in Hydraulic-Cement Concrete, Mortar, and Grout

38. D75: Standard Practice for Sampling Aggregates

39. E154: Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

40. E1745: Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs

41. E329: Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials used in Construction

C. American Association of State Highway and Transportation Officials (AASHTO):

1. M182: Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

D. American Water Works Association (AWWA)

1. D110: Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks

E. National Sanitation Foundation (NSF):

1. 61: Drinking Water System Components – Health Effects

F. State of Connecticut, Department of Public Health

1. Guidelines for the Design and Operation of Public Water System Treatment, Works, and Sources

1.03 SUBMITTALS:

A. Submit the following shop drawings in accordance with Section 01300.

B. Product Data:

1. Manufacturer's specifications and instructions including Material safety Data Sheets (MSDS) for admixtures and curing materials. Manufacturer’s certification of compatibility of all admixtures.

C. Shop Drawings:

1. Provide certificate that cement used complies with ASTM C150 and these specifications.

2. Provide certificates that aggregates comply with ASTM C33. Submit gradation analysis with concrete mix designs.

3. Provide certificate of compliance with these specifications from the manufacturer of the concrete admixtures.

4. For each formulation of concrete proposed, prepare mix designs in accordance with ACI 318, Chapters 4 and 5, except as modified herein. Submit mix design for review by the Contracting Officer at least 21 days before placing of any concrete.

5. Provide certificate that materials used in concrete mix design including admixtures and additives for concrete in potable water service complies in all respects with the requirements of the Stae of Connecticut, Department of Public Health, Guidelines for the Design and Operation of Public Water System Treatment, Works, and Sources, Chapter VI, Potable Water Storage Facilities for conformance with NSF Standards.

6. Provide proposed special procedures for protection of concrete under wet weather placement conditions.

7. Provide proposed special procedures for protection and curing of concrete under hot and cold weather conditions.

D. Test and Evaluation Reports

1. Provide results of drying shrinkage tests from trial concrete mixes by the Contractor's testing laboratory firm.

E. Manufacturers' Instructions

1. Provide epoxy bonding compound manufacturer's specific instructions for use. Provide manufacturer's data sheets as to suitability of product to meet job requirements with regard to surface, pot life, set time, vertical or horizontal application, and forming restrictions.

F. Field Quality Control Submittals

1. Provide delivery tickets for ready-mix concrete or weighmasters certificate per ASTM C94, including weights of cement and each size aggregate and amount of water added at the plant and record of pours. Record the amount of water added on the job on the delivery ticket. Water added at the plant shall account for moisture in both coarse and fine aggregate.

1.04 QUALITY ASSURANCE:

A. Provide in accordance with Section 01400.

B. Concrete will be tested as identified in the mix performance part of this specification which includes Paragraph 1.03.E, Paragraph 1.06.C “Trial Mixes”, Paragraph 1.06.D “Testing of Ready Mix Concrete” and Section 3.13 “Concrete Quality Assurance”.

C. Unless otherwise indicated, materials, workmanship, and practices shall conform to the following standards:

1. State of Connecticut Building Code, including supplements and ammendments.

2. ACI 301, "Structural Concrete for Buildings.”

3. ACI 318, "Building Code Requirements for Reinforced Concrete."

4. ACI 350, "Code Requirements For Environmental Engineering Concrete Structures."

5. ANSI/NSF 61, "Drinking Water System Components – Health Effects."

6. AWWA D110, "Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks".

D. Where provisions of pertinent codes and standards conflict with this specification, the more stringent provisions govern.

E. Concrete not meeting the minimum specified 28-day design strength shall be cause for rejection and removal from the work.

F. Perform concrete work in conformance with ACI 301 unless otherwise specified.

G. Do not use admixtures, including calcium chloride, which will cause accelerated setting of cement in concrete.

H. Do not place concrete until design mix, material tests and trial concrete batch mix compression test results are accepted by the Contracting Officer.

I. Employ an independent testing laboratory, acceptable to the Contracting Officer, to develop concrete mix designs and testing. Concrete testing shall be performed by an ACI Concrete Field Technician, Grade I or equivalent.

J. The Contractor shall employ an independent testing laboratory, acceptable to the Contracting Officer, to test conformity of materials to specifications. Concrete testing shall be performed by an ACI Concrete Field Technician, Grade I or equivalent. Allow free access to obtain test samples.

K. Methods of Sampling and Testing:

1. Fresh Concrete Sampling: ASTM C172

2. Specimen Preparation: ASTM C31

3. Compressive Strength: ASTM C39

4. Air Content: ASTM C231

5. Slump: ASTM C143

6. Temperature: ASTM C1064

7. Unit Weight: ASTM C138

8. Obtaining Drilled Cores: ASTM C42

9. Drying Shrinkage: ASTM C157

L. Acceptance of Structure: Acceptance of completed concrete work requires conformance with dimensional tolerances, appearance and strength as indicated or specified.

M. Hot weather concrete to conform to ACI 305R and as specified herein.

N. Cold weather concrete to conform to ACI 306R and as specified herein.

O. Reject concrete delivered to job site that exceeds the time limit or temperature limitations specified.

P. Do not place concrete in water or on frozen or uncompacted ground.

Q. Workability

1. Concrete shall be of such consistency and composition that it can be worked readily into the forms and around the reinforcement without excessive vibrating and without permitting the materials to segregate or free water to collect on the surface.

2. Concrete mix shall be designed to reflect the method of transportation to the project site.

3. Adjust the proportions to secure a plastic, cohesive mixture, and one that is within the specified slump range.

4. To avoid unnecessary changes in consistency, obtain the aggregate from a source with uniform quality, moisture content, and grading. Handle materials to minimize variations in moisture content that would interfere with production of concrete of the established degree of uniformity and slump.

1.05 DELIVERY, STORAGE, AND HANDLING:

A. Provide in conformance with Section 01610 and as specified herein.

B. Deliver concrete to discharge locations in watertight agitator or mixer trucks without altering the specified properties of water-cement ratio, slump, air entrainment, temperature and homogeneity.

C. Reject concrete not conforming to specification, unsuitable for placement, exceeding the time or temperature limitations or not having a complete delivery batch ticket.

1.06 SITE CONDITIONS:

A. Do not place concrete until conditions and facilities for making and curing control test specimens are in compliance with ASTM C31 and as specified herein.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Cement:

1. Portland Cement, ASTM C150, Type II.

2. Use only one brand of cement in any individual structure. Use no cement that has become damaged, partially set, lumpy, or caked. Reject the entire contents of the sack or container that contains such cement. Use no salvaged or reclaimed cement.

3. Maximum tricalcium aluminate shall not exceed 8 percent. The maximum percent alkalies shall not exceed 0.6 percent.

B. Fine Aggregates:

1. Clean, sharp, natural sand conforming to requirements of ASTM C33 with a fineness modulus between 2.50 and 3.0.

C. Coarse Aggregate:

1. Well graded crushed stone, natural rock conforming to requirements of ASTM C33.

2. Limit deleterious substances in accordance with ASTM C33, Table 3, Severe Weathering Regions, limit clay lumps not to exceed 1.0 percent by weight, and limit loss when tested for soundness using magnesium sulfate to 12 percent.

D. Water and Ice:

1. Use water and ice free from injurious amounts of oil, acid, alkali, salt, organic matter or other deleterious substances and conforms to requirements of ASTM C94.

2. Water shall not contain more than 500 mg/L of chlorides nor more than 500 mg/L of sulfate.

3. Heat or cool water to obtain concrete temperatures specified, and in conformance with ACI 305R and ACI 306R.

E. Color Additive for Exterior Electrical Duct Encasement:

1. For exterior electrical duct concrete encasements, use a color additive for identification purposes.

F. Concrete Admixtures:

1. Maintain compressive strength and maximum water-cement ratios specified in Table 03300-1 when using admixtures. Include admixtures in solution form in the water-cement ratio calculations.

2. Do not use any admixture that contains chlorides or other corrosive elements in any concrete. Admixtures shall be nontoxic after 30 days.

3. Use admixtures in compliance with the manufacturer's printed instructions. The manufacturer shall certify the compatibility of multiple admixtures used in the same mix.Do not use admixtures in greater dosages than recommended by manufacturer.

5. Air Entrainment:

a. Class A concrete; an air-entraining admixture conforming to ASTM C260.

b. Products:

(1) BASF Corporation – MasterAir AE 90, MasterAir VR 10, or MasterAir AE 200

(2) Sika Corporation, AER.

(3) WR Grace & Co.; Darex II-AEA

(4) Or accepted equivalent product.

c. Adjust the admixture content to accommodate fly ash or pozzolan requirements, and other admixtures when used, in order to obtain the specified air content.

6. Water Reducing:

a. Class A concrete; a water-reducing admixture conforming to ASTM C494, Type A and compatible with the air-entraining admixtures. The amount of admixture added to the concrete shall be in accordance with the manufacturer's recommendations.

b. Products:

(1) BASF Corporation; MasterPozzolith Series or MasterPolyHeed Series

(2) Sika Corporation, Plastocrete 161

(3) WR Grace & Co.; Daracem 65

(4) Euclid Chemical Company; Eucon NW

(5) Or accepted equivalent product.

7. Water Reducing and Retarding:

a. Class A concrete; a water-reducing and retarding admixture conforming to ASTM C494, Type D and compatible with the air-entraining admixtures. The amount of admixture added to the concrete shall be in accordance with the manufacturer's recommendations.

b. Products:

(1) BASF Corporation; MasterPozzolith Series

(2) Sika Corporation; Plastiment

(3) WR Grace & Co.; WRDA 64

(4) Or accepted equivalent product.

8. High-Range Water-Reducing Admixture (Superplasticizer):

a. Class A concrete; a High-Range water-reducing admixture conforming to ASTM C494, Type F or ASTM C1017, Type I.

b. Products:

(1) BASF Corporation; MasterRheobuild 1000 or MasterGlenium Series

(2) WR Grace & Co.; Daracem 100

(3) Euclid Chemical company; Eucon SPC

(4) Or accepted equivalent product.

G. Fiber Reinforcement:

1. Fiber reinforcing shall conform to ASTM C 1116, Type III.

2. Fibers shall be macro fibers. Micro fibers are prohibited.

3. Fibers shall be 100 percent virgin polypropylene fibrillated fibers containing no reprocessed olefin materials and specifically manufactured to an optimum gradation for use as concrete secondary reinforcement

4. Physical Characteristics:

a. Specific gravity: 0.91

b. Tensile strength: 40,000 to 110,000 psi (275 to 758 MPa)

c. Fiber length: 1/2-inch (13 mm) to 3/4-inch (19 mm)

5. Fibrous concrete reinforcement materials provided in this section shall produce concrete conforming to the requirements for strength of concrete specified.

H. Epoxy Bonding Agent:

1. Epoxy bonding agent shall conform to ASTM C881 Type I, II, IV or V; Grade 2 for epoxy resin adhesives. The class of epoxy bonding agent shall be suitable for ambient and substrate temperatures.

2. Products:

a. Sika Corp.; Sikadur 32

b. Euclid Chemical Company; Duralcrete

c. BASF Corporation, Concresive Liquid LPL

3. Vapor Retarder: 10 mil (0.25 mm) polyethylene sheet conforming to ASTM E1745.

I. Curing Compound:

1. Liquid form, which will form impervious membrane over, exposed surface of concrete when applied to fresh concrete by means of spray gun. Compound shall not inhibit future bond of floor covering or concrete floor treatment. Use Type I-D compound with red fugitive dye, Class B, having 18 percent minimum solids conforming to ASTM C309.

2. Provide a copy of manufacturer's certification that the curing compound meets the requirements of ANSI/NSF 61 for concrete surfaces that will be in contact with potable water.

3. Products:

a. BASF Building Systems; Kure 1315.

b. Euclid Chemical Company; Super Diamond Clear VOX.

c. W. R. Meadows, Inc.; VOCOMP-30.

d. Dayton Superior Corp; Safe Cure and Seal 30 percent.

J. Burlap Mats:

1. Conform to AASHTO M182.

K. Sisal-Kraft Paper and Polyethylene Sheets for Curing:

1. Conform to ASTM C171.

2.02 MIXES:

A. Conform to ASTM C94, except as modified by these specifications.

B. Air content as determined by ASTM C231:

1. 5 +/- 1-1/2 percent for concrete using 1-1/2 inch (38 mm) maximum aggregate size.

2. 6 +/- 1-1/2 percent for concrete using 3/4-inch (19 mm) maximum aggregate size.

C. Provide concrete with the following compressive strengths at 28 days and proportion it for strength and quality requirements in accordance with ACI 318. The resulting mix shall not conflict with limiting values specified in Table 03300-1.

Table 03300-1

Class	Type of Work	28-Day Minimum Compressive Strength (psi)[Mpa]	Minimum Cementitous Content (lbs per C.Y.)	Maximum Water/ Cement Ratio
A	Concrete for all structures and concrete not otherwise specified. Concrete fill at structure foundations, concrete topping, concrete cradle, supports across pipe trenches, and reinforced pipe encasement.	4,000 [28]	560	0.44
B	Pavement	3,000 [20]	500	0.54
C	Concrete fill below structure foundations, miscellaneous unreinforced concrete.	2,000 [13]	376	0.60
D	Prestressed concrete	4,000 [28]	560	0.44
E	Precast concrete	5,000 [35]	630	0.40

D. Measure slump in accordance with ASTM C143:

1. Proportion and produce the concrete to have a maximum slump of 4 inches (102 mm). A tolerance of up to 1 inch (25 mm) above the indicated maximum is allowed for individual batches provided the average for all batches or the most recent 10 batches tested, whichever is fewer, does not exceed the maximum limit. Concrete of lower than usual slump may be used provided it is properly placed and consolidated.

2. Mixes containing water reducers shall have a maximum slump of 6 inches (152 mm) after the addition of a mid-range water reducer and maximum slump of 8 inches (203 mm) after the addition of a high range water reducer.

E. Aggregate Size:

1. Aggregate size shall be 3/4-inch (19 mm) maximum for slabs and sections 8 inches (203 mm) thick and less. Aggregate size shall be 1 inch (25 mm) maximum for sections greater than 8 inches (203 mm) and less than 17 inches (432 mm). Aggregate size shall be 1-1/2 inches (38 mm) maximum for all larger slabs and sections. Aggregate size for floor topping shall be maximum 3/8-inch (10 mm).

2. Combined aggregate grading shall be as shown in the following table:

Table 03300-2

Sieve Sizes	**Maximum Aggregate Size**		
	1 1/2 inch	1 inch	3/4 inch
	Percent Passing		
2 inch	100	---	---
1 1/2 inch	90 to 100	100	---
1 inch	50 to 86	90 to 100	100
3/4-inch	45 to 75	55 to 100	90 to 100
3/8-inch	38 to 55	45 to 75	60 to 80
No. 4	30 to 45	35 to 60	40 to 60
No. 8	23 to 38	27 to 45	30 to 45
No. 16	17 to 33	20 to 35	20 to 35
No. 30	10 to 22	12 to 25	13 to 23
No. 50	4 to 10	5 to 15	5 to 15
No. 100	1 to 3	1 to 5	0 to 5
No. 200	0 to 2	0 to 2	0 to 2

2.03 POLYETHYLENE SHEETS:

A. The Polyethylene slip sheet under the concrete mudslab shall be 10 mil thick.

PART 3 - EXECUTION

3.01 SUBGRADE INSPECTION:

A. Examine the subgrade and the conditions under which work is to be performed and notify the Contracting Officer in writing of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions are corrected to comply with specified subgrade conditions in a manner acceptable to the Contracting Officer.

3.02 MIXING AND TRANSPORTING CONCRETE:

A. General: Conform to concreting procedures set forth in ASTM C94, ACI 304R and as specified herein.

1. Transport concrete to discharge locations without altering the specified properties of water-cement ratio, slump, air entrainment, temperature and homogeneity.

2. Discharge concrete into forms within 1-1/2 hours after cement has entered mixing drum or before the drum has revolved 300 revolutions after the addition of water, whichever occurs first.

3. Do not add water at the jobsite unless permitted by the Contracting Officer. If it is necessary to add water to obtain the specified slump, add water per ASTM C94, but do not exceed the maximum water content in the reviewed concrete design mix. Added water shall be incorporated by additional mixing of at least 35 revolutions.

4. Do not add water to concrete containing high range water reducing admixture. Do not add water to concrete in delivery equipment not acceptable for mixing.

5. Keep a record showing time and place of each pour of concrete, together with transit-mix delivery slips certifying the contents of the pour.

6. Discharge of concrete shall be completed within the limits set out in Table 03300-3.

Table 03300-3

Maximum Time to Concrete Discharge

Concrete Temperature	Limit
Over 90 Degree F	Remove concrete from jobsite and discard concrete
86 to 90 Degree F	45 minutes
81 to 85 Degree F	60 minutes
70 to 80 Degree F	75 minutes
Below 70 Degree F	90 minutes

B. Conveying: Convey concrete from agitator or mixer truck to place of final deposit in forms by one of the following methods:

1. Buckets or hoppers with discharge gates having a clear opening equal to not less than one-third the maximum interior horizontal area or five times the maximum aggregate size being used, whichever is greater, and side slopes of not less than 60 degrees to horizontal.

2. Buggies or wheelbarrows equipped with pneumatic tires.

3. Round bottom, metal or metal-lined chutes with inclined slope of between 2 to 3 feet (600 to 900 mm) horizontally to 1 foot (300 mm) vertically and of sufficient capacity to avoid overflow.

4. Circular drop pipes with a top diameter of at least eight times the maximum aggregate size, but not less than 6 inch (150 mm), or tapered to not less than six times maximum aggregate size.

3.03 CONCRETE ACCEPTANCE:

A. Accept or reject each batch of concrete delivered to the point of agitator or mixer truck discharge. Sign delivery batch tickets to indicate concrete acceptance.

B. Reject concrete delivered without a complete concrete delivery batch ticket as specified herein. The concrete supplier will furnish copies of the signed batch ticket to the Contractor and Contracting Officer.

C. The testing agency shall perform field tests at the point of agitator or mixer truck discharge. Accept or reject concrete on the basis of conformity with slump, air content and temperature specified.

D. The testing agency shall inspect concrete transit truck's barrel revolution counter and gauge for measuring water added to the concrete. Reject concrete that exceeds the maximum barrel revolution of 300, the limits in Table 03300-3 or concrete that has water content exceeding the specified water-cement ratio.

E. Reject concrete not conforming to specification before discharging into the forms.

3.04 PREPARATION AND COORDINATION:

A. Laitance must be mechanically removed from the face of concrete from previous castings at construction joints and the surface must be thoroughly cleaned before adjacent concrete is placed.

B. Hardened concrete paste and rust shall be clean of the surface of the reinforcement projecting from the face of the concrete before adjacent concrete is placed.

C. Sleeves and Inserts:

1. No sleeves, ducts, pipes, or other openings shall pass through joists, beams, column capitals or columns, except where indicated or approved by the Contracting Officer.

2. Where approved by the Contracting Officer, set sleeves, ties, pipe hangers, and other inserts and openings as indicated or specified elsewhere. Sleeves and openings, greater than 100 mm x 100 mm, that are not indicated must be approved by the Contracting Officer.

3. Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of modifications from the Contracting Officer before placing of concrete.

4. Check locations and sizes of sleeves and openings shown on drawings.

D. Anchor Bolts:

1. Set anchor bolts to templates under supervision of appropriate trade prior to placing concrete.

2. Under special circumstances, with approval of the Contracting Officer, grouted anchor bolts may be installed into preformed holes or holes drilled after concrete has set. Formed holes or sleeves shall be a minimum 100 mm diameter and be deformed or dovetailed.

3. Protect anchor bolt holes from water accumulations and snow, and ice build up.

4. When using proprietary anchor systems set bolts and fill holes with epoxy grout, in accordance with the manufacturer's requirements. All proprietary anchors must be approved by the Contracting Officer.

5. Locate anchor bolts used in connection with expansion shoes, rollers, and rockers with due regard to ambient temperature at time of erection.

E. Drainage Holes and Weep Holes:

1. Form the weep holes and drainage holes in accordance with Section 03100 – "Concrete Forms and Accessories". If wood forms are used, remove them after concrete has set.

2. Install the weep hole tubes and drains as indicated.

F. Coordination:

1. Adjust the work to suit final shop drawings of the equipment being supplied. Verify all sizes with the trade supplying and installing the equipment. Obtain, utilize and submit data on relevant sizes to suit any change in equipment. Confirm the adjustments with the Contracting Officer.

G. Grouting:

1. Grout under base plates and/or machinery using procedures in accordance with manufacturer’s recommendations that result in 100 percent contact over grouted area. Install bleed holes in base plates to ensure full coverage of grout.

H. Contractor shall notify the Contracting Officer and local building official of readiness to place concrete in any portion of the work a minimum of 2 working days prior to concrete placement. Failure to provide this notification will be cause for delay in placing until observations can be completed.

I. Reinforcement, installation of waterstop, positioning of embedded items, and condition of formwork will be observed by the Contracting Officer and local building official prior to concrete placement.

J. Coordinate the sequence of placement such that construction joints will occur only as designed.

K. Schedule sufficient equipment for continuous concrete placing. Provide for backup equipment and procedures to be taken in case of an interruption in placing. Provide backup concrete vibrators at the project site. Test concrete vibrators the day before placing concrete.

L. Compact the subgrade and/or bedding. Saturate the subgrade approximately eight hours before placement and sprinkle ahead of the placement of concrete in areas where vapor barrier is not used. Remove standing water, mud, and foreign matter before concrete is deposited.

M. Where shown on contract drawings, intentionally roughen surfaces of set concrete in a manner to expose bonded aggregate uniformly at joints.

N. Provide mud slabs to obtain a dry and stable working platform for placement of slabs.

O. When shown on contract drawings, install a granular base beneath slabs on ground. Place granular material on a compacted subgrade and compact granular base.

P. Place vapor barrier under structural slabs and buildings and where shown on contract drawings. Install material with 6 inch (150 mm) lap at joints and seal joints with tape as recommended by the vapor barrier manufacturer. Tape material cut for slab penetrations to the pipe, conduit or other items passing through the slab. Use tape recommended by the vapor barrier manufacturer.

Q. Install vapor barrier without punctures or tears and protect against punctures and breaks.

R. Where concrete is required to be placed and bonded to existing concrete, coat the contact surfaces with epoxy bonding agent. The method of preparation and application of the bonding agent shall conform to the manufacturer's recommendations.

3.05 CONCRETE PLACEMENT:

A. Placement shall conform to ACI 304R as modified by these specifications.

B. Alternate sections of concrete walls and slabs may be cast simultaneously. Do not place adjacent sections of walls and slabs until seven days after placement of first placed concrete.

C. Do not place concrete until free water has been removed or has been diverted by pipes or other means and carried out of the forms, clear of the work. Do not deposit concrete underwater, and do not allow free water to rise on any concrete until the concrete has attained its initial set. Do not permit free or storm water to flow over surfaces of concrete so as to injure the quality or surface finish.

D. Do not place concrete during inclement weather. Protect concrete placed from inclement weather. Keep sufficient protective covering ready at all times for this purpose.

E. Deposit concrete at or near its final position to avoid segregation caused by rehandling or flowing. Do not deposit concrete in large quantities in one place to be worked along the forms with a vibrator.

F. Deposit concrete continuously and in level layers 1 to 2 feet (305 to 610 mm) thick. Avoid inclined layers and cold joints. Place concrete at lower portion of slope first on sloping surfaces.

G. Do not deposit partially hardened concrete in forms. Retempering of partially hardened concrete is not permitted. Remove partially hardened concrete from site at no additional compensation.

H. Do not allow concrete to fall freely in forms to cause segregation (separation of coarse aggregate from mortar). Limit maximum free fall of concrete to 4 feet (1,220 mm). Do not move concrete horizontally more than four feet from point of discharge. Space points of deposit not more than eight feet apart.

I. At least two hours shall elapse after depositing concrete in the columns or walls before depositing in beams, girders, or slabs supported thereon. Place beams, girders, brackets, column capitals, and haunches monolithically as part of the floor or roof system, unless otherwise shown on contract drawings.

J. Consolidate concrete using mechanical vibrators operated within the mass of concrete and/or on the forms conforming to procedures set forth in ACI 309R and as specified herein.

K. Conduct vibration to produce concrete of uniform texture and appearance, free of honeycombing, streaking, cold joints or visible lift lines.

L. Conduct vibration in a systematic manner with regularly maintained vibrators. Furnish sufficient backup units at job site. Use vibrators having minimum frequency of 8,000

vibrations per minute and of sufficient amplitude to consolidate concrete. Use not less than one vibrator with crew for each 35 to 40 cubic yards (25 to 30 cubic meters) of concrete placed per hour.

M. Insert and withdraw vibrator vertically at a uniform spacing over the entire area of placement. Space distances between insertions such that spheres of influence of each insertion overlap.

N. Use additional vibration with pencil vibrators on vertical surfaces and on exposed concrete to bring full surface of mortar against the forms so as to eliminate air voids, bug holes and other surface defects. Employ the following additional procedures for vibrating concrete as necessary to maintain proper consolidation of concrete:

1. Reduce distance between internal vibration insertions and increase time for each insertion.

2. Insert vibrator as close to face of form as possible without contacting form or reinforcement.

3. Thoroughly vibrate area immediately adjacent to waterstops without damaging the waterstop.

4. Use spading as a supplement to vibration where particularly difficult conditions exist.

O. Pumping Concrete:

1. Conform to the recommendations of ACI 304.2R except as modified herein.

2. Base pump size on rate of concrete placement, length of delivery pipe or hose, aggregate size, mix proportions, vertical lift, and slump of concrete.

3. Use pipe with inside diameter of at least three times the maximum coarse aggregate size, but not less than 2 inches (50 mm).

4. Do not use aluminum pipes for delivery of concrete to the forms.

P. Waterstops:

1. Prevent displacement of waterstops during concrete placement,

3.06 CURING AND PROTECTION:

A. General:

1. Protect concrete from premature drying, hot or cold temperatures, and mechanical injury, beginning immediately after placement and maintain concrete with minimal moisture loss at relatively constant temperature.

2. Comply with curing procedures set forth in ACI 301, ACI 308 and as specified herein.

3. Perform hot weather concreting in conformance with ACI 305R and as specified herein when the ambient atmospheric temperature is 80 degrees F (27 degrees C) or above.

4. Perform cold weather concreting in conformance with ACI 306R.

5. Concrete required to be moist cured shall remain moist for the entire duration of the cure. Repeated wetting and drying cycles of the curing process will not be allowed.

B. Curing Duration:

1. Start initial curing after placing and finishing concrete as soon as free moisture has disappeared from unformed concrete surfaces. Initial curing starts as soon as concrete achieves final set. Forms left tightly in place are considered as part of the curing system, provided that wooden forms are kept continuously moist. Keep continuously moist for not less than 72 hours.

2. Begin final curing procedures immediately following initial curing and before the concrete has dried. Continue final curing for at least 7 days and in accordance with ACI 301 procedures for a total curing period, initial plus final, of at least 10 days.

3. Avoid rapid drying at the end of the final curing period

C. Curing Requirements:

1. Unformed Surfaces: Cover and cure entire surface of newly placed concrete immediately after completing finishing operations and water film has evaporated from surface or as soon as marring of concrete will not occur. Protect finished slabs from direct rays of the sun to prevent checking, crazing and plastic shrinkage.

2. Formed Surfaces: Minimize moisture loss for formed surfaces exposed to heating by the sun by keeping forms wet until safely removed. Keep surface continuously wet by warm water spray or warm water saturated fabric immediately following form removal.

3. Water containment and below Grade Structures: Moist cure by the application of water to maintain the surface in a continually wet condition. Use water that is free of impurities that could etch or discolor exposed concrete surfaces.

4. Other concrete: Moist cure by moisture-retaining cover curing, or by the use of curing compound.

D. Curing Methods:

1. Water Curing: Use water curing for unformed surfaces. Continuously water cure all exposed concrete for the entire curing period. Provide moisture curing by any of the following methods:

    a. Keeping the surface of the concrete continuously wet by ponding or immersion.

    b. Continuous water-fog spray or sprinkling.

    c. Covering the concrete surface with curing mats, thoroughly saturating the mats with water, and keeping the mats continuously wet with sprinklers or porous hoses. Place curing mats so as to provide coverage of the concrete surfaces and edges, with a 4 inch (100 mm) lap over adjacent mats. Weight down the curing cover to maintain contact with the concrete surface.

2. Sealing Materials:

    a. Use common sealing materials such as plastic film or waterproofing (kraft) paper.

    b. Lap adjacent sheets a minimum of [12 inch (300 mm)]. Seal edges with waterproof tape or adhesive. Use sheets of sufficient length to cover sides of concrete member.

    c. Place sheet materials only on moist concrete surfaces. Wet concrete surface with fine water spray if the surface appears dry before placing sheet material.

    d. The presence of moisture on concrete surfaces at all times during the prescribed curing period is proof of acceptable curing using sheet material.

3. Membrane Curing Compound:

    a. If approved in writing by the Contracting Officer, a membrane curing compound can be used under limited circumstances, to assist in the curing of the concrete. Apply membrane-curing compound uniformly over concrete surface by means of roller or spray at a rate recommended by the curing compound manufacturer, but not less than 1 gallon per 150 sq. ft. (1 liter per 4 sq. meters) of surface area. Agitate curing material in supply container immediately before transfer to distributor and thoroughly agitate it during application for uniform consistency and dispersion of pigment.

    b. Do not use curing compounds on construction and expansion joints or on surfaces to receive liquid hardener, dustproofer/sealer, concrete paint, tile, concrete fills and toppings or other applications requiring positive bond.

c. Reapply membrane-curing compound to concrete surfaces that have been subjected to wetting within 3 hours after curing compound has been applied by method for initial application.

E. Protection from environmental conditions: Maintain the concrete temperature above 50 degrees F (10 degrees C) continuously throughout the curing period. Make arrangements before concrete placing for heating, covering, insulation or housing to maintain the specified temperature and moisture conditions continuously for the curing period.

1. When the atmospheric temperature is 80 degrees F (25 degrees C) and above, or during other climatic conditions which will cause too rapid drying of the concrete, make arrangements before the start of concrete placing for the installation of wind breaks or shading, and for fog spraying, wet sprinkling, or moisture-retaining covering.

2. Protect the concrete continuously for the entire curing period.

3. Maintain concrete temperature as uniformly as possible, and protect from rapid atmospheric temperature changes.

4. Avoid temperature changes in concrete that exceed 5 degrees F (3 degrees C) in any one hour and 50 degrees F (10 degrees C) in any 24-hour period.

F. Protection from physical injury: Protect concrete from physical disturbances such as shock and vibration during curing period. Protect finished concrete surfaces from damage by construction equipment, materials, curing procedures and rain or running water. Do not load concrete in such a manner as to overstress concrete.

G. Protection from Deicing Agents: Do not apply deicing chemicals to concrete.

3.07 FIELD QUALITY CONTROL:

A. Hot Weather Requirements

1. During hot weather, give proper attention to ingredients, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures or water evaporation in accordance with ACI 305R and the following.

2. When the weather is such that the temperature of the concrete as placed would exceed 90 degrees F (32.2 degrees C), use ice or other means of cooling the concrete during mixing and transportation so that the temperature of the concrete as placed will not exceed 90 degrees F (32.2 degrees C).

3. Take precautions when placing concrete during hot, dry weather to eliminate early setting of concrete. This includes protection of reinforcing from direct sunlight to

prevent heating of reinforcing, placing concrete during cooler hours of the day, and the proper and timely application of specified curing methods.

4. There will be no additional reimbursement to the Contractor for costs incurred for placing concrete in hot weather.

B. Cold Weather Requirements

1. Provide adequate equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather in accordance with ACI 306R and the following.

2. When the temperature of the surrounding atmosphere is 40 degrees F (4.4 degrees C) or is likely to fall below this temperature, use heated mixing water not to exceed 140 degrees F (60 degrees C). Do not allow the heated water to come in contact with the cement before the cement is added to the batch.

3. When placed in the forms during cold weather, maintain concrete temperature at not less than 55 degrees F (12.8 degrees C). Materials shall be free from ice, snow, and frozen lumps before entering the mixer.

4. Maintain the air and the forms in contact with the concrete at temperatures above 40 degrees F (4.4 degrees C) for the first five days after placing, and above 35 degrees F (1.7 degrees C) for the remainder of the curing period. Provide thermometers to indicate the ambient temperature and the temperature 2 inches (50 mm) inside the concrete surface.

5. There will be no additional reimbursement made to the Contractor for costs incurred for placing concrete during cold weather.

C. Backfill Against Walls

1. Do not place backfill against walls until the concrete has obtained a compressive strength equal to the specified 28-day compressive strength. Where backfill is to be placed on both sides of the wall, place the backfill uniformly on both sides.

2. Do not backfill the walls of structures that will be laterally restrained or supported by suspended slabs or slabs on grade until the slab is poured and the concrete has reached the specified compressive strength.

D. Concrete Testing

1. The Contracting Officer or the Contracting Officer’s authorized agent, other than the contractor shall employ an independent testing agency retained by the Contractor.

2. The testing agency will use concrete samples provided by the Contractor at the point of agitator or mixer truck discharge to perform slump (per ASTM C143) , air

content (per ASTM C231), and temperature tests (per ASTM C1064) and for field control test specimens.

3. The testing agency will submit test reports of concrete field measurements specified above to the Contractor and to the Contracting Officer.

4. Provide and maintain facilities for safe storage and proper curing of concrete test specimens on the project site, as required by ASTM C31.

5. Concrete Quality Test Specimen:

    a. Perform sampling and curing of test specimen in accordance with ASTM C31.

    b. Testing agency personnel will record truck and load number from the delivery batch ticket, the concrete placement location of each specimen, the date, concrete strength, slump, air content and temperature.

    c. The testing agency will cast a minimum of one set of 6 test specimens, each 6 inch (150 mm)] diameter by 12 inch (300 mm)] long cylinders, for each 50 cubic yard (38 cubic meters) of each mix design of concrete but not less than once a day nor less than once for each 5,000 sq. ft. (450 sq. meters) of surface area of foundation mats, base slabs, footings, pile caps, slabs on grade, grade beams, walls, or elevated slabs.

    d. Test cylinders in accordance with ASTM C39. Test one cylinder at 7 days for information; test three [2 cylinders at 28 days for acceptance; and hold two reserve cylinders for verification. Strength acceptance will be based on the average of the strengths of the three cylinders tested at 28 days. If one cylinder of a 28-day test manifests evidence of improper sampling, molding, or testing, other than low strength, discard it and use a reserve cylinder for the test result

6. The Contractor may take field control test specimens for small quantities of concrete.

7. Concrete acceptance shall be based on the requirements of ACI 318.

8. Field cured cylinders conforming to ASTM C31 will be required to determine field compressive strength of concrete. Laboratory cured cylinders for concrete quality testing shall not be used for determining field compressive strength.

9. Concrete Coring:

    a. When the concrete quality test specimen compression tests fail to be in compliance with the Contract Documents or when the Contracting Officer detects deficiencies in the concrete, the Contractor will take concrete cores at

least 2 inches (50 mm) in diameter from the structure in conformance with ASTM C 42 at locations determined by the Contracting Officer.

b. Obtain at least three representative cores from each member or area of concrete that is considered potentially deficient.

c. Obtain additional cores to replace cores that show evidence of having been damaged subsequent to or during removal from the structure.

d. The testing agency shall compression test the cores taken from the structure in conformance with ASTM C39 and submit test strength test results of cores specified above to the Contractor and to the Contracting Officer.

e. All costs associated with coring and testing of cores will be borne by the Contractor at no additional cost to the Contracting Officer.

3.08 EXAMINATION OF COMPLETED STRUCTURES:

A. Undertake, with the Contracting Officer, review of concrete surfaces for defects and finishes.

B. Undertake, with the Contracting Officer, assessments and measurements of the concrete structures for cracking.

C. Provide a written summary of defects noted complete with a plan showing locations of each defect.

D. Submit a plan for repair of each defect in accordance with these specifications.

3.09 CLOSEOUT ACTIVITIES:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 03410

PRECAST STRUCTURAL CONCRETE BUILDINGS

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes:

1. Precast Concrete Structures.

1.02 REFERENCES:

A. Aluminum Association (AA):

1. Aluminum Design Manual–Specifications and Guidelines for Aluminum Structures.

2. B26: Specification for Aluminum-Alloy Sand Castings.

3. B209: Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

4. B211: Specification for Aluminum-Alloy Bars, Rods, Profiles and Tubes.

5. B221: Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.

6. B247: Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings and Rolled Ring Forgings.

7. B429: Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

B. American Concrete Institute (ACI):

1. 301: Specifications Structural Concrete for Buildings.

2. 318/318M: Building Code Requirements for Structural Concrete.

C. ASTM International (ASTM):

1. A185: Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.

2. A497: Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.

3. A1064/1064M: Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

4. A706 - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.

5. C150: Standard Specification for Portland Cement.

D. American Welding Society, (AWS):

1. D1.1: Structural Welding Code - Steel.

2. D1.4: Structural Welding Code -Reinforcing Steel.

E. Precast/Prestressed Concrete Institute, (PCI):

1. MNL-116S: Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.

2. MNL-120: PCI Design Handbook - Precast and Prestressed Concrete.

1.03 DESIGN REQUIREMENTS:

A. Design components and connections for the following:

1. Live loads, wind, snow and seismic are specified on Drawing 00 S-001.

2. Seismic Design: Design and detail elements and connections to resist seismic force prescribed on Drawing 00 S-001.

3. Design buildings for thermal movements.

4. Design system to accommodate construction tolerances and clearances and provide openings shown on the Contract Documents.

5. The building shall be professionally designed and engineered to meet all zoning and building code requirements for the state and county in which the building is to be located. Furnish a letter of certification signed and sealed by a Professional Structural Engineer registered in the State of Connecticut stating the building system meets the prescribed design load requirements.

B. Design Description;

1. Provide one precast concrete Pump Station and one precast concrete meter vault dimensions as indicated. Concrete Pump Station shall be installed on precast concrete foundation as indicated on the Drawings. The pump station building shall be cast as sections and combined on site to form a water proof structure. The meter vault shall be cast as one piece.

1.04 SUBMITTALS:

A. Submit the following shop drawings in accordance with the Section 01300, Submittals.

B. Detailed shop drawings for all precast concrete structures. Indicate dimensions, layouts, architectural details, reinforcing steel, inserts, connections, openings, edge conditions, bearing requirements, support conditions, connection details, lifting devices and openings intended to be field cut.

C. Submit mix designs and test results for concrete used in the precast structural concrete in accordance with Section 03300, Cast-In-Place Concrete.

D. Shop Drawings shall be signed and sealed by a Structural Engineer registered in the State where the building will be installed**.**

E. Mark each member for identification. Show mark on erection plan and place it legibly on unit at time of manufacture.

F. Product Data: Indicate standard component configurations, design loads, deflections, cambers, and bearing requirements.

G. Samples: Submit two (2) samples 24” x 36” in size illustrating surface finish treatment.

H. Certification, signed and sealed by a Professional Structural Engineer Registered in the State of Connecticut and employed by the building manufacturer stating:

1. Elements and connections are designed to withstand required loads and forces.

2. Codes and specifications to which structural design conforms.

3. Do not submit calculations.

1.05 QUALITY ASSURANCE:

A. Comply with requirements as specified in Section 01400, Quality Requirements.

B. Perform Work in accordance with requirements of PCI MNL-116S, PCI MNL-123, and PCI MNL-120.

C. Perform Work in accordance with applicable state building code.

1.06 QUALIFICATIONS:

A. Fabricator qualifications: Company specializing in manufacturing the Work of this section with minimum 5 years documented experience.

B. Erector qualifications: Company specializing in erecting the Work of this section with 5 years documented experience approved by manufacturer.

C. Design precast concrete members under direct supervision of Structural Engineer experienced in design of this Work and licensed in the state where the Project is located.

D. Welding Qualification and Certification:

1. Furnish written welding procedure for welds in conformance with the AWS D 1.1.

2. Each welder and welding operator shall be certified by test to perform type of work required in conformance with AWS D 1.1.

3. If a welder or welding operator has not been engaged in a specific welding process for a period of six months or more, that individual shall be deemed unqualified and shall not perform work on the project until the individual has been qualified again by testing in conformance with AWS D 1.1.

1.07 PRE-INSTALLATION MEETING:

A. Administrative Requirements: Pre-installation meeting required.

B. Convene minimum 1 week prior to commencing Work of this section.

C. Coordinate all Work associated with the Work of this section.

1.08 DELIVERY, STORAGE, AND HANDLING:

A. Handle precast members in position consistent with their shape and design. Lift and support only from support points.

B. Lifting or Handling Devices: Capable of supporting member in positions anticipated during manufacture, storage, transportation, and erection.

C. Load structural members in such a manner that they may be transported and unloaded without being over-stressed, deformed or otherwise damaged.

D. Protect members to prevent staining, chipping, and spalling of concrete.

E. Mark each member with date of production and final positions in structure.

1.09 TRAFFIC MANAGEMENT:

A. Refer to Section 01046 and the Contract Drawings for a description of the traffic management requirements.

PART 2 – PRODUCTS

2.01 FABRICATORS:

A. Fabricators:

1. United Concrete Products, Inc.

2. Shea Concrete Products Inc.

3. Old Castle Precast, Inc.

4. Or Contracting Officer approved equal.

2.02 CONCRETE:

A. Concrete used in the manufacture of the various structural components of the precast concrete building shall be factory batched and shall meet the following requirements:

1. Portland cement shall be Type I, II or III conforming to ASTM C-150.

2. Fine aggregate shall consist of natural sand conforming to ASTM specification C-33.

3. Coarse aggregate shall consist of ½" maximum well graded crushed stone conforming to ASTM specification C-33.

4. Air entrainment admixture shall conform to ASTM C260. The air-entrained content shall be not less than 4% or greater than 7%.

5. A superplasticizer shall be used and shall conform to ASTM C494 Type F or G. Concrete shall be placed at a slump of between 5 and 8 inches.

6. Concrete used for structural components shall attain a minimum 28-day compressive strength of 5,000 psi.

2.03 STEEL REINFORCING:

A. Welded wire fabric shall conform to ASTM A1064. Reinforcing steel shall be new billet steel meeting the requirements of ASTM A615.

B. All reinforcement shall be free from loose rust, oil, and contaminants which reduce bond. Any foreign material shall be removed by suitable means prior to installation.

C. Provide supports for reinforcement including chairs, bolster bars, and other devices for spacing and securing reinforcing in accordance with CRSI requirements. Legs of all supports in contact with exposed-to-view surfaces shall be plastic coated in accordance with CRSI, class I.

2.04 ACCESSORIES:

A. Connecting and Supporting Devices: ASTM A36/A36M carbon steel plates, angles, items cast into concrete or items connected to steel framing members**,** inserts, conforming to PCI MNL-123; prime painted. Do not paint surfaces in contact with concrete or surfaces requiring field welding.

B. Bearing Pads: Provide in accordance with the calculations made by the precast manufacturer's engineer.

C. Bolts, Nuts and Washers: Stainless steel.

2.05 FABRICATION:

A. Fabrication procedure to conform to PCI MNL-116S.

B. Maintain plant records and quality control program during production of precast members. Make records available upon request.

C. Ensure reinforcing steel, anchors, inserts, plates, angles, and other cast-in items are embedded and located as indicated on shop drawings.

D. Tension reinforcement tendons as required to achieve design load.

E. Fabricate required openings with a dimension larger than 10 inch and embed accessories provided by other sections, at indicated locations.

F. Exposed Ends at Stressing Tendons: Fill recess with non-shrink grout, trowel flush.

G. Weld steel fabrications in accordance with ANSI/AWS D1.1. Do not weld reinforcing.

2.06 FINISHES:

A. Finish exposed-to-view finish surfaces of precast concrete members uniform in color and appearance.

B. Cure members under identical conditions to develop required concrete quality, and minimize appearance blemishes including non-uniformity, staining, or surface cracking.

C. Finish members to PCI MNL-116S Commercial grade.

D. Architectural Finish: Exterior finish shall be an architectural chamfer finish.

2.07 FABRICATION TOLERANCES:

A. Conform to PCI MNL-116S.

B. Maximum Variation from Nominal Dimension: 1 inch.

C. Maximum Variation from Intended Camber: 5/8-inch.

D. Maximum Out-of-Square: 1/8-inch in 10 feet, non-cumulative.

E. Maximum Out-of-Round: 1/8-inch in 10 feet diameter, non-cumulative.

F. Maximum Misalignment of Anchors, Inserts, Openings: 1/8-inch.

G. Maximum Bowing of Members: Length of Bow/ 360.

2.08 COMPONENTS:

A. Provide the precast concrete structures, fasteners, anchors, sealants, flashing, louvers, dampers, exhaust fan, and all other parts necessary for complete building systems as specified and indicated on the Drawings.

2.09 WALLS-INTERIOR INSULATED:

A. Insulate the walls and ceilings of the structures per related precast structures details.

2.10 BUILDING FINISHES:

A. Exterior finish shall be natural stone veneer formliner. Color to be selected by City of Middletown.

B. Interior walls and ceilings shall be FRP with insulation specified and ¾-in fire/mold treated plywood (drycon).

C. Building floors shall be non-skid epoxy slate gray. (Sikagard 62 high-gloss sealer with non skid additive).

PART 3 – EXECUTION

3.01 PREPARATION:

A. Prepare support equipment for the erection procedure, temporary bracing, and induced loads during erection.

B. Prepare a means of protection of embeds from damage during construction, transportation and erection.

3.02 ERECTION:

A. Erect members without damage to structural capacity, shape or finish. Replace or repair damaged components.

B. Align and maintain uniform horizontal and vertical joints, as erection progresses.

C. Maintain temporary bracing in place until final support is provided. Protect members from staining.

D. Provide temporary lateral support to prevent bowing, twisting, or warping of members.

E. Adjust differential camber between precast members to tolerance before final attachment.

F. Install bearing pads.

G. Level differential elevation of adjoining horizontal members with grout to maximum slope of 1:12.

H. Set vertical units dry, without grout, attaining joint dimension with lead or plastic spacers.

I. Secure units in place. Perform welding in accordance with AWS D1.1.

3.03 ERECTION TOLERANCES:

A. Erect members level and plumb within allowable tolerances.

B. Conform to PCI MNL-116S.

C. Design and erect to the following tolerances:

1. Maximum variation from plane or location as indicated and/or specified: 1/4-inch in 10 feet and 3/8-inch in 100 feet, non-cumulative.

2. Maximum offset from indicated alignment between members: 1/4-inch.

3. Maximum variation from dimensions: Plus or minus 1/8-inch.

D. Exposed joint dimension: 3/8-inch plus or minus 1/4-inch.

3.04 PROTECTION OF INSTALLED CONSTRUCTION:

A. Protect members from damage caused by field welding or erection operations.

B. Use non-combustible shields during welding operations to protect adjacent Work.

3.05 FOUNDATION:

A. Structure shall be placed on and secured to a reinforced cast in place foundation as indicated and/or specified. A compressible butyl gasket shall be installed between the structure and the foundation to prevent leakage.

3.06 WARRANTY:

A. Manufacturer shall warrant the building and its components for one (1) year from the date of installation.

B. Precast concrete structure shall endure and not deteriorate for a period of 25 years.

3.07 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700, Contract Closeout.

B. Clean weld marks, dirt, or blemishes from surface of exposed members.

END OF SECTION

SECTION 03420

PRECAST REINFORCED CONCRETE VAULTS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. This section includes materials, design, and installation of factory-built precast reinforced concrete underground vaults and related access hatches.

1.02 REFERENCES:

A. American Association of State Highway and Transportation Officials (AASHTO):

1. HB: Standard Specifications for Highway Bridges.

2. M198: Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

B. American Concrete Institute (ACI):

1. ACI 211.1: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete

2. ACI 301: Standard Specifications for Structural Concrete

3. ACI 304R: Guide for Measuring, Mixing, Transporting and Placing Concrete

4. ACI 305R: Hot Weather Concreting

5. ACI 306R: Cold Weather Concreting

6. ACI 308: Standard Practice for Curing Concrete

7. ACI 309R: Guide for Consolidation of Concrete

1. 318: Building Code Requirements for Structural Concrete and Commentary

C. ASTM International (ASTM):

1. A48: Standard Specification for Gray Iron Castings.

2. C31: Practice for Making and Curing Concrete Test Specimens in the Field

3. C33: Specification for Concrete Aggregates

4. C39: Test Method for Compressive Strength of Cylindrical Concrete Specimens

5. C143: Test method for Slump of Hydraulic Cement Concrete

6. C150: Specification for Portland Cement

7. C172: Practice for Sampling Freshly Mixed Concrete

8. C192: Practice for Making and Curing Concrete Test Specimens in the Laboratory

9. C231: Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

10. C260: Specification for Air-Entraining Admixtures for Concrete

11. C494: Specification for Chemical Admixtures for Concrete

12. C857: Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.

13. C858: Specification for Underground Precast Utility Chambers

14. C1064: Test Method for Temperature of Freshly Mixed Portland Cement Concrete

15. D75: Practice for Sampling Aggregates

16. D4101: Standard Specification for Polypropylene Injection and Extrusion Materials

1.03 SUBMITTALS:

A. Shop Drawings: Submit the following in accordance with Section 01300.

1. Completely detailed shop drawings for precast concrete vaults. Indicate all dimensions, details, reinforcing steel, inserts, connections, openings, and lifting devices. Mark each component for identification. Show mark on erection plan and place legibly on unit at time of manufacture.

2. Submit manufacturer's specification and product data for all items specified.

B. Drawings of modifications or changes in features or details, which are necessitated by design requirements. Make such modifications without additional compensation.

C. Do not fabricate precast concrete vaults before shop drawings are accepted by the Contracting Officer.

D. Certification, signed and sealed by a Professional Structural Engineer registered in the jurisdiction where the vaults will be installed and employed by the vault manufacturer and stating:

1. Elements and connections are designed to withstand required loads and forces

2. Structure is not affected by buoyant forces.

3. Codes and specifications to which structural design conforms.

4. Do not submit calculations.

1.04 QUALITY ASSURANCE:

A. Comply with the requirements specified in Section 01400.

B. Vault design and construction comply with the specified design load conditions, ASTM C858 and as specified herein.

1.05 DELIVERY, STORAGE AND HANDLING:

A. Comply with the requirements specified in Section 01610.

B. Store vaults on clean blocking, off the ground and protected from rain and ground splatter.

C. Coordinate the delivery, storage, handling and installation of precast concrete vaults.

PART 2 - PRODUCTS

2.01 PRECAST REINFORCED CONCRETE VAULTS:

A. Manufacturers:

1. United Concrete, Inc.

2. Oldcastle Precast, Inc.

3. Or acceptable equivalent product.

B. Materials:

1. Minimum concrete compressive strength of 5,000 psi at 28 days conforming to Section 03300.

2. Portland cement: ASTM C150, Type II.

3. Coarse Aggregate and sand conforming to Section 03300

4. Steel reinforcement conforming to ASTM A615, Grade 60.

5. Water: Potable.

6. Provide air entraining and water reducing concrete admixtures as specified in Section 03300

7. Butyl rubber-based sealants conforming to AASHTO M198, Type B but with no bitumen content.

8. Non-Shrink Grout:

   a. BASF Chemical Company; Masterflow 713 Plus

   b. The Euclid Chemical Co.; Euco NS Grout

   c. Sika Corporation; SikaGrout 212

   d. Or acceptable equivalent product.

C. Design Criteria. Use design loads according to ASTM C857 or as indicated below, whichever produces the more severe conditions:

1. Design precast reinforced concrete vault to withstand earth and groundwater loads. Provide design based on an equivalent fluid pressure equal to a minimum of 65 pounds per cubic foot.

2. Design precast reinforced concrete vault to withstand an H20 vehicle loading with an impact factor as prescribed in ASTM C857 with a minimum surcharge of 250 psf. Account for vehicle positions both above and alongside vault including directly on each manhole cover.

3. Design precast reinforced concrete vault ceiling to withstand additional concentrated loads from lifting hooks located directly above each valve, meter or other equipment. Provide lifting hook capable of supporting the load, but not less than 2,500 pounds each hook.

4. Design and install vaults to withstand hydrostatic uplift caused by a groundwater elevation at grade level or equal to the top of the vault,

whichever produces the most severe condition. Use only the weight of the vault and hold-down slab to resist hydrostatic uplift with a minimum safety factor of 1.3. Do not include side friction of soil on walls.

5. Walls and floor slab: minimum of 6 inches in thickness. Cast lower wall section and floor slab together in one placement.

6. Precast reinforced concrete vault roof: minimum of 8 inches in thickness.

7. Design vault to withstand the load condition where the vault roof is removed while the structure is backfilled to grade and subject to live and dead loads.

8. Provide precast reinforced concrete vault as indicated on the drawings. Provide a watertight vault enclosure including sump as indicated**.**

9. Fabricate precast reinforced concrete vault in sections for as required for handling and installation.

10. Provide pipe sleeves with water stops, rubber pipe boots, or other devices at pipe penetrations as indicated.

2.02 BITUMINOUS WATERPROOFING MATERIAL:

A. Manufacturers:

1. Tnemec Company, Inc.; Series 46-465 H.B. Tnemecol

2. PPG Industries; Amercoat 78HB.

3. Carboline; Bitumastic 300M

4. Or acceptable equivalent product.

2.03 ACCESS HATCH:

A. Type 304L Stainless steel roof hatches, type and size as indicated in the Drawings, pre-assembled from the manufacturer.

B. Performance Characteristics:

1. Cover shall be reinforced to support a minimum live load of 40 psf with a maximum deflection of 1/150th of the span and 20 psf wind uplift.

2. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.

3. Operation of the cover shall not be affected by temperature.

4. Entire hatch shall be insulated, gasketed, and weathertight with fully welded corner joints on cover and curb.

C. Cover shall be minimum 14 gauge Type 304L stainless steel with a 3-inch minimum beaded flange with formed reinforcing members. Cover shall have a heavy extruded EPDM rubber gasket that is bonded to the cover interior to assure a continuous seal when compressed to the top surface of the curb. Cover shall include a minimum 1-inch thick rigid insulation protected by a 22 gauge Type 304L stainless steel liner.

D. Curb shall be minimum 14 gauge Type 304L stainless steel, height as indicated on Drawings. Curb shall be formed to encapsulate a minimum of 1-inch rigid insulation and include a rigid flange with mounting holes spaced for attachment and creating a watertight seal to the vault roof.

E. Lifting mechanism: Provide compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe through bolted to the curb assembly.

F. Hardware shall be Type 316 stainless steel with the following features:

1. Provide heavy pintle hinges.

2. Provide an enclosed two point spring latch with interior and exterior turn handles.

3. Provide interior and exterior padlock hasps.

4. The latch strike shall be a stamped component bolted to the curb assembly.

5. Cover shall automatically lock in the open position with a rigid hold open arm equipped with a red vinyl grip handle to permit easy release for closing.

6. Compression spring tubes shall be Type 316L stainless steel.

7. Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.

8. Factory finish shall be mill finish stainless steel.

2.04 MAINTENANCE HATCH

A. All hatch covers shall be of aluminum as manufactured by Bilco or approved equal.

B. The hatch opening sizes and locations shall be as shown on the Drawings to allow installation and/or removal of the equipment below.

C. Hatch covers shall be double leaf, watertight, self-draining type. Door leaf shall be of 1/4 inch thick aluminum diamond pattern plates reinforced with aluminum stiffeners as required and capable of withstanding a live load of 300 pounds per square foot. Channel frame shall be 1/4 inch thick aluminum with anchor flange around the perimeter. Each door leaf shall be equipped with a minimum of 2 hinges, with stainless steel pins, compression spring operators enclosed in telescopic tubes to afford easy operation, and an automatic hold-open arm with release handle. Snap locks with removable handle and safety chains

D. Provide a hinged safety grate with the entrance hatch. Grate shall have openings 5-inch by 5-inch, shall have a permanent hinging system which will lock the gate in the 90 degree position once opened, shall have an opening arm with a vinyl grip handle which will allow opening of the grate while providing the grate as a barrier between the operator and the opening, and shall be painted with a safety orange paint. Safety grate shall be constructed of 6061-T6 aluminum with a minimum ultimate strength of 38,000 psi and minimum yield strength of 35,000 psi as per A.S.T.M. B221. Grate shall withstand live loads of 300 pounds per square foot with a deflection not to exceed $1/150^{th}$ of the opening. Welding shall be in accordance with ANSI/AWS D1.2-90 Structural Welding Code for Aluminum. Hinged safety gate shall be as manufactured by Syracuse Casting Sales Corp., Cicero, New York, or equal. Size shall be coordinated between grate and hatch.

E. Hatches that are not shown connected to a drainage system shall be provided with extensions to the drainage coupling to allow drainage to the area below.

F. Hatch covers shall be installed in accordance with the recommendations of the manufacturer and as approved by the Contracting Officer.

2.05 LIFTING HOOKS:

A. Provide lifting hooks in the ceiling above pumps, valves, and meters.

1. Lifting hooks shall have adequate capacity to lift the equipment, but not less than 2,500 pounds.

PART 3 - EXECUTION

3.01 PROTECTION:

A. Protect aluminum from contact with dissimilar metals, concrete, masonry or mortar.

B. Before coating application, clean contact surfaces, remove dirt, grease, oil, foreign substances.

3.02 FINISHES:

A. Finishes: Ships ladders and entrance hatches shall receive and Aluminum Association clear anodic finish, designation C22A31.

3.03 INSTALLATION:

A. Install precast reinforced concrete vault, and related appurtenances in accordance with manufacturer's instructions.

B. Place precast reinforced concrete vault onto level prepared bedding as indicated. Provide uniform bearing over entire base of vault.

C. Seal all joints inside and out with specified sealant to ensure joints are waterproof.

D. Repair or replace damaged waterproofing.

E. Backfill vault excavation uniformly and in such a manner so as not to damage the waterproofing.

3.04 PROTECTIVE COATING:

A. Apply two coats of protective coating material (minimum 10 mils dry film thickness per coat) to exterior of walls, floor and ceiling by brush or spray according to manufacturer’s printed instructions.

B. Repair or replace damaged protective coating as determined by the Contracting Officer at no additional cost to the Contracting Officer.

C. Backfill vault excavation uniformly and in such a manner so as not to damage the waterproofing.

3.05 CLOSEOUT ACTIVITIES:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 03800

LEAKAGE TESTING OF CONTAINMENT STRUCTURES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. This section describes the method of testing concrete containment structures for leakage. All containment structures shall be leak tested unless specifically exempted by the Contracting Officer.

1.02 REFERENCES:

A. American Concrete Institute (ACI):

1. 350.1: Tightness Testing of Environmental Engineering Concrete Structures and Commentary.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Provide piping and equipment to test concrete structures for leakage as described herein.

PART 3 - EXECUTION

3.01 GENERAL:

A. Hydrostatically test reinforced concrete structures which will contain fluids to determine that they conform to leakage criteria specified herein and are free of detectable leaks. Do not hydrostatically test walls that are to be restrained or laterally supported by slabs until slab concrete has obtained the specified compressive strength.

B. Prior to testing, clean exposed surfaces by thoroughly hosing and removing surface laitance and loose matter from walls and slabs. Remove wash water and debris from the structures by means other than washing through plant piping. All potential leakage points shall be identified and repaired prior to filling the tank with water for the tightness test.

C. No backfilling, floor finish, concrete or mortar fill, wall insulation, gas proofing or protective coatings shall be applied to or installed in any new containment structures until they have been subjected to loading for settlement and tested for leakage. Testing shall not be done until the concrete has reached its specified design strength.

3.02 PRELOADING TEST:

A. For the Preloading Test the Contractor shall maintain the liquid level in the structures at the design maximum water level for 72-hours. If the characteristics of settlement of the structure so require, the loading shall continue for a longer period to permit the necessary consolidation of the foundation material, in which case the Contractor shall be entitled to no extra compensation, but a commensurate extension of time for completion of the whole work under this contract shall be allowed.

3.03 LEAK TEST PROCEDURE:

A. Leakage testing shall meet the provisions of ACI 350.1 – Tightness Testing of Environmental Engineering Concrete Structures. The test criterion shall be HST-NML (no measurable loss) as defined by ACI 350.1.

B. During the test period, the excavation around the structure shall be kept dewatered by the Contractor. Dewatering shall maintain the groundwater level to below the top of the base slab. The Contractor shall temporarily seal all bottom openings and wall openings below maximum water level in the structures, furnish and fill the structures to the design maximum water level with clean water. The Contractor shall make his own arrangements for handling the water for testing and its transfer from one structure to another and its final disposal.

C. Filling rate shall not exceed a rate as permitted by the Contracting Officer. Filling shall be at a uniform rate with continuous monitoring.

D. During the leakage test period, the Contracting Officer will inspect the structure for leakage or change in volume. If moist spots become visible, indicating the existence of minor leaks, or if the water level indicates hidden leakage, the Contractor shall furnish all materials and do all work necessary to locate the leaks and make the structure watertight to the complete satisfaction of the Contracting Officer. No additional compensation will be allowed for such work.

E. If, in the opinion of the Contracting Officer, during the course of the test weather conditions are such that it becomes difficult to accurately monitor the water level in the tank, the test shall be stopped, and started over again when weather permits, at no additional cost to the Contracting Officer.

F. On conclusion of the test, the Contractor shall pump or drain the water from the structure and dispose of it without damage to structures or surrounding facilities.

G. The structure will be considered as passing the water tightness test when no wet spots are observed on the exterior surfaces of the containment structure during the water tightness test period and when the measured loss is less than the maximum specified.

3.04 REPAIR METHODS

A. Methods for repairing concrete not passing the leakage test (if allowed) shall be only as approved by the Contracting Officer.

3.05 CLOSEOUT ACTIVITIES

A. Provide in accordance with Section 01700.

END OF SECTION

DIVISION 5

METALS

SECTION 05515

ALUMINUM STAIRS AND LADDERS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. This section describes materials, fabrication, and installation of aluminum stairs for vaults and ladders as indicated and in compliance with Contract Documents.

1.02 REFERENCES:

A. Aluminum Association (AA):

1. Aluminum Design Manual–Specifications and Guidelines for Aluminum Structures.

B. American Society for Testing and Materials International (ASTM):

1. A276: Standard Specification for Stainless Steel Bars and Shapes.

2. B26: Specification for Aluminum-Alloy Sand Castings.

3. B209: Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

4. B211: Specification for Aluminum-Alloy Bars, Rods, Profiles and Tubes.

5. B221: Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.

6. B247: Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings and Rolled Ring Forgings.

7. B429: Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

C. American Welding Society (AWS):

1. A2.4: Standard Symbols for Welding, Brazing, and Nondestructive Examination.

2. D1.1: Structural Welding Code - Steel.

D. State of Connecticut Building Code including ammendments and supplements.

E. Occupational Safety and Health Administration (OSHA):

1. 29 CFR, Part 1910, Occupational Safety and Health Standards.

1.03 DESIGN CRITERIA:

A. Stairs and ladders shall conform to OSHA Safety Standards, and State of Connecticut Building Code requirements.

B. Stairs and inclined (ships) ladders shall be designed to withstand a minimum uniform live load of 100 psf (4.8 kPa) or a concentrated live load of 300 pounds (1.3 kN) applied on an area of 4 square inches (2,500 square millimeters) at any point along the element.

C. Vertical ladders shall be designed to withstand a minimum of two loads of 250 pounds (1.1 kN) each, concentrated between any two consecutive attachments. The number and spacing of additional loads shall be in accordance with the anticipated usage of the ladder. Individual steps or rungs shall be designed to support a load of 250 pounds (1.1 kN) applied at any point.

1.04 SUBMITTALS:

A. Submit the following shop drawings in accordance with Section 01300.

1. Shop drawings showing clearly the location, size and details of all members

2. Indicate materials, dimensions, connection attachments, anchorage, size and type of fasteners, holes, finishes, and accessories for aluminum stairs and ladders.

3. Reference materials of construction by ASTM designation and grade.

4. Indicate welds including length and size of all shop and field welds by symbols conforming to AWS standards.

5. Letter certifying that stairs and ladders are designed and detailed to meet the requirements of standards, building codes, specifications and design criteria herein described.

B. Product Data:

1. Manufacturer’s catalog sheets on pre-manufactured items.

2. Manufacturer’s specifications, load tables, anchor details, and installation details.

C. Certificates:

1. Welders' Certificates: Certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.

2. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE:

A. Comply with the requirements specified in Section 01400.

B. Obtain field measurements and elevations prior to preparation of shop drawings and fabrication.

C. Welding Qualification and Certification:

1. Furnish written welding procedure for all welds in conformance with AWS Structural Welding Code.

2. Use welders, tackers and welding operators certified by test to perform type of work required in conformance with AWS Structural Welding Code. Maintain current test records certified by an independent testing laboratory.

3. Maintain duplicate qualification and certification records at the job site readily available for examination.

1.06 DELIVERY, STORAGE AND HANDLING:

A. Comply with the requirements specified in Section 01610

B. Identify and match-mark materials, items and fabrications, for installation and field assembly.

C. Deliver items to jobsite as complete units, wherever practicable, ready for installation or erection, with anchors, hangers, fasteners and miscellaneous metal items required for installation.

D. Carefully handle and store materials, protected from weather, corrosion and other damage.

E. Store off the ground on suitable supports.

F. Accept material on site. Inspect for damage.

G. Do not incorporate damaged material in the work.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Aluminum plates, shapes, pipe and castings shall conform to the following ASTM specifications, alloy and temper designations.

1. Extruded structural shapes, bars and tubes: ASTM B221 Alloy 6061-T6.

2. Extruded structural tube or pipe: ASTM B429 Alloy 6061-T6.

3. Sheet and plate: ASTM B209 Alloy 6061-T6.

4. Die and hand forgings: ASTM B247 Alloy 6061-T6.

5. Castings: ASTM B26.

6. Bolts, washers and nuts: Type 304 stainless steel.

7. Gratings (bearing bars): ASTM B211 Alloy 6061-T6 (connecting bars): ASTM B211 Alloy 6061-T5.

B. Welding:

1. Provide filler materials appropriate for the alloys and tempers in accordance with the AWS Structural Welding Code.

2. Provide Class 4043 electrodes.

C. Handrails and Railings per Section 05520.

2.02 FABRICATION:

A. General:

1. Fabricate true to shape, size and tolerances as indicated and specified.

2. Straighten work bent by shearing or punching.

3. Dress exposed edges and ends of metal smooth, with no sharp edges and with corners slightly rounded.

4. Provide sufficient quantity and size of anchors for the proper fastening of the work.

5. Fabricate details and connection assemblies in accordance with drawings, with projecting corners clipped and filler pieces welded flush.

6. Provide clips, lugs, brackets, straps, plates, bolts, nuts, washers, and similar items, as required for fabrication and erection.

7. Use connections of type and design required by forces to be resisted, and to provide secure fastening.

8. Fit work together in fabrication shop and deliver complete, or in parts, ready to be set in place.

B. Welding:

1. Grind exposed edges of welds to a 1/8 inch (3 mm) minimum radius. Grind burrs, jagged edges and surface defects smooth.

2. Prepare welds and adjacent areas such that there is no undercutting or reverse ridges on the weld bead and no sharp peaks or ridges along the weld bead.

3. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.

C. Bolting:

1. Provide stainless steel stud bolts and nuts with heavy aluminum washers for fastening aluminum material.

2. Provide holes required for the connection of adjacent or adjoining work wherever noted on drawings. Locate holes for bolting to supports to a tolerance of 1/16-inch (2 mm) of exact dimensions indicated.

2.03 ALUMINUM STAIRS:

A. Provide aluminum stairs fabricated from structural aluminum channel stringers, aluminum pipe rails and aluminum treads.

B. Rectangular Bar Grating Treads:

1. Provide stair treads of the same type and bar spacing as grating specified.

2. Provide non-skid top surface of bearing bars.

3. Provide minimum 3 inch by 3/16 inch (75 mm by 5 mm) carrier end plates welded to stair treads and punched for bolting to stringers.

4. Provide 1-1/4 inch (30 mm) abrasive nosings.

5. Manufacturers:

a. Borden Metal Products Co.; Type S/BX.

b. Harsco Industrial IKG, Safe-T-Grid

c. Ohio Gratings, Inc.; Type SGI Series.

2.04 VERTICAL LADDERS:

A. Fabricate ladders as shown in the contract drawings.

B. Minimum diameter of rungs shall be 3/4-inch (20 mm). The distance between rungs, cleats, and steps shall not exceed 12 inches (305 mm) and shall be uniform throughout the length of the ladder.

C. The minimum clear length of rungs or cleats shall be 16 inches (405 mm).

D. Coat rungs with coarse grain nonskid epoxy coating. Color of coating shall be yellow. Apply nonskid coating per manufacturer's recommendations.

PART 3 - EXECUTION

3.01 GENERAL:

A. Set and secure in place as indicated. Where bolted connections are used, draw together and draw nuts tightly. Use bolts of lengths required so that they do not project more than 1/4-inch (6 mm) beyond face of nut. Do not use washers unless specified. Provide hexagonal head bolts with hexagonal nuts.

B. Locate anchors and anchor bolts and build into connecting work.

C. Install stairs and ladders in accordance with accepted shop drawings.

3.02 STAIRS:

A. Provide structural aluminum angles, struts, rod hangers, closure plates, and brackets indicated.

3.03 LADDERS:

A. Anchor uprights to wall with angles or bent plates welded to uprights and anchored to wall. Grind welds smooth where required. Provide assemblies with no sharp or rough surface.

B. Secure interior ladders to floor slabs with floor flanges.

C. Provide safety cages or fall prevention system as indicated.

D. Provide structural aluminum angles, struts, rod hangers, closure plates, and brackets indicated.

3.04 CORROSION PROTECTION FOR ALUMINUM SURFACES:

A. Coat aluminum surfaces to be embedded or which will be in contact with concrete or masonry per Section 09940.

B. Where aluminum surfaces come in contact with dissimilar metals, keep the dissimilar metallic surfaces from direct contact by use of neoprene gaskets or washers.

3.05 CLOSEOUT ACTIVITIES:

A. Provide in accordance with Section 01700

END OF SECTION

DIVISION 7

THERMAL AND MOISTURE PROTECTION

SECTION 07900

JOINT SEALANTS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide joint sealants as indicated and specified including the following:

1. Exterior Joints in Vertical Surfaces and Non-traffic Horizontal Surfaces as Indicated Below:

a. Joints between architectural precast concrete units.

b. Control and expansion joints in unit masonry.

c. Perimeter joints between materials listed above and frames of doors, louvers, and windows.

d. Other joints as indicated.

e. Joints at precast concrete coping.

2. Interior Joints in Vertical Surfaces and Horizontal Non-traffic Surfaces as Indicated Below:

a. Control and expansion joints on exposed interior surfaces of exterior walls.

b. Perimeter joints of exterior openings where indicated.

c. Tile control and expansion joints.

d. Vertical control joints on exposed surfaces of interior unit masonry walls and partitions.

e. Perimeter joints between interior wall surfaces and frames of interior doors, louvers, and windows.

f. Perimeter joints of toilet fixtures.

g. Other joints as indicated.

3. Interior Joints in Horizontal Traffic Surfaces as Indicated Below:

a. Joints as indicated.

1.02 RELATED WORK:

A. Section 03410: Precast Structural Concrete Building.

B. Section 03420: Precast Reinforced Concrete Vaults.

C. Section 10200: Louvers.

1.03 REFERENCES:

A. American Society for Testing and Materials (ASTM) Publications:

1. ASTM C 834: Standard Specification for Latex Sealing Compounds.

2. ASTM C 919: Standard Practice for Use of Sealants in Acoustical Applications.

3. ASTM C 920: Standard Specification for Elastomeric Joint Sealants.

4. ASTM C 1193: Standard Guide for Use of Joint Sealants.

1.04 SUBMITTALS:

A. Submit the following in accordance with Section 01300:

1. Product Data: For each joint sealant product specified.

2. Samples: For selection purposes submit three (3) of manufacturer's standard color chart including bead samples, consisting of strips of actual products showing full range of colors available, for each product exposed to view.

3. VOC Content Submittal:

a. Product Data for sealants and sealant primers used inside the weatherproofing system, including printed statement of VOC content.

1.05 QUALITY ASSURANCE:

A. Provide in accordance with Section 01400 and as specified.

B. Installer Qualifications: Engage an experienced Installer who has completed joint sealant applications similar in material, design, and extent to that indicated for Project that have

resulted in construction with a record of successful in service performance.

C. Single Source Responsibility for Joint Sealant Materials: Obtain joint sealant materials from a single manufacturer for each different product required.

1.06 DELIVERY, STORAGE, AND HANDLING:

A. Provide in accordance with Section 01610 and as specified.

B. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

C. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.07 SYSTEM PERFORMANCE REQUIREMENTS:

A. Provide joint sealants that have been produced and installed to establish and to maintain watertight and airtight continuous seals without causing staining or deterioration of joint substrates.

B. Provide joint sealants for interior applications that have been produced and installed to establish and maintain airtight continuous seals that are water resistant and cause no staining or deterioration of joint substrates.

1.08 PROJECT CONDITIONS:

A. Environmental Conditions: Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer.

2. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer or below 40 degrees F (4.4 degrees C).

3. When joint substrates are wet.

B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.

C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

1.09 SEQUENCING AND SCHEDULING:

A. Sequence installation of joint sealants to occur not less than 21 nor more than 30 days after completion of waterproofing, unless otherwise indicated.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

1. Provide paintable sealants at locations that are exposed to view.

B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

2.02 TYPES/MANUFACTURERS:

A. Type 1 - General Purpose Exterior Sealant: Polyurethane; ASTM C920, Type M, Grade NS, Class 25; two component.

1. Sonolastic NP-2; Sonneborne

2. Dymeric; Tremco

3. Sikaflex-2c, NS; Sika

4. Dynatrol 2; Pecora

5. Vulkem 922; Vulkem

6. Chem-Calk 500; Bostik

7. Or acceptable equivalent product.

B. Type 2 - General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, single component, paintable.

1. Tremco Acrylic Latex; Tremco

2. AC-20; Pecora

3. Chem-Calk 600; Bostik

4. Or acceptable equivalent product.

C. Type 3 - Bathtub/Tile Sealant: White silicone; ASTM C920, Uses M and A; single component, mildew resistant.

1. Sanitary 1700; GE Silicones

2. 898 Silicone; Pecora

3. 786 MR Silicone; Dow Corning

4. Or acceptable equivalent product.

D. Type 4 - Acoustical Sealant: Butyl or acrylic sealant; ASTM C920, Grade NS, Class 12-1/2, Uses M and A; single component, solvent release curing, non-skinning.

1. Tremco Acoustical Sealant; Tremco

2. AC-20 FTR Acoustical Sealant; Pecora Corp.

3. Sheetrock Acoustical Sealant; United States Gypsum Co.

4. Or acceptable equivalent product.

2.03 JOINT SEALANT BACKING:

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Plastic Foam Joint Fillers: Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding strips of flexible plastic foam of material indicated below and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

1. Closed cell polyethylene foam, nonabsorbent to liquid water and gas, nonoutgassing in unruptured state.

C. Bond Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self adhesive tape where applicable.

2.04 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealant substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming in any way joint substrates and adjacent nonporous surfaces, and formulated to promote optimum adhesion of sealants with joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint sealant performance. Do not proceed with installation of joint sealants until unsatisfactory conditions have been corrected.

3.02 PREPARATION:

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturer and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean concrete, masonry, unglazed surfaces of ceramic tile, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil free compressed air.

3. Remove laitance and form release agents from concrete.

4. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealant manufacturer based on preconstruction joint sealant substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's recommendations. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION OF JOINT SEALANTS:

A. General: Comply with joint sealant manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Acoustical Sealant Application Standard: Comply with recommendations of ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:

1. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

a. Do not leave gaps between ends of joint fillers.

b. Do not stretch, twist, puncture, or tear joint fillers.

2. Install bond breaker tape between sealants where backer rods are not used between sealants and joint fillers or back of joints.

E. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.

F. Tooling of Nonsag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

1. Provide concave joint configuration unless otherwise indicated.

G. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, and to comply with sealant manufacturer's directions for installation methods, materials, and tools that produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in conformance with sealant manufacturer's recommendations.

3.04 CLEANING:

A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.05 PROTECTION:

A. Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so that and installations with repaired areas are indistinguishable from original work.

3.06 SCHEDULE:

A. Exterior Joints for Which No Other Sealant Type is Indicated: Type 1; colors as selected.

B. Joints Between Exterior Metal Frames and Adjacent Work (except masonry): Type 2.

C. Interior Joints for Which No Other Sealant is Indicated: Type 2; colors as selected.

D. Joints Between Plumbing Fixtures and Walls and Floors, and Between Countertops and Walls: Type 3.

E. Exposed and Concealed Joints where Acoustical Sealant is indicated and required: Type 4, colors as selected.

3.07 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

DIVISION 8

OPENINGS

SECTION 08111

FLUSH PANEL ALUMINUM DOORS AND FRAMES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide aluminum doors and frames with sidelight and accessories as indicated and in compliance with Contract Documents.

1. Section Includes:

a. Exterior and interior manual-swing entrance doors and door-frame units.

1.02 REFERENCES:

A. Aluminum Association (AA):

1. M12C22A31: Mechanical Finish

2. M12C22A31/A34: Mechanical Finish

3. M12C22A32/A34: Mechanical Finish

4. M12C22A41: Anodized Plus Finish

5. M12C22A42/A44: Mechanical Finish

B. American Architectural Manufacturers Association (AAMA):

1. AAMA 603.8: Performance Requirements and Test Procedures for Pigmented Organic Coatings on Extruded Aluminum.

2. AAMA 607.1: Guide Specification and inspection methods for clear Anodize Finishes for Architectural Aluminum.

3. AAMA 608.1: Guide Specification and inspections methods for Electrolytically Deposited Color Anodic Finished for Architectural Aluminum.

4. AAMA 609 & 610-2: Cleaning and Maintenance Guide for Architecturally Finished Aluminum.

C. American National Standards Institute (ANSI):

1. ANSI/NFPA 80: Standard for Fire Doors and fire Windows: National Fire protection Association.

2. ANSI A 117.1: Accessible and Usable Buildings and Facilities.

D. American Society for Testing and Materials International (ASTM):

1. B209/B209M: Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

2. B221/B221M: Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

3. B308/B308M: Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles

4. B429: Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube

5. D2287: Standard Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds.

6. E90: Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

7. E413: Classification for Rating Sound Insulation

8. E699: Standard Practice for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating of Building Components

E. American Welding Society (AWS):

1. A5.10/A5.10M: Specification for Bare Aluminum and Aluminum-Alloy Welding Electrodes and Rods

2. D1.2: Structural Welding Code - Aluminum

F. Builders Hardware Manufacturer's Association Inc. (BHMA):

1. A156.1: Butts and Hinges.

2. A156.3: Exit Devices.

3. A156.4: Door Controls - Closers.

4. A156.5: Auxiliary Locks & Associated Products.

5. A156.6: Architectural Door Trim.

6. A156.8: Door Controls - Overhead Stops and Holders.

7. A156.16: Auxiliary Hardware

8. A156.21: Thresholds.

G. GANA:

1. Glazing Manual

H. International Building Code (IBC):

1. ICC/IBC: International Building Code

I. National Association of Architectural metal Manufacturers (NAAMM):

1. NAAMM: Metal Finished Manual for Architectural and Metal Products.

J. National Fire Protection Association (NFPA):

1. 101: Life Safety Code

2. 252: Standard Method of Fire Tests of door Assemblies.

K. The Society for Protective Coatings (SSPC):

1. Guide 12: Guide for Illumination of Industrial Painting Projects

2. Paint 12: Cold-Applied Asphalt Mastic (Extra Thick Film)

3. SP COM: Surface Preparation Commentary for Steel and Concrete Substrates

L. Underwriters' Laboratories, Inc. (UL).

1. 305: Safety Panic Hardware

1.03 DEFINITIONS:

A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

1.04 PERFORMANCE REQUIREMENTS:

A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:

1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.

2. Dimensional tolerances of building frame and other adjacent construction.

3. Failure includes the following:

a. Deflection exceeding specified limits.

b. Glazing-to-glazing contact.

c. Loosening or weakening of fasteners, attachments, and other components.

d. Failure of operating units.

B. Sound Transmission: Provide aluminum-framed systems with fixed glazing and framing areas having the following sound-transmission characteristics:

1. Sound Transmission Class (STC): Minimum 35 STC when tested for laboratory sound transmission loss according to ASTM E90 and determined by ASTM E413.

C. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by aluminum-framed systems without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.

1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.

2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.

1.05 SUBMITTALS:

A. Submit the following shop drawings in accordance with Section 01300.

B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.

C. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.

1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

F. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.

2. Anchorage.

3. Expansion provisions.

4. Glazing.

G. Welding certificates.

H. Preconstruction Test Reports: For sealant.

I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems, indicating compliance with performance requirements.

J. Source quality-control reports.

K. Quality-Control Program for Structural-Sealant-Glazed System: Include reports.

L. Field quality-control reports.

M. Warranties: Sample of special warranties.

N. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.

1.06 SPARE PARTS:

A. Comply with the requirements specified in Section 01610.

1.07 QUALITY ASSURANCE:

A. Comply with the requirements specified in Section 01400.

B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

C. Testing Agency Qualifications: Qualified according to ASTM E699 for testing indicated.

D. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.

E. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

1. Do not revise intended aesthetic effects, as judged solely by Engineer, except with Engineer's acceptance. If revisions are proposed, submit comprehensive explanatory data to Engineer for review.

F. Accessible Doors and Frames: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

G. Source Limitations for Aluminum Doors and Frames: Obtain from single source from single manufacturer.

H. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code - Aluminum."

I. Preinstallation Conference: Conduct conference at Project site.

1. Convene minimum one week prior to commencing Work of this section.

1.08 DELIVERY STORAGE AND HANDLING:

A. Deliver aluminum frames and doors individually protective wrapped within cartons and marked for the corresponding scheduled opening. Do not bulk pack frames.

B. Inspect frames upon delivery for damage.

1. Repair minor damage to pre-finished products as recommended by manufacturer.

2. Replace frames that cannot be satisfactorily repaired.

C. Store aluminum frames and doors at Project site under cover and as near as possible to final installation location. Do not use covering material that will cause discoloration of aluminum finish.

D. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond when exposed to sunlight or weather.

1.09 PROJECT/SITE CONDITIONS:

A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

B. Environmental Conditions: Do not install sealants nor glazing materials when ambient temperature is less than 40 degrees F during and 48 hours after installation.

C. Do not install aluminum frames and door until area of work has been completely enclosed and interior is protected from the elements.

D. Maintain temperature and humidity in areas of installation within reasonable limits, as close as possible to final occupancy standards. If necessary, provide artificial heating, cooling and ventilation to maintain required environmental conditions.

1.10 COORDINATION:

A. Coordinate the Work with installation of firestopping, components or materials.

1.11 WARRANTY:

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.

b. Deterioration of metals**,** metal finishes, and other materials beyond normal weathering.

c. Adhesive or cohesive sealant failures.

d. Failure of operating components.

2. Warranty Period: 10 years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION:

A. Aluminum doors and frames include tubular aluminum sections, aluminum, shop fabricated, factory finished, infill, related anchorage and attachment devices.

B. System Assembly: Shop unitized assembly.

2.02 MANUFACTURERS:

A. Special-Lite, Inc.

B. Commercial Door Systems

C. Cline Doors

D. Alutech Corporation.

2.03 ALUMINUM FLUSH DOORS:

A. As Basis of Design provide Model: SL-16 aluminum flush doors with aluminum frames, as manufactured by Special-Lite or comparable product which meets or exceeds the performance, material and appearance characteristics of the Basis of Design as judged by the Contracting Officer's representative.

B. Construction:

1. Door Thickness: 1-3/4 inches.

2. Stiles and Rails: Aluminum extrusions made from prime-equivalent billet that is produced from 100% reprocessed 6063-T6 alloy recovered from industrial processes, minimum of 2-5/16-inch depth.

3. Corners: Mitered.

4. Provide joinery of 3/8-inch diameter full-width tie rods through extruded splines top and bottom integral to standard tubular shaped stiles and rails reinforced to accept hardware as specified.

5. Securing Internal Door Extrusions: 3/16-inch angle blocks and locking hex nuts for joinery. Welds, glue, or other methods are not acceptable.

6. Furnish extruded stiles and rails with integral reglets to accept face sheets. Lock face sheets into place to permit flush appearance.

7. Rail caps or other face sheet capture methods are not acceptable.

8. Extrude top and bottom rail legs for interlocking continuous weather bar.

9. Meeting Stiles: Pile brush weatherseals. Extrude meeting stile to include integral pocket to accept pile brush weatherseals.

10. Bottom of Door: Install bottom weather bar with nylon brush weatherstripping into extruded interlocking edge of bottom rail.

11. Glue: Use of glue to bond sheet to core or extrusions is not acceptable

C. Face Sheet:

1. Material: 0.062-inch thick aluminum.

2. Texture: Embossed pattern.

D. Core:

1. Material: Poured-in-place polyurethane foam.

2. Density: Minimum of 5 pounds per cubic foot.

3. R-Value: Minimum of 9.

4. ASTM E84: Class A.

E. Cutouts:

1. Manufacture doors with cutouts for required vision lites, louvers, and panels.

2. Factory install vision lites, louvers, and panels.

F. Hardware:

1. Premachine doors in accordance with templates from specified hardware manufacturers and hardware schedule.

2. Factory install hardware.

2.04 MATERIALS:

A. Aluminum Members:

1. Aluminum extrusions made from prime-equivalent billet that is produced from 100% reprocessed 6063-T6 alloy recovered from industrial processes: ASTM B 221.

2. Sheet and Plate: ASTM B 209.

3. Alloy and Temper: As required by manufacturer for strength, corrosion resistance, application of required finish, and control of color.

B. Components: Door and frame components from same manufacturer.

C. Fasteners:

1. Material: Aluminum, 18-8 stainless steel, or other non-corrosive metal.

2. Compatibility: Compatible with items to be fastened.

3. Exposed Fasteners: Screws with finish matching items to be fastened.

2.05 FABRICATION:

A. Sizes and Profiles: Required sizes for door and frame units, and profile requirements shall be as indicated on the Drawings.

B. Coordination of Fabrication: Field measure before fabrication and show recorded measurements on shop drawings.

C. Assembly:

1. Complete cutting, fitting, forming, drilling, and grinding of metal before assembly.

2. Remove burrs from cut edges.

D. Welding: Welding of doors or frames is not acceptable.

E. Fit:

1. Maintain continuity of line and accurate relation of planes and angles.

2. Secure attachments and support at mechanical joints with hairline fit at contacting members.

2.06 ALUMINUM DOOR FRAMING SYSTEMS:

A. Tubular Framing:

1. Size and Type: As indicated on the Drawings.

2. Materials: Aluminum extrusions made from prime-equivalent billet that is produced from 100% reprocessed 6063-T6 alloy recovered from industrial processes, 1/8-inch minimum wall thickness.

3. Applied Door Stops: 0.625-inch high, with screws and weatherstripping. Doorstop shall incorporate pressure gasketing for weathering seal. Counterpunch fastener holes in door stop to preserve full metal thickness under fastener head.

4. Frame Members: Box type with 4 enclosed sides. Open-back framing is not acceptable.

5. Caulking: Caulk joints before assembling frame members.

6. Joints:

   a. Secure joints with fasteners.

   b. Provide hairline butt joint appearance.

7. Field Fabrication: Field fabrication of framing using stick material is not acceptable.

8. Applied Stops: For side, transom, and borrowed lites and panels. Applied stops shall incorporate pressure gasketing for weathering seal. Reinforce with solid bar stock fill for frame hardware attachments.

9. Hardware:

   a. Premachine and reinforce frame members for hardware in accordance with manufacturer's standards and hardware schedule.

   b. Factory install hardware.

10. Anchors:

    a. Anchors appropriate for wall conditions to anchor framing to wall materials.

    b. Doorjamb and header mounting holes shall be spaced no more than 24 inches apart.

    c. Secure head and sill members of transom, side lites, and similar conditions.

11. Side Lites:

    a. Factory preassemble side lites to greatest extent possible.

    b. Mark frame assemblies according to location.

B. Framing System:

1. As Basis of Design provide Model: SL-1030 Series, or comparable product by an approved manufacturer which meets or exceeds performance, material and appearance characteristics of Basis of Design as judged by Contracting Officer’s representative.

2. Insert frame as indicated on the Drawings, using integral stop fitted with weatherstripping.

3. Corner joints of miter design, secure with furnished aluminum clips, and screw into place.

4. Hardware:

   a. Premachine and reinforce insert frame members for hardware in accordance with manufacturer's standards and hardware schedule.

   b. Factory install hardware.

5. Anchors:

   a. Anchors of suitable type to fasten insert framing to existing frame materials.

   b. Minimum of 5 anchors on jambs up to 7'-4" height, 3 anchors on headers, and 1 additional anchor for each additional foot of frame.

C. Frame Capping:

1. Model: SL-70.

2. Capping: With insert frame as indicated on the Drawings.

3. Finish: Match framing.

2.07 HARDWARE:

A. Premachine doors in accordance with templates from specified hardware manufacturers and hardware schedule.

B. Factory install hardware.

C. Hardware Schedule: As specified in Section 08710.

2.08 ALUMINUM FINISHES:

A. High High-Performance Organic Coating Finish: AA-C12C42R1x. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Examine areas to receive doors. Notify Contracting Officer of conditions that would adversely affect installation or subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected.

B. Verify dimensions and method of attachment with other work.

3.02 PREPARATION:

A. Ensure openings to receive frames are plumb, level, square, and in tolerance.

3.03 INSTALLATION:

A. Install doors in accordance with manufacturer's instructions. Do not install damaged components.

B. Install doors plumb, level, square, true to line, and without warp or rack.

C. Anchor frames securely in place.

D. Separate aluminum from other metal surfaces with bituminous coatings or other means approved by Contracting Officer.

E. Set thresholds in bed of mastic and backseal.

F. Install exterior doors to be weathertight in closed position.

G. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Contracting Officer.

H. Remove and replace damaged components that cannot be successfully repaired as determined by Contracting Officer.

3.04 FIELD QUALITY CONTROL:

A. Manufacturer's Field Services: Manufacturer's representative shall provide technical assistance and guidance for installation of doors.

3.05 ADJUSTING:

A. Adjust doors, hinges, and locksets for smooth operation without binding.

3.06 CLEANING:

A. Clean doors promptly after installation in accordance with manufacturer's instructions.

B. Do not use harsh cleaning materials or methods that would damage finish.

3.07 PROTECTION:

A. Protect installed doors to ensure that, except for normal weathering, doors will be without damage or deterioration at time of substantial completion.

3.08 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 08710

FINISH HARDWARE

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Section Includes:

1. Finish hardware for doors as specified and as listed in "Hardware Groups" and required by actual conditions.

2. Include screws, special screws, bolts, special bolts, expansion shields, and other devices for proper application of hardware.

B. General Requirements:

1. Provide items, articles, materials, operations and methods listed, mentioned or scheduled herein or on drawings, in quantities as required to complete project. Provide hardware that functions properly. Prior to furnishing hardware, advise Contracting Officer of items that will not operate properly, are improper for conditions, or will not remain permanently anchored.

1.02 REFERENCES:

A. ANSI 156: American National Standards Institute

B. DHI: Door and Hardware Institute

C. BHMA: Builders Hardware Manufacturers Association

1.03 SUBMITTALS:

A. Submit the following in accordance with Section 01300:

1. Hardware Schedule: Submit hardware schedule in vertical format as illustrated by the Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Schedules, which do not comply, will be returned for correction before checking. Hardware schedule shall clearly indicate Contracting Officer's hardware group and manufacturer of each item proposed. The schedule shall be reviewed prior to submission by a certified Architectural Hardware Consultant (AHC).

a. Provide illustrations from manufacturers catalogs and data in brochure form for all products, including model, function, design, finishes, and options.

b. Check specified hardware for suitability and adaptability to details and surrounding conditions. Indicate unsuitable or incompatible items and proposed substitutions in hardware schedule.

c. Provide listing of manufacturer's template numbers for each item of hardware in hardware schedule.

d. Furnish other Contractors, and Subcontractors concerned, with copies of final approved hardware schedule. Submit necessary templates and schedules as soon as possible to door fabricators in accordance with schedule that is required for fabrication.

e. Samples: Lever design or finish sample: Provide samples if requested by Contracting Officer.

2. Installation Instructions: Provide manufacturer's written installation and adjustment instructions for finish hardware. Send installation instructions to site with hardware after approval of finish hardware.

3. Templates: Submit templates and final approved hardware schedule to door and frame supplier and others as applicable to enable proper and accurate sizing and locations of cutouts and reinforcing.

4. Closeout Submittals: Comply with Section 01700 including specific requirements indicated.

a. Operating and maintenance manuals: Submit sets containing the following:

(1) Complete information in care, maintenance, and adjustment, and data on repair and replacement parts, and information on preservation of finishes.

(2) Catalog pages for each product.

(3) Name, address, and phone number of local representative for each manufacturer.

(4) Parts list for each product.

b. Copy of final approved hardware schedule, edited to reflect "As installed."

c. Copy of final keying schedule.

d. One complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

e. Copy of all warrantees; including all appropriate reference numbers for manufacturers to identify the project.

1.04 QUALITY ASSURANCE:

A. Provide in accordance with Section 01400 and as specified.

B. Manufacturer: Obtain each type of hardware (ie. latch and locksets, hinges, closers) from single manufacturer, although several may be indicated as offering products complying with requirements.

C. Supplier: Recognized architectural finish hardware supplier, with warehousing facilities, who has been providing hardware for period of not less than 3 years. The supplier shall be, or employ, a certified Architectural Hardware Consultant (AHC), who is registered in the continuing education program as administered by the Door and Hardware Institute. The hardware schedule shall be prepared and signed by a certified AHC.

D. Installer: Firm with 3 years experience in installation of similar hardware to that required for this project, including specific requirements indicated.

E. Regulatory Label Requirements: Provide nationally recognized testing agency label or stamp on hardware for labeled openings. Where UL requirements conflict with drawings or specifications, hardware conforming to UL requirements shall be provided. Conflicts and proposed substitutions shall be clearly indicated in hardware schedule.

F. Handicapped Requirements: Doors to stairs (other than exit stairs), loading platforms, boiler rooms, stages and doors serving other hazardous locations shall have knurled or other similar approved marking of door lever handles or cross bars in accordance with local building codes.

G. Pre-Installation Conference: Prior to the installation of hardware, manufacturer's representatives for locksets, closers, and exit devices shall arrange and hold a jobsite meeting to instruct the installing contractor's personnel on the proper installation of their respective products. A letter of compliance, indicating when this meeting is held and who is in attendance, shall be sent to the Contracting Officer.

1.05 DELIVERY, STORAGE AND HANDLING:

A. Provide in accordance with Section 01610 and as specified.

B. Deliver hardware to jobsite in manufacturer's original packaging, marked to correspond with approved hardware schedule. Do not deliver hardware until suitable locked storage space is available. Check hardware against reviewed hardware schedule. Store hardware to protect against loss, theft or damage.

C. Deliver hardware required to be installed during fabrication of hollow metal, aluminum, wood, or stainless steel doors prepaid to manufacturer.

1.06 GUARANTEE/WARRANTY:

A. General: Guarantee workmanship and material provided against defective manufacture. Repair or replace defective workmanship and material appearing within period of one year after Substantial Completion.

B. Provide five year factory warranty on exit devices against defects in material and workmanship from date of occupancy of Project.

C. Provide ten year factory warranty on door closer body against defects in material and workmanship from date of occupancy of Project.

D. Replace shortages and incorrect items with correct material at no additional cost to Contracting Officer.

E. At completion of project, a qualified factory representative shall inspect closer installations. After this inspection, letter shall be sent to Contracting Officer reporting on conditions, verifying that closers have been properly installed and adjusted.

1.07 SEQUENCING AND SCHEDULING:

A. Deliver finish hardware to the jobsite in a timely manner so as not to delay progress of other trades.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Manufacturers listed have been chosen to establish a standard of quality, design, and function.

B. Manufacturer information:

1. The following is a list of approved manufacturers, address, and website (if available). This information is being supplied for reference only and in no way implies product acceptance. Only the products listed in the respective category are considered to be acceptable for this project.

a.	ABH	Elk Grove, IL
b.	Corbin-Russwin	Monroe, NC
c.	Detex	New Braunfels, TX
d.	Don-jo	Sterling, MA
e.	Folger Adam	Lemont, IL
f.	Glynn-Johnson	Indianapolis, IN
g.	Hager	St. Louis, MI
h.	HES	Phoenix, AZ
i.	Key Control	Katy, TX
j.	LCN	Princeton,IL
k.	Locknetics	Forestville, CT
l.	Lund	Bath, OH
m.	Markar	Lancaster, NY
n.	McKinney	Scranton, PA
o.	National Guard	Memphis, TN
p.	Norton	Monroe, NC
q.	Pemko	Memphis, TN
r.	Precision	Romulus, MI
s.	Reese	Rosemont, MN
t.	Rixson	Monroe, NC
u.	Rockwood	Altoona, PA
v.	Sargent	New Haven, CT
w.	Schlage	Colorado Springs, CO
x.	Securitron	Sparks, NV
y.	Sentrol	Tualatin, OR
z.	Stanley	New Britain, CT
aa.	Telkee	Dover, DE
bb.	Von Duprin	Indianapolis, IN
cc.	Westguard	Twinsburg, OH

2.02 BUTTS AND HINGES:

A. Acceptable Manufacturers and Products:

	Type	McKinney	Hager	Stanley
1.	Type 1	T4A3795	BB1262	FBB268
2.	Type 2	TA2714	BB1279	FBB179
3.	Type 3	TA2314	BB1191	FBB191
4.	Type 4	T4A3786	BB1168	FBB168
5.	Type 5	T4A3386	BB1199	FBB199

B. Application:

1. Exterior over 36 inches wide: Type 5

2. Exterior 36 inches wide or less: Type 3

3. Interior doors over 36 inches wide: Type 5

4. Interior doors 36 inches wide or less: Type 3

5. Interior corridor pairs of doors swinging in same direction: Type 1 (unless reveal or clearance does not allow)

6. Provide NRP (non-removable pins) at out-swinging lockable doors (interior or exterior).

C. Size:

1. 2-1/4 inch Doors: 5 inch by 5 inch

2. 1-3/4 inch Doors: 4-1/2 inch by 4-1/2 inch

3. 1-3/8 inch Doors: 3-1/3 inch by 3-1/2 inch

D. Quantity:

1. 2 - hinges per leaf for openings through 60 inches high.

2. 1 - additional hinge per leaf for each additional 30 inches in height or fraction thereof.

3. 4 - Dutch doors up to 90 inches in height.

E. Drill 5/32 inch hole and use No. 12, 1-1/4 inch steel threaded to the head wood screws for hinges on wood doors.

2.03 FLUSH BOLTS AND DUSTPROOF STRIKES:

A. Acceptable Manufacturers and Products:

	Type	Rockwood	Hager	Donjo
1.	Manual, Hollow Metal Doors	555	282D	1555
2.	Manual, Wood Doors	555	282D	1555
3.	Automatic, Hollow Metal Doors	1842	292D	FLM-1
4.	Automatic, Wood Doors	1942	291D	FLW-22
5.	Dust Proof Strike	570	280X	1570

B. Non-labeled Openings: Provide 2 flush bolts 555 for inactive leaf of pairs of locked and latched doors. Locate centerline of top bolt not more than 78 inches from finished floor. Provide dust proof strike 570 for bottom bolt.

C. Labeled Openings: Provide automatic flush bolt set 1842 or 1942, as applicable, for inactive leaf of pairs of doors. Provide dust proof strike 570 for bottom bolt.

2.04 LOCKSETS – MORTISE:

A. Acceptable Manufacturers and Products:

	Manufacturer	Series
1.	Sargent	8200 x LNL
2.	Schlage	L9000 x 06A
3.	Corbin-Russwin	ML2000 x NSA

B. Provide lock series and functions as specified in Hardware Groups, with the provisions below. Sargent product numbers are referenced in the Hardware Groups.

1. Cylinders: Refer to keying requirements

2. Backsets: 2-3/4 inches.

3. Strikes: Provide wrought boxes and strikes with proper lip length to protect trim but not to project more than 1/8 inch beyond trim, frame or inactive leaf. Where required, provide open back strike and protected to allow practical and secure operation.

4. Doors to stairs (other than exit stairs), loading platforms, boiler rooms, stages and doors serving other hazardous locations shall have knurled or other similar approved marking of door lever handles or cross bars in accordance with local building codes.

2.05 DEADLOCKS:

A. Acceptable Manufacturers and Products:

	Manufacturer	Series
1.	Sargent	4870
2.	Schlage	L460
3.	Corbin-Russwin	DL4000

B. Provide deadlock series and functions as specified in Hardware Groups, with the provisions below. Sargent product numbers are referenced in the Hardware Groups.

1. Cylinders: Refer to keying requirements.

2. Backsets: 2-3/4 inches.

3. Strikes: Provide manufacturers standard wrought brass, bronze, or steel strike.

2.06 EXIT DEVICES:

A. Acceptable Manufacturers and Products:

	Manufacturer	Series
1.	Sargent	80 Series
2.	Von Duprin	98/35 Series
3.	Precision	Apex Series

B. Provide exit device series and functions as specified in Hardware Groups. Sargent product numbers are referenced in the Hardware Groups.

C. All exit devices shall be UL listed for panic. Exit devices for labeled doors shall be UL listed as "Fire Exit Hardware".

D. Where lever trim is specified, provide lever design to match lockset levers.

E. Provide cylinders for exit devices with locking trim and cylinder dogging.

F. Provide cylinder dogging feature for non-rated exit devices.

G. Provide keyed removable mullions, as specified in the Hardware Groups.

2.07 KEYING:

A. Acceptable Manufacturers and Products:

	Manufacturer
1.	Sargent
2.	Schlage
3.	Corbin-Russwin

B. Provide manufacturers standard removable core cylinders. Provide construction cores with construction master keying for use during construction. The hardware supplier shall install permanent master keyed cores upon completion of the project.

C. Factory key all cylinders with manufacturer retaining permanent keying records.

D. Comply with City of Middletown Water and Sewer Department standards and requirements. Coordinate with City of Middletown Water and Sewer Department

locksmithing vendor.

E. Submit proposed keying schedule to Contracting Officer. Meet with Contracting Officer to review schedule.

F. All cylinders, unless noted otherwise, shall be operated by one of a series of Master Keys, conforming to the existing City of Middletown, Water and Sewer Department keying system.

G. Visual key control:

1. All keys shall be stamped with their respective key set number and stamped “DO NOT DUPLICATE".

2. Grand master and master keys shall be stamped with their respective key set letters.

3. Do not stamp any keys with the factory key change number.

4. Do not stamp any cores with key set on face (front) of Core. Stamp on back or side of cores so not to be visible when core is in cylinder.

2.08 DOOR TRIM:

A. Acceptable Manufacturers and Products:

	Type	Rockwood	Hager	Donjo
1.	Push Plate	70	30S	71
2.	Pull	BF111	H4J	H20
3.	Pull, offset	BF157	H12J	H1157
4.	Push Bar	47	130S	147
5.	Kick Plate	K1050 B4E	194S	90 B4E
6.	Door Edges	306B	182P	1299

B. Push Plates:

1. Rockwood #70, provide 4 inches by 16 inch unless otherwise indicated.

2. Where width of door stile prevents use of 4 inch wide plate, provide push plate 3 1/2 inches wide.

C. Push Bars:

1. Rockwood #47, unless otherwise indicated.

2. Where required, mount back to back with pull.

D. Pull, offset:

1. Rockwood #BF157, unless otherwise indicated.

2. Where required, mount back to back with push bar.

E. Pulls:

1. Rockwood #BF111, unless otherwise indicated.

2. Where required, mount back to back with push bar.

F. Pull Plate:

1. Rockwood #BF111 pull x #70 plate, provide plate 4 inches by 16 inch unless otherwise indicated.

2. Where width of door stile prevents use of 4 inch wide plate, provide push plate 3 1/2 inches wide.

G. Kick Plates and Armor Plates:

1. Minimum of 0.050 inch thick, beveled 4 edges.

2. At single doors provide width 1-1/2 inch less than door width on stop side and one inch less than door width on face side.

3. At pairs of doors provide width one inch less than door width on either sides.

4. Provide Height:

a. Mop Plates: 4 inches, unless otherwise indicated.

b. Kick Plates: 8 inches, unless otherwise indicated.

c. Armor Plates: 34 inches, unless otherwise indicated.

H. Edge Guards:

1. Minimum .050" thick, stainless steel.

2. Rockwood #306B x 42 inches high as noted in Hardware Groups.

2.09 COORDINATORS:

A. Acceptable Manufacturers and Products:

	Manufacturer	Series
1.	Rockwood	1600 Series
2.	Hager	297D
3.	Donjo	2010/2020 Series

B. Provide 1600 Series coordinator for labeled pairs of doors equipped with automatic flush bolts and those with vertical rod/mortise lock fire exit device combinations with astragals.

C. Provide filler bars for total opening width, closer mounting brackets, carry bars, and special preparation for top latches where applicable.

2.10 DOOR CLOSERS:

A. Acceptable Manufacturers and Products:

	Type	Sargent	LCN	Norton
1.	Stop Arm	351-CPS	4040S-CUSH	UNI-7500-BF
2.	Stop/Holder Arm	351-CPSH	404S-H-CUSH	UNI-7500BF-H
3.	Regular Arm	351-O	4040	7500BF
4.	HD Parallel Arm	351-P10	4040EDA	PR7500BF

B. Provide all closers on exterior openings with a stop arm, unless noted otherwise.

C. Provide all closers on interior openings with a regular arm or heavy duty parallel arm, unless noted otherwise.

D. Provide non-sized closers, adjustable to meet maximum opening force requirements of ADA.

E. Provide drop plates, brackets, or adapters for arms as required to suit details.

F. Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors. Closers shall not be visible in corridors, lobbies and other public spaces unless necessary.

G. Provide back-check for closers.

H. Provide holder arms where indicated.

I. Provide stop arms where indicated.

J. Provide delayed action where indicated.

K. Provide closers for doors as noted in Hardware Groups and, in addition, provide closers for labeled doors whether or not specifically noted in group.

L. Provide closers meeting the requirements of UBC 7-2 and UL 10C positive pressure tests.

M. Provide bolt attachments or blocking for mineral core door application as directed by Contracting Officer and/or door specifications.

2.11 OVERHEAD STOPS/HOLDERS:

A. Acceptable Manufacturers and Products:

	Type	Sargent	ABH	Glynn Johnson
1.	Surface, med. Duty	1540	3300	450
2.	Surface, heavy duty	590	9000	900

B. Provide 1540 Series overhead stop for interior doors equipped with regular arm surface type closer that swing more than 140 degrees before striking wall, and for doors that open against equipment, casework, sidelights, other objects that would make wall stops inappropriate. Provide 590 Series overhead stop for exterior doors where specified.

C. Provide bolt attachments or blocking for mineral core door application as directed by Contracting Officer and/or door specifications.

2.12 STOPS AND HOLDERS:

A. Acceptable Manufacturers and Products:

	Type	Rockwood	Hager	Donjo
1.	Wall, convex	406	232W	1406
2.	Floor	440/442	241F/243F	1440/1442
3.	Floor, heavy duty	470/471	267F267S	1471
4.	Stop/Holder, heavy duty	472/472	268F/268S	1473

B. Provide Rockwood #406 wall stop for each door leaf except where floor stops are scheduled in Hardware Groups. Where conditions do not allow a wall stop or a floor stop presents a tripping hazard than provide an overhead stop.

C. Provide 1540 Series overhead stop for interior doors and 590 Series overhead stop for exterior doors that swing more than 140 degrees before striking a wall.

D. Floor or base stops shall be used only where definitely specified or absolutely unavoidable.

2.13 THRESHOLDS:

A. Acceptable Manufacturers and Products:

		Interior Door Saddle Type	Exterior Door Stop Type
	Manufacturer	Series	Series
1.	Pemko	171	2000B
2.	Reese	S205	5483
3.	National Guard	425	896

B. Provide thresholds as indicated on drawings and as specified.

1. Refer to drawings for special details. Provide accessories, shims and fasteners.

2. Where thresholds occur at openings with one or more mullions, they shall be cut for the mullions and extended continuously for the entire opening.

2.14 WEATHERSTRIPPING:

A. Acceptable Manufacturers and Products:

	Type	Pemko	Reese	National Guard
1.	Sweeps	315CN	323	200N
2.	Jambs	316AV	DS75	152
3.	Astragals	18061CP	964C	C607
4.	Rain Drip	346C	R201	16D

B. Where weatherstripping is specified in hardware groups, provide 316AV at jambs, unless detailed or scheduled otherwise.

1. Provide self-tapping fasteners for weatherstripping being applied to hollow metal frames.

C. Where astragals are specified in hardware groups, provide 2 pieces of 18061CP unless detailed or scheduled otherwise.

D. Where sweeps are specified in hardware groups, provide 315CN unless detailed or scheduled otherwise.

E. Where rain drips are specified in hardware groups, provide 346C x full frame width, unless detailed otherwise.

2.15 GASKETING:

A. Acceptable Manufacturers and Products:

	Type	Pemko	Reese	National Guard
1.	Smoke	PK55D	F-897B	2525

B. Where smoke gasket is specified in hardware groups, provide PK55D, unless detailed otherwise.

C. Provide accessories, shims and fasteners.

D. Provide gaskets for 20-minute doors and doors designated for smoke and draft control.

E. Where frame applied intumescent seals are required by the manufacturer, provide gaskets that comply with UBC 7-2 and UL 10C positive pressure tests.

2.16 ASTRAGALS:

A. Acceptable Manufacturers:

1. Reese

2. Pemko

3. National Guard.

B. Provide overlapping type astragal (tee type) on key side of pair of doors.

C. Provide extruded aluminum overlapping type astragal (tee type) with integral (vertical groove) weathering gasket on key side of pairs of exterior doors.

2.17 SILENCERS:

A. Acceptable Manufacturers and Products:

	Type	Westguard	Hager	Donjo
1.	Hollow Metal Frame	650ST	307D	1608
2.	Wood Frame	640WD	308D	1609

B. Where weatherstipping or gasketing is not used provide the appropriate silencer for each frame.

2.18 DOOR POSITION SWITCHES:

A. Acceptable Manufacturers and Products:

	Manufacturer	Series
1.	Sargent	3287
2.	Sentrol	1078
3.	Detex	MS-2049F

B. Coordinate door and frame preparations with door and frame suppliers.

C. Switches shall be installed in frame head approximately 4" from latching door edge.

2.19 FASTENERS:

A. Including, but not limited to, wood or machine screws, bolts, nuts, anchors, etc. of proper type, material, and finish required for installation of hardware.

B. Use phillips head for exposed screws. Do not use aluminum screws to attach hardware.

C. Provide self-tapping (TEC) screws for attachment of sweeps and stop-applied weatherstripping.

D. Install all hardware with only fasteners provided by the manufacturer for use with the specific product and according to the manufacturers written instructions.

2.20 TYPICAL FINISHES AND MATERIALS:

A. Finishes, unless otherwise specified:

1. Butts: Exterior Doors

   a. US32D (BHMA 630) on Stainless Steel

2. Butts: Interior Doors

   a. US32D (BHMA 630) on Stainless Steel

3. Continuous Hinges:

   a. US32D (BHMA 630) on Stainless Steel

4. Flush Bolts:

   a. US26D (BHMA 626) on Brass or Bronze

5. Exit Devices:

    a. US32D (BHMA 630) on Stainless Steel

6. Locks and Latches:

    a. US32D (BHMA 630) on Stainless Steel

7. Push Plates, Pulls and Push Bars:

    a. US32D (BHMA 630) on Stainless Steel

8. Coordinators:

    a. US26D (BHMA 626) on Brass or Bronze

9. Kick Plates, Armor Plates, and Edge Guards:

    a. US32D (BHMA 630) on Stainless Steel

10. Overhead Stops and Holders:

    a. US26D (BHMA 626) on Brass or Bronze

11. Closers: Surface mounted:

    a. Sprayed Aluminum Lacquer

12. Miscellaneous Hardware:

    a. US32D (BHMA 630) on Stainless Steel or US26D (BHMA 626) on Brass or Bronze

PART 3 – EXECUTION

3.01 EXAMINATION:

A. Examine doors, frames, and related items for conditions that would prevent the proper application of finish hardware. Do not proceed until defects are corrected.

B. Field verify existing doors, frames, hardware, and conditions prior to scheduling hardware.

3.02 INSTALLATION:

A. Install finish hardware in accordance with reviewed hardware schedule and manufacturer's printed instructions. Prefit hardware before finish is applied. Remove and reinstall after finish is completed. Install hardware so that parts operate smoothly, close tightly and do not rattle.

B. Installation of hardware shall comply with NFPA 80 and NFPA 101 requirements.

C. Set units level, plumb and true to line and location. Adjust and reinforce attachment to substrate as necessary for proper installation and operation.

D. Drill and countersink units that are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

E. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant, forming tight seal between threshold and surface to which set. Securely and permanently anchor thresholds, using countersunk non-ferrous screws to match color of thresholds (stainless steel screws at aluminum thresholds).

F. Lead Protection: Lead wrap hardware penetrating lead-lined doors. Levers and roses to be lead lined. Apply kick and armor plates with 3M adhesive #1357, as recommended by 3M Co., on lead-lined doors.

3.03 FIELD QUALITY CONTROL:

A. After installation has been completed, a qualified person from the hardware supplier is to check the Project to determine proper application of finish hardware according to schedule. Also check operation and adjustment of all hardware items.

B. Installer shall deliver to Contracting Officer, upon completion, one set of installation and maintenance instructions and specialty tools for all hardware items.

3.04 ADJUSTING AND CLEANING:

A. At completion, hardware shall be left clean and free from disfigurement. Make adjustment to door closers and other items of hardware. Where hardware is found defective repair or replace or otherwise correct as directed.

B. Adjust door closers to meet opening force requirements of Uniform Federal Accessibility Standards.

C. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

D. Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of space or area, return to work during week prior to acceptance or occupancy, and make/ check adjustments of hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors.

E. Final Adjustment: Installer shall return six months after substantial completion to make final adjustments of all hardware items.

F. Installer shall instruct Contracting Officer's personnel in proper adjustment and maintenance of door hardware and hardware finishes.

G. Clean adjacent surfaces soiled by hardware installation.

3.05 PROTECTION:

A. Provide for proper protection of items of hardware until Contracting Officer accepts Project as complete.

3.06 HARDWARE GROUPS AND SUFFIXES:

A. The following schedule of hardware groups shall be considered a guide only, and the supplier is cautioned to refer to general conditions, special conditions, and the preamble to this section. It shall be the hardware supplier's responsibility to furnish all required hardware.

B. Refer to the door schedule for special hardware notes, applications, and/or requirements.

3.07 HARDWARE GROUPS:

A. GROUP 70: Exterior egress pair with exit devices allowing entry at one leaf.

1. Hardware:

	Type	Quantity	Comments
a.	Hinges	6 each	
b.	Exit Device	1 each	8813 ET. [F08 – Key locks or unlocks lever.]
c.	Exit Device	1 each	8810. [F01 – No outside operation.]
d.	Keyed Removable Mullion	1 each	12-L980 Steel
e.	Closers	2 each	
f.	Kick Plates	2 each	
g.	HD Floor Stops	2 each	
h.	Threshold	1 each	
i.	Weatherstripping	2 sets	

j.	Sweeps	2 each	
k.	Rain Drip	1 each	
l.	Closer	1 each	
m.	Stop	1 each	
n.	Silencers	3 each	

3.08 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

DIVISION 9

FINISHES

SECTION 09941

FIELD PAINTING

PART 1 – GENERAL

1.01 DESCRIPTION:

A. Provide and apply paints and coatings specified and indicated. Prepare, clean, and finish all surfaces to be field painted as specified and indicated.

1. The terms “paint” and “coating” used herein include emulsions, enamels, paints, stains, varnishes, seal waters, and other coatings, organic or inorganic, whether used as intermediate, or finish coats.

2. Stainless steel piping, fittings and supports will not be field painted.

B. Complete painting in accordance with specifications, paint manufacturer's current surface preparation and application instructions and safety requirements. In the event of conflict, the more stringent specifications will apply.

1.02 RELATED WORK:

C. Section 13225: Prestressed Concrete Tanks

D. Section 15101: Process Piping, Valves and Appurtenances

1.03 REFERENCES:

A. Society for Protective Coatings (SSPC) Specifications:

B. SSPC-PA 1: Shop, Field, and Maintenance Painting of Steel.

C. SSPC-PA-2: Measurement of Dry Coating Thickness with Magnetic Gages.

D. SSPC-SP 1: Solvent Cleaning.

E. SSPC-SP 3: Power Tool Cleaning.

F. SSPC-SP 6: Commercial Blast Cleaning.

G. SSPC-SP10: Near-White Blast Cleaning.

H. American National Standards Institute (ANSI):

1.04 QUALITY ASSURANCE:

A. Provide in accordance with Section 01400 and as specified.

B. Use products of one manufacturer in any one paint coating system with compatible coating materials. Provide same coating product for touch-up as for original coating.

C. Do not use or retain contaminated, outdated, or diluted materials for painting. Do not use materials from previously opened containers.

D. Provide paint products having a minimum of five (5) years of service, with no peeling, flaking, chipping, blistering, or fading, under similar service conditions.

1.05 SUBMITTALS:

A. Submit the following in accordance with Section 01300:

1. List of coating products (Paint Schedule) with brand, type and manufacturer including dry film thickness and volatile organic compound (V.O.C.) regulations conforming to these specifications. Refer to Paragraph 2.04.

2. Manufacturer's current printed recommendations and data sheets for each product including performance criteria, surface preparation, application instructions.

3. Product data and pertinent information including results of test patch data indicating compatibility of field applied coatings with shop applied primers including a schedule listing each primer with field applied coatings to be applied over the primer.

4. Color chip samples of materials proposed and matching color of coatings indicated in Finish Schedule.

5. Color chip samples matching colors indicated in Piping Identification Schedule, included in this specification. Submit list of piping to be included under each color.

6. Submit manufacturer's published data showing service record specified in paragraph 1.04 D.

7. Submit letter(s) signed by paint manufacturer certifying that submitted products are suitable for application on the surfaces to be coated and for the service conditions.

8. Submit a Certificate of Compliance for coatings submerged in potable water with National Sanitation Foundation approval.

9. Product data for mil thickness testing equipment including operating instructions.

B. Field Submittals:

1. Submit letter(s) signed by Painting Subcontractor, certifying that surfaces to be coated have been prepared in accordance with paint manufacturer's printed instructions and are ready for field paint application.

2. Approved mil thickness test results, including location, and surface or item for identification.

1.06 PAINT STORAGE AND MIXING AREAS, AND WASTE DISPOSAL:

A. Store paints and painter's materials in area or areas designated by the Contracting Officer solely for this purpose. Confine mixing, thinning, clean-up and associated operations, and storage of painting debris, to these areas before authorized disposal.

B. Do not use plumbing fixtures, piping or mechanical equipment for mixing or disposal of paint materials.

1. Transport water to paint area by temporary hose or piping.

2. Store waste temporarily in closed, nonflammable containers until final disposal. Keep no rubbish in painter's area longer than 24 hours. Dispose any hazardous materials in accordance with Connecticut requirements and OSHA regulations, and place all non-hazardous waste in the central trash trailer area.

1.07 DELIVERY, STORAGE, AND HANDLING:

A. General Contractor will provide storage and protection in accordance with Section 01610 and as specified.

B. Deliver materials to painter's area in original, unbroken, containers with name and analysis of product, manufacturer's name, and shelf life date. Do not use or retain contaminated, outdated, prematurely opened, or diluted materials.

C. Store coated items and protect coating from damage and foreign matter, by not allowing contact with soil or pavement, exposure to wind-blown particles, or other harmful contacts which necessitate special cleaning. Use blocking during storage.

D. Protect coated items, whether prime or finish, from damage due to shipping and handling.

1.08 JOB CONDITIONS:

A. Environmental Requirements:

1. Comply with manufacturer's printed recommendations as to environmental conditions under which coatings and coating systems can be applied.

2. Do not apply coatings when dust is being generated.

B. Protection:

1. Cover or otherwise protect finish work of other trades and surfaces not being painted concurrently or not to be painted.

2. Do not paint over nameplates, tagging or other identification devices.

PART 2 – PRODUCTS

2.01 MANUFACTURERS:

A. Tnemec Co., Inc.

B. Carboline.

C. PPG Protective & Marine Coatings, Inc.

D. TAMOSEAL (Tank exterior)

E. Or acceptable equivalent product.

2.02 MATERIALS – GENERAL:

A. Products:

1. Recommended by their manufacturer for intended service.

2. Potable Water:

a. Ferrous metals submerged or which are subject to splash action in contact with potable water, provide one coat with a dry mil thickness of 3.0 to 3.5 mils of a certified NSF Standard 61 product by one of the following or equal:

(1) 91 H20 Urethane Zinc Rich Primer made by Tnemec Co.

(2) Carboguard 561 made by Carboline Co.

(3) Aquapon High Build Potable Water Epoxy 95-132 Series made by PPG Protective & Marine Coatings (4.0 – 6.0 DFT).

(4) Or acceptable equivalent product.

3. Non-buried (Vault) Piping:

a. All ferrous metals not subject to potable water provide one coat with a dry film thickness of 2.5 to 3.0 mils. By one of the following or equal:

(1) Series 1 Prime made by Tnemec Co.

(2) Carbozinc 859 by Carboline Co.

(3) Multiprime EFD Epoxy Fast Day Inhibitive Primer 94-109 made by PPG Protective & Marine Coatings (4.0 – 6.0 DFT).

B. Material Compatibility:

1. Provide block fillers, undercoats and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

2. Provide field applied coatings that are compatible with shop applied primers.

2.03 COLORS AND FINISHES:

A. Interior finish colors: As indicated in Finish Schedule and Pipe Identification Schedule.

B. To provide contrast between successive coats, lightly tint each coat to distinguish it from preceding coats.

C. Unless otherwise indicated for finish paint, use gloss or semi-gloss on metal and satin finish on masonry and concrete.

2.04 COATING TYPES:

A. Coatings are described in the COATING IDENTIFICATION SCHEDULE by abbreviations, generic type, minimum solids by volume and minimum dry film thickness. Provide coatings that comply with the volatile organic compounds (VOC) regulations applicable to the project site and in no case to exceed 3.5 lbs/gal.

B. COATING IDENTIFICATION SCHEDULE

ABBR.	GENERIC TYPE	SOLIDS BY VOL. (%)**	DFT THICKNESS (PER COAT) ***	TNEMEC PRODUCT	CARBOLINE PRODUCT	PPG PMC PRODUCT
APE	High Build Acrylic Polyurethane Enamel	60/ 74	3.0-5.0	Series 73 1074	Carbothane 134HG	PPG High Build SG Urethane Enamel 95-8800 Series
BF	Cementious Acrylic Filler	68	100 sq. ft. per gal.	Series 130	Sanitile 100	PPG Cementitious Waterproofing Block Filler 95-217 Series
HSE	High Solids Catalyzed Epoxy	70	6.0-8.0	Series N69	Carboguard 893SG or 691 NSF	PPG Pitt-Guard DTR Epoxy Mastic 97-145 Series
LTE	Polyamide Epoxy	58	4.0-6.0	Series 161 or N69F	Carboguard 893SG or 691 NSF	PPG Pitt-Guard Rapid Coat 95-245 Series (97-946 for immersion)
PE*	Polyamide Epoxy	60	5.0-7.0	Series 161/ or N69F	Carboguard 893SG or 691 NSF	PPG Aquapon HB Semi-Gloss 97-130 Series

* If application of PE type coating occurs during low temperatures, provide and apply LTE type coating in lieu of PE and substitute throughout in Paint Schedule at end of Section, unless otherwise recommended by coating manufacturer.

** Solids by volume based on Tnemec Coatings.

*** Dry film thickness and performance criteria based on Tnemec Coatings. Provide dry film thicknesses for equivalent products as recommended by manufacturer.

C. Description of coating types includes minimum acceptable percent, by volume, of component solids. Brand identification is to establish standard of quality. Products meeting general physical characteristics and performance criteria, are acceptable.

D. Provide coatings submerged in potable water with National Sanitation Foundation approval.

2.05 PIPE, VALVE/EQUIPMENT IDENTIFICATION AND COLOR CODING:

A. Provide identification of pipes, valves, pumps, tanks and similar vessels by color as specified in the Pipe Identification Schedule and with name of contents, directional flow arrows and other required legend.

1. Use stenciled letters and arrows or self-adhesive labels or tapes located at intervals no greater than 20 ft. apart on straight runs except that stainless steel piping at intervals shall be no greater than 15 ft. apart on straight runs. Mark each valve, branch, wye change in direction and each side of floor and wall penetrations.

a. Labels or tapes shall be moisture and U.V. resistant.

B. Provide legend of size, character and location conforming to ANSI A13.1 for stenciled letters or labels.

C. Refer to notes at end of Pipe Identification Schedule for further clarifications.

PART 3 - EXECUTION

3.00 HOISTING, SCAFFOLDING, STAGING, AND PLANKING:

A. Provide, set-up, and maintain all required derricks, hoisting machinery, scaffolds, and staging and planking, and perform all hoisting required to complete the Work of this section as indicated and specified.

3.01 INSPECTION:

A. Examine surfaces scheduled to receive paint and finishes for conditions that will adversely affect execution, permanence or quality of work.

B. Do not proceed with surface preparation or coating application until after submitting to the Engineer a letter signed by Contractor, stating that surfaces to be painted are in acceptable condition for preparation and painting according to the Painting Subcontractor and in accordance with paint manufacturer’s printed instructions.

C. Do not proceed with coating application until after submitting to the Contracting Officer a letter signed by paint manufacturer certifying that submitted products are suitable for application in accordance with paint manufacturer’s printed instructions.

3.02 PREPARATION:

A. Basic Steps:

1. Prepare and paint surfaces in heated enclosure unless the ambient weather conditions ensure still, dry air above 50 degree F temperature, and humidity above manufacturer's printed recommended level. Do not apply paints to surfaces in direct sunlight. Conform to manufacturer's printed instructions for safety requirements.

2. Coordinate cleaning and painting operations to eliminate contamination of one by the other.

3. Maintain coating materials at manufacturer's recommended mixing and application temperatures for not less than 24 hours before use. Have clean containers, spray equipment, applicators, and accessory items ready for use before decanting or mixing paint materials.

4. Coordinate materials to be applied with previous coatings on affected surfaces. Obtain, in all cases, manufacturer's written directions, and follow them strictly, except where otherwise specified.

5. Coordinate preparation and material compatibility requirements with the work specified.

B. Before any paint application, clean surfaces to be coated of dust, dirt, grease, white rust, paint unsuitable for top coating, efflorescence, oil, moisture, foreign matter, or similar conditions detrimental to coating bond and durability.

1. Following cleaning, apply preparatory treatment in strict accordance with manufacturer's written instructions.

2. Fill imperfections and holes in surfaces to be painted with material recommended by paint manufacturer.

C. Metals to Receive Paint Finishes:

1. Prepare ferrous metals, including field welds and unprimed shop welds, without shop prime coats as follows:

a. Near White blast cleaned (SSPC-SP-10), for submerged components.

b. Commercial blast cleaned (SSPC-SP-6), for non-submerged components.

c. Use needle gun for field welds and shop welds which occur in narrow, unprimed areas in an otherwise shop primed surface, followed by SSPC-SP1-solvent wipe.

2. Clean previously shop primed ferrous metals in accordance with manufacturers printed recommendations prior to field painting.

3. Non-ferrous and galvanized metal surfaces scheduled for paint finish:

   a. Clean in accordance with manufacturers recommendations prior to field painting (SSPC-SP-1 including power washing).

   b. For interior galvanized and non-ferrous metals not exposed to wet environments apply in accordance with manufacturers written instructions.

D. Concrete to Receive Paint Finishes:

1. Clean thoroughly of form oil, release agents, dirt, dust, grease, paint, loose material and foreign matter. Remove laitance, roughen smooth surfaces by brush sand blasting, remove fins and projections, and fill voids and honeycombs with material recommended by paint manufacturer.

2. Prime after concrete has dried in strict accordance with manufacturer's printed instructions.

E. Concrete unit masonry for paint finishes:

1. Clean thoroughly by brushing, scraping and sanding or grinding slick areas. Remove loose or projecting mortar, solvent wash oil, grease, paint spots before applying block filler.

F. Provide higher degree of cleaning for acceptable equivalent paint products when paint manufacturer recommends in his printed surface preparation recommendations.

G. Delay painting of areas which will be damaged by heat from welding, until welding is complete. Reclean and recoat substrate as specified for original coats, when coated areas have been damaged by welding or have not been painted to allow welding.

H. PVC Pipe:

1. Sand all surfaces with 60-80 grit paper to provide profile to adhere coatings.

3.03 TOUCH-UP:

A. Before applying field coat, touch-up abraided areas of shop coats with paint of the same type. Apply an entire coat to abraided area. Touch-up coats are in addition to, and not a substitute for first field coat. Clean deteriorated surfaces as specified herein and in accordance with manufacturer’s recommendations before applying touch-up coat.

B. Equipment, motors, pumps, instrumentation panels, electrical switchgear, and similar items with shop coats, paint filler, enamel or other treatment customary with manufacturer; after installation, touch-up scratches and blemishes before applying field coats.

3.04 APPLICATION:

A. Refer to Paint Schedule at end of this specification for coating requirements. Provide additional prime, undercoat, and finish coats as specified, indicated, and recommended by coating manufacturer's printed instructions.

B. Conditions:

1. Do not apply paints or other finish to wet or damp surfaces, except in accordance with instructions of manufacturer. Do not apply exterior paint during cold, rainy, or frosty weather, or when temperature is likely to drop to freezing. Do not apply paints to surfaces in direct sunlight.

2. Paint surfaces which have been cleaned, pretreated, or otherwise prepared for painting with first field coat as soon as practicable after such preparation has been completed, but in any event prior to deterioration of prepared surface.

3. Coat blast cleaned metal surfaces in accordance with SSPC guidelines, before any rusting or other deterioration or contamination of the surface occurs. Do not coat blast cleaned surfaces later than 8 hours after cleaning.

C. Methods:

1. Spraying with apparatus may be substituted for brush application of paints in locations approved for spraying.

2. Prepare surfaces, mix and apply paint materials in strict accordance with manufacturer's printed instructions and recommendations. Control temperature of materials upon mixing and application, surface temperature and condition, thinning and modifying.

3. Protect surfaces to be coated, before, during and after application.

D. Workmanship:

1. Apply coating materials to meet manufacturer's spreading rate and dry film thickness recommendations. Dry film thicknesses specified are constant for brush, spray, roller or other form of application.

a. Control thinning in accordance with V.O.C. regulations for spray use and to manufacturer's printed instructions, and produce specified dry film thickness on level surfaces, interior and exterior angles.

2. Apply paints and coatings using painters continuously employed in the painting profession for no less than five (5) years, brushed or rolled out carefully to a smooth, even coating without runs or sags. Curing time in accordance with manufacturers printed instructions.

3. Finish surfaces: Uniform in finish and color, and free from flash spots and brush marks.

3.05 PROTECTION AND CLEAN-UP:

A. Protect surfaces to be painted or coated under this Section as follows:

1. Arrange for preparation and coating activities to be performed in areas and during times when no continuous traffic and no dust generating activity will be present.

2. During time between preparation and coating, protect work from dust and dirt with dropcloth. Do not allow contact with surfaces in this time period.

3. During painting activity, clearly mark the area being used by painters to prevent interference with painting being applied as specified.

4. After painting, clearly barricade painted surfaces with cones, plastic barrier tape, or other visible barrier. Locate "WET PAINT" signs near painted surfaces. Do not remove barriers and signs until paint surface dries throughout entire film thickness.

B. Remove or completely mask accessory items, finish hardware, lighting fixtures, escutcheon plates, trim and similar finish items not to be painted before painting adjacent surfaces. Carefully replace and reposition upon completion of adjacent painting and cleaning work.

C. Upon completion of the work, clean up paint spots, oil, and stains from floors, glass, hardware, and similar finished items and remove tape.

3.06 SCHEDULE OF PAINTING:

A. Coordinate and schedule the various cleaning, touch-up and finishing operations. Transmit and coordinate the transmission of materials data, color selections, and coating system methods between the coating applicators. Do not exceed exposure and recoat time limits.

B. Colors to be as follows unless otherwise specified or directed by the Contracting Officer.

1. All valves shall be Safety Red.
2. Exposed water pipe in vaults shall be blue (as approved by Town of Durham and City of Middletown in respective locations.)

3. Tank Exterior to be Tamoseal Oyster, or as directed by the City of Middletown

PAINT SCHEDULE

Item No.	Surface or Item	Field Coats 1st	2nd	Final
1	Interior concrete indicated to be painted	PE	-	PE
2	New miscellaneous ferrous metal-work, ferrous piping, ferrous parts of operating devices, valve handles and supports	PE	-	PE
3	Exterior shop painted structural steel, exterior galvanized structural steel, lintel angles, ferrous piping, ferrous parts of operating devices and supports, guard posts, bollards and exterior surfaces of roll-up door frames	PE	PE	APE
4	Emulsified asphalt-coated ferrous piping	PE	-	PE
5	Items with factory finish	Touch-up with materials supplied by manufacturer		
6	Shop painted ferrous metals, galvanized metals and equipment submerged and non-submerged	PE	HSE	HSE
7	Interior shop painted ferrous metals, galvanized metals and equipment non-submerged and subject to splashing	PE	HSE	HSE
8	Exterior shop painted ferrous metals, galvanized metals and equipment non-submerged and subject	PE	HSE	APE

Note:

4. If prime coat has been exposed for more than 6 months, Painting Subcontractor will provide test patches to insure adhesion of field-applied coatings. Test patches in accordance with paint manufacturer's instructions.

3.07 FINAL TOUCH-UP:

A. Prior to final completion and acceptance, examine painted and finished surfaces and retouch or refinish areas to leave touched-up areas with same appearance as and even with the surrounding finish specified.

3.08 TESTING:

A. Conduct field testing in the presence of the Contracting Officer for specified mil thickness in accordance with SSPC-PA-2.

B. Test results shall meet requirements of SSPC-PA-2. Failure of test results shall require that surfaces be repainted until approved results of testing have been obtained for the specified mil thickness.

3.09 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

DIVISION 10

SPECIALTIES

SECTION 10200

LOUVERS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide aluminum louvers as indicated and specified.

B. The extent of louver work includes the following:

1. Fixed, extruded all welded aluminum louvers.

1.02 RELATED WORK:

A. Section 07900: Joint Sealants for joint sealant materials and installation.

B. Section 15806: Heating, Ventilation and Air Conditioning.

1.03 REFERENCES:

A. American Architectural Manufacturers Association (AAMA) Specification.

1. AAMA 2605-02: Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions and Panels.

2. AAMA 611-98: Voluntary Guide Specification for Anodized Architectural Aluminum.

B. AMCA: Air Movement and Control Association Publications.

1. Test Standard: AMCA 500-L-99, Laboratory Methods of Testing Louvers for Rating, Section 8.3.1-Water Penetration Test.

2. Test Standard: AMCA 500-L-99, Laboratory Methods of Testing Louvers for Rating, Section 8.3.2 – Wind Driven Rain Water Penetration Test.

C. American Society for Testing Materials (ASTM) Publications:

1. ASTM B209-95: Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

2. ASTM B221-95a: Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.

3. ASTM E90-97: Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.

4. ASTM E 413-87 (Reapproved 1994): Classification for Rating Sound Insulation.

D. American Welding Society

1. AWD D1.2-90: Structural Welding Code – Aluminum

E. National Association of Architectural Metal Manufacturers

1. Metal Finishes Manual for Architectural and Metal Products. 1988.

F. Sheet Metal and Air Conditioning Contractors Association (SMACNA).

G. Society for Protective Coatings – SSPC – Paint 12: Cold Applied Asphalt Mastic (Extra Thick Film).

1.04 QUALITY ASSURANCE:

A. Provide in accordance with Section 01400 and as specified.

B. Structural Performance: Provide exterior metal louvers and aluminum architectural screen capable of withstanding the effects of loads and stresses from wind and normal thermal movement without evidencing permanent deformation of louver components including blades, frames and supports; noise or metal fatigue caused by louver blade rattle or flutter; or permanent damage to fasteners and anchors.

1. Wind Load: Uniform pressure (velocity pressure) of 30 lbf/sq. ft. (1440 Pa), acting inward or outward.

2. Thermal Movements: Provide louvers that allow for the thermal movements resulting from change in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, and other detrimental effects.

C. Air Performance and Water-Penetration Ratings: Provide louvers complying with performance requirements indicated, as demonstrated by testing manufacturer's stock units 48-in. wide by 48-in. high. Test units according to AMCA 500.

1.05 SUBMITTALS:

A. Submit the following in accordance with Section 01300:

1. Shop drawings of louver units and architectural screen accessories shall include plans, elevations, sections and details showing profiles, angles, spacing of louver blades, unit dimensions related to wall openings and construction; free areas for each size indicated; profiles of frames at jambs, head and sills; and anchorage details and locations.

2. Submit three (3) color charts for aluminum finish.

3. Product test reports indicating compliance for louvers with performance requirements specified for standard free area, wind driven rain, airborne sound transmission loss and structural performance.

4. Product certificates signed by louver manufacturer certifying that their products which comply with project requirements are licensed to bear the AMCA seal based on tests made in accordance with AMCA Standard 500 and complying with AMCA Certified Ratings Program.

1.06 DELIVERY, STORAGE AND HANDLING:

A. Provide in accordance with Section 01610 and as specified.

B. Brace and support units to prevent deformation during delivery.

C. Factory wrap units with approved materials to protect finish during delivery and storage.

D. Handle units with care to prevent bending or scratching.

PART 2 – PRODUCTS

2.01 MANUFACTURERS:

A. The Airolite Co.

B. Construction Specialties, Inc.

C. Industrial Louvers, Inc.

D. Or acceptable equivalent product.

2.02 MATERIALS:

A. Aluminum Extrusions: ASTM B221, alloy 6063-T5 or 6063-T52.

B. Aluminum Sheet: ASTM B209, alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Fasteners: Type 304A series stainless steel.

D. Provide continuous aluminum perimeter angles (alloy 6063) and anchors of type, size, and material required for loading and installation indicated. Provide stainless steel anchors.

E. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12 but containing no asbestos fibers.

2.03 GENERAL:

A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations.

B. Maintain equal louver blade spacing to produce uniform appearance.

C. All Welded Assembly: Join stationary blade and frames and frame members with fillet welds concealed from view. Louver blades shall be joined to each jamb frame with a minimum of two fillet welds produced with the Pulsed Gas Metal Arc Welded (GMAW/Mig) process. Each weld shall be a minimum of 1-inch (25.4 mm) in length with a minimum 3/16-inch (4.76 mm) leg. Frames shall be joined at each corner with a full-length GMAW fillet weld with a minimum 3/16-inch (4.76 mm) throat.

D. Fabricate frames, channel type to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining materials; tolerances, and perimeter sealant joints.

E. Include supports, anchorages, and accessories required for complete assembly.

F. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or 72-in. (1830 mm) o.c., whichever is less.

G. Provide sill extensions fabricated of continuous 0.125-in. thick aluminum where indicated and required for drainage to exterior and to prevent water penetrating to interior.

H. Provide 0.125-in thick interior aluminum stools where indicated on drawings. Color and finish of sills to match louver.

2.04 FIXED ALUMINUM DRAINABLE LOUVERS:

A. Louver Construction: Provide fixed-blade, sight-proof, drainable type louvers with extruded-aluminum frames and blades complying with the following:

1. Louver Depth: 5 in. unless otherwise indicated.

2. Frame and Blade Thickness: 0.081-in. (2.06 mm).

3. Standard Free Area: Not less than 56% based on 48-in. x 48-in. tested unit to AMCA Standard.

4. Free Area Velocity at Beginning Point of Water Penetration – 0.01 oz H_20/sq. ft. Free Area: 1,134 fpm (5.76 m/s).

5. Air Volume Flow Rate at Beginning Point of Water Penetration – 4 ft. x 4 ft. Unit: 10,331 cfm (4,896 m^3/s).

6. Pressure Drop at Beginning Point of Water Penetration: 0.40 in. H_20 (0.100 pKa)

2.05 LOUVER SCREENS:

A. General: Provide each exterior louver with louver screens complying with the following requirements:

1. Screen Location for Fixed Louvers: Interior face.

2. Screening Type: 1/2-in. mesh, 0.063-in. diameter aluminum bird screening, unless otherwise indicated.

3. Screening Type: 18x14 mesh, .0123-in. 5056 alloy aluminum insect screening where indicated.

B. Secure screens to louver frames with stainless-steel machine screws, spaced a maximum of 6-in. (150 mm) from each corner and at 12-in. (300 mm) o.c.

C. Louver Screen Frames: Fabricate rewirable screen frames with mitered corners to louver sizes indicated and with the same kind and form of metal as indicated for louver to which screens are attached.

1. Finish: Same finish as louver frames to which louver screens are attached.

D. Provide louver guards fabricated to dimensions indicated, of 12 gage steel wire woven in a 3/4-in. mesh, crimped woven in a 3/4-in. mesh, crimped into 1/2-in. x 1/8-in. steel channel frames hot dipped galvanized louver guards dipped galvanized louver guards after fabrication and shop apply two coats epoxy paint finish to match color of paint finish to match color of louver.

2.06 BLANK-OFF PANELS:

A. Provide laminated metal-faced panels where required to seal off louver area not connected to ductwork, consisting of insulating core surfaced on back and front with metal sheets.

1. Thickness: 2-in. (50 mm).

2. Metal Facing Sheets: Aluminum sheet, 0.032-in. (0.8 mm) thick.

3. Insulating Core: Extruded-polystyrene insulation board complying with ASTM C578, Type VII.

4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames 0.081-in. (2.06 mm) thick, with corners mitered and with same finish as panels.

5. Finish: Same as finish applied to louvers.

6. Attach blank-off panels to back of louver frames with stainless steel sheet-metal screws.

2.07 FINISHES:

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish louvers and aluminum screen after assembly.

C. Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finish.

D. High-Performance Organic Coating Finish: AA-C12C42R1x. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Fluoropolymer Two-Coat Coating System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluorpolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605-02.

a. Custom color to be selected by Contracting Officer.

a. Provide custom color as indicated.

PART 3 – EXECUTION

3.01 PREPARATION:

A. Coordinate Setting Drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction.

3.02 INSTALLATION:

A. Locate and place louver and architectural screen units level, plumb, and as indicated alignment with adjacent work.

B. Provide continuous angle supports mitered at corners with finish to match louver.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Repair finishes damages by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

F. Isolate aluminum from contact with masonry or dissimilar metals with heavy coat of bituminous paint or neoprene gaskets.

G. Mount bird screens of all louvers unless indicated otherwise on inside face with clips, machine screw into frames.

H. Verify size, location and placement of continuous louvers and individual louver units prior to fabrication. Coordinate field measurement and shop assembly to minimize field adjustment.

3.03 CLEANING:

A. Upon completion remove any and all protective coatings, and clean off all parts of the work.

3.04 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

DIVISION 11

EQUIPMENT

SECTION 11316

SUMP PUMPS AND APPURTENANCES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide and test pumps, motors, and appurtenances as indicated and specified.

1.02 REFERENCES:

A. American Society for Testing and Materials International (ASTM):

1. A36: Standard Specification for Carbon Structural Steel.

2. A48: Standard Specification for Gray Iron Castings.

3. A108: Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished

4. B584: Standard Specification for Copper Alloy Sand Castings for General Applications

B. Hydraulic Institute (HI):

1. Current Standards.

C. National Electrical Manufacturers Association (NEMA):

1. MG1: Motors and Generators.

1.03 SUBMITTALS:

A. Submit the following shop drawings in accordance with Section 01300:

1. Data regarding pump and motor characteristics and performance:

a. Provide catalog performance curves at maximum pump speed indicated and specified for each service showing acceptable operating range (AOR) and preferred operating range (POR).

b. Submit curves for guaranteed performance, and shop performance tests on 8-1/2-inch by 11-inch (A4) sheets, one curve per sheet.

2. Shop drawing data for accessory items.

3. Certified setting plans, with tolerances, for anchor bolts.

4. Manufacturer's literature as needed to supplement certified data.

5. Operating and maintenance instructions and parts lists.

6. List of recommended spare parts other than those specified.

7. Shop and field inspection reports.

8. Special tools.

1.04 QUALITY ASSURANCE:

A. Comply with the requirements specified in Section 01400.

B. Pumps shall be manufacturer’s standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

1.05 DELIVERY, STORAGE AND HANDLING:

A. Comply with the requirements specified in Section 01610.

PART 2 - PRODUCTS

2.01 SUMP PUMPS (SUBMERSIBLE TYPE):

A. UL listed, factory assembled and tested submersible type pumps for operation under water up to maximum 120 degrees F and capable of passing minimum 1/2-inch spherical solids. Pump shall be complete with cast-iron casing with corrosion resistant finish, cast iron or bronze impeller, stainless steel shaft, carbon/ceramic mechanical seals, sealed bearings, water-cooled hermetically-sealed motor, built-in automatic reset thermal protection, stainless steel lift handle, and waterproof three-conductor cables and grounded plugs. Pumps shall have single seal design. Pumps shall have integral float switch.

B. Minimum 6 foot power cord.

C. Pump shall be Zoeller Model M57 or equal by Gould or Hydromatic.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Install items in accordance with accepted shop drawings, manufacturer's printed instructions and as indicated.

3.02 FIELD TESTING:

A. Make all adjustments necessary to place equipment in specified working order.

B. Remove all replace equipment at no additional cost to the Contracting Officer with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Contracting Officer that equipment will perform the service specified, indicated and as submitted and accepted.

3.03 FIELD TOUCH-UP PAINTING:

A. After installation and accepted testing by the Contracting Officer, apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

3.04 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 11353

BOOSTER CHLORINATION SYSTEM

PART 1 – GENERAL

1.1 SCOPE

A. The system shall be designed to feed low concentrations of chlorine in solution intermittently or continuously as required at the Long Hill Pump Station. The system shall be a single pre-assembled, factory prewired, package unit in a welded powder coated stainless steel frame consisting of chlorinator, chlorine system control panel, booster pumps as required, and solution tank for ease of installation and operation. Field assembled systems shall not be acceptable.

B. Chlorination system manufacturer shall also supply all accessories and appurtenances as specified herein and as indicated on the Drawings, including a supply water pressure reducing valve, particulate filter, inline heater as required, booster pump, chlorine solution eductor with automatic dose control valve, chlorine injection quill, air circulation system, and chlorine analyzer as specified in this section.

C. CONTRACTOR shall furnish and install chemical containment pallet with dimensions as shown on Drawings. Minimum containment capacity shall be 25 gallons. Materials shall be resistant to chlorine solutions up to 2% solutions.

D. CONTRACTOR shall furnish pre-assembled three step 24” x 36” mobile work platform ladder with handrails for tablet tank access (as needed, depending on manufacturer selected). Tubular steel, all-welded construction. Corrosion resistant powder coat finish. 800 lb capacity. Two casters for transport with brakes. 30” high handrails. Meets OSHA and ANSI requirements.

1.2 REFERENCES

A. Underwriters Laboratories Inc., UL 508

B. NSF / ANSI Standard 60 & 61

C. National Fire Protection Association (NFPA):

1. 70: National Electrical Code (NEC).

2. Connecticut Electrical Code (CEC).

D. National Electrical Manufacturers Association (NEMA):

1. 250: Enclosures for Electrical Equipment (1000 Volts Maximum).

2. ICS 1: Industrial Control and Systems General Requirements.
3. MG1: Motors and Generators.

1.3 RELATED WORK

A. The system manufacturer shall coordinate with the following items:

1. Division 11 – Piping and valves between items of equipment.

2. Division 13 – Utility Controls and Instrumentation.

3. Division 15 – Drain piping.

4. Division 16 – Electrical.

1.4 CONTRACTOR SUBMITTALS

A. NSF Certification

1. Copies of the NSF-60 and NSF-61 certified listing for all materials.

B. Installation, Operations, and Maintenance Manuals shall be obtained and submitted. The following sections shall be included:

1. General equipment specifications and data sheets.

2. Installation, start-up, operation, and maintenance instructions.

3. Factory-recommended maintenance schedule and list of recommended spare parts.

4. List of equipment or tooling necessary for diagnostics, trouble-shooting, repair or general maintenance.

5. Shop drawings for the equipment.

6. A copy of the warranty statement.

7. Control philosophy provided in both written and schematic form.

8. Wiring diagrams of field connections with identification of terminations between local panel, junction boxes, equipment items, instrument devices and the like.

9. Electrical schematics and interconnection wiring diagrams.

10. Control Panels:

    a. Bill of materials.

    b. Front elevations, with and without door.

    c. Elementary wiring connection diagrams.

11. Manufacturer's standardized elementary wiring diagrams will not be acceptable unless application portions of the diagram have been clearly annotated to show what is being provided.

1.5 QUALITY ASSURANCE

A. The systems shall be tested prior to deployment. Certification of this completed testing shall accompany the equipment documentation.

B. The manufacturer of the equipment shall have extensive experience in the production of such equipment, and the equipment shall be manufactured in the continental United

States. The major components of the chlorination system shall be furnished by a single supplier.

C. For factory delivery and installation, services shall be performed by full time factory employees experienced in the operation of this equipment.

1.6 WARRANTY

A. The manufacturer shall guarantee in writing that this unit, if operated in accordance with written instructions given and accepted by the Contracting Officer, will perform in complete accord with the specifications. All components will be warranted against manufacturers' defects for twelve (12) months from its original installation date or eighteen (18) months from its shipment date, whichever first occurs.

PART 2 – PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Design Parameters

Minimum Flow Rate to be treated, GPM	50
Maximum Flow Rate to be treated, GPM	590
Minimum Chlorine Dosing Rate, PPM	2
Maximum Chlorine Dosing Rate, PPM	3
Available Chlorine Maximum Feed Rate, PPH	
Maximum Injection Line Pressure, PSI	110
Injection Point Line Size, IN	6
Supply Water Inlet Size, IN	½ or 1*
Supply Water Outlet Size, IN	½ or 1*

*As required by the manufacturer

2.2 SYSTEM FEATURES

A. The chlorine solution concentration shall be maintained at a level that prevents calcification in system components to minimize required maintenance.

B. Delivery shall be by erosion feed technology to control accurate and consistent concentration limits in the chlorine treatment solution. Spray and/or vortex technology systems shall not be acceptable.

C. The chlorinator shall automatically and continuously feed chlorine in solution as needed, to treat the flow rate as required by the Design Parameters in the table above. Chlorine loss shall be prevented by sizing and controlling the solution feed to minimize excess quantities of solution to be produced and held for an extended period of time. Batch systems preparing excess quantities of solution for delivery over an extended period shall not be acceptable.

D. A booster pump wired to the chlorine system control panel shall feed freshly mixed chlorine treatment solution only as required for maximum efficiency.

E. All piping in the chlorinator unit shall be Schedule 80 PVC or chlorine solution

compatible materials of equivalent durability. Chlorinator unit shall be hard-piped to injection point.

F. The Chlorine System Control Panel shall be skid mounted and factory prewired. Factory pre-wiring shall include all wire and conduit from the Chlorine System Control Panel to all skid mounted components, including valves, pumps, switches, and instrumentation.

2.3 SYSTEM COMPONENTS

A. Tablet Chlorinator. Tablet capacity of 200 lbs.

B. Inlet Water Supply Connection with Filter. See Design Parameters table above for Inlet size. Inlet Supply Water Particulate Filter, 20 microns.

C. Inline Supply Water Heater, 480 VAC, 27 kW, to maintain water temperature between 65ºF and 85 ºF. (Optional equipment based on actual incoming water temperature.)

D. Inlet Solenoid Valve. Opens and closes on command when the system receives a signal. Size to match inlet supply piping, 115 VAC, 60 Hz, NEMA 4X.

E. Inlet Flow Meter. A flow-through flow meter shows the flow of the fresh water-dissolving stream. Meter shall be capable of measuring zero flow. Range shall be sized to deliver accurate metering appropriate to the magnitude of the incoming flow.

F. Solution Tank. Made of medium-density polyethylene. Capacity: 22 gallons.

G. Primary Solution Tank Level Control. Made from PVC, float valve shall meter the tablet by-pass flow. The by-pass stream balances the variation in the water-dissolving stream. In VFD controlled systems, ALL water is metered via this valve to maintain constant solution tank level. Alternately, tank level may be controlled by feedback loop to automatically feed a set quantity of incoming water through solenoid into tablet tank, creating a set quantity of chlorine solution in proportion to flow from the flowmeter's 4-20 mA analog signal.

H. Secondary High/Low Level Solution Tank Control. Prevents the solution tank from overflowing. High level: when activated, a switch opens the circuit to the solenoid valve, causing the valve to close. Low level: shuts pump down preventing cavitation. A restart timer prevents the pump from "chattering".

I. Solution Delivery Booster Pump. Delivers chlorinated solution into a pressurized stream. A 3 HP, 460V vertical multi-stage centrifugal pump shall be provided. Inverter duty rated, NEMA premium efficient motor in accordance with Section 16220 and NEMA MG1.

J. Field Installed Spare Pump. Secondary pump that is field installed on a separate stand and factory prewired to the chlorine system control panel. Can be switched from main system pump via a Pump Selection Switch.

K. Solution Injection Pump Air Bleed. Used to prime the pump at start-up, or at any time, if necessary. Also functions as a recycle line for tank cleaning. IPM Systems TC90 tablet chlorinator using ACL90 trichlor tablets does not require tank cleaning, thereby reducing cost of additional pump.

L. Primary Backflow Prevention. A PVC Ball check valve prevents reverse flow of water into the system.

M. Chlorine Solution Eductor, with PVC Check Valve, sized to match Outlet pipe.

N. Chlorine Injection Quill, ball valve, PVC, sized to match Supply Water Outlet size.

O. Dose Control Valve, an electrically actuated ½" PVC ball valve, for proportioning chlorine dosing rate to the 4-20 mA input signal from chlorine residual analyzer. Rated NEMA 4X.

P. Outlet Connection. See Design Parameters table above for Outlet size.

Q. Air Ventilation System to dry tablets on shut down and remove fumes from the system to outside atmosphere, 120 VAC, 27W.

R. All electrical and controls equipment shall be NEMA 4X rated, UL listed enclosures.

S. Support Frame. Powder Coated 304 Stainless Steel.

T. Inlet Pressure Regulator. Schedule 80 PVC pressure regulator installed for water inlet pressure above 70 PSIG.

U. Inlet Pressure Gauge. Gauge reading 0 to 150 PSIG installed for inlet pressure above 70 PSIG.

V. Variable frequency drives (VFDs) and inverter duty rated motors for the solution delivery pumps. VFDs shall be controlled by the chlorine system control panel. An electrically actuated ball valve may be substituted for the VFD if required. Capability to control in Flow-Pacing, Residual, or Compound Loop modes shall be provided.

U. Weight Scale. Load cell factory-installed under the chlorinator to measure tablet weight.

V. Chlorine Residual Analyzer

1. Chlorine Analyzer shall be provided to continuously measure free chlorine residual at a sample point enough downstream from chemical injection points that the chemistry is stabilized. Sample piping shall be supplied by the CONTRACTOR.
   a. The method of measuring free or total chlorine will be with a three-electrode amperometric sensor immersed into an electrolytic medium with a membrane, selective to chlorine, separating it from the sample.
   b. Model CLF10sc Reagentless Free Chlorine Analyzer, HACH Company, Loveland, CO or equal.

W. All power for the chlorine system equipment except the in-line heater and ventilation fan shall be obtained from the Chlorine System Control Panel (CL-CP) and be provided as factory pre-wired.

2.4 CONTROL SYSTEM:

A. Chlorine System Control Panel

1. Enclosure: NEMA 4X, 316 Stainless Steel

2. Power

   a. Control Panel shall operate on 480VAC, 3 phase.

   b. Provide 480-120VAC fused control power transformer.

c. Provide through-the-door main disconnecting circuit breaker with lockable handle. Circuit breaker short circuit rating shall be a minimum of 42,000 amps.

3. Control panel shall be UL508A-Listed.
4. Provide a skid mounted, factory prewired control panel.
5. Provide enclosure with main circuit breakers, motor starters, VFDs, reset buttons, fused control circuit transformer, relays, switches, indication and alarm lights and all necessary appurtenances, completely factor prewired to provide a coordinate and operating set of controls.
6. Provide red running lights, green off/ready lights, and amber lights for alarms.
7. RUN-OFF-AUTO selector switches.
8. Provide dry alarm contacts for remote indication of the following:
   a. In Auto
   b. CL Booster Pump No.1 Fault
   c. CL Booster Pump No.2 Fault
   d. CL Booster Pump No.1 Running
   e. CL Booster Pump No.2 Running
   f. Tank Low Level Alarm
   g. Tank High Level Alarm
9. Provide terminal board for all external circuits.
10. Provide all necessary controls for ancillary devices including solenoid valves, flow control valves, exhaust fans, heaters, analyzers, level instruments and switches.
11. Provide identification labels for all internal components.

2.5 ACCEPTABLE MANUFACTURERS

A. Specified Equipment. The chlorination system package shall be manufactured by:
   1. IPM Systems, Lee's Summit, MO.
   2. Axiall Corporation, Pittsburgh, PA.
   3. Or approved equal.

PART 3 – EXECUTION

3.1 INSTALLATION

A. The CONTRACTOR shall furnish services of a factory-trained installer or crew having experience with installation procedures as well as operation and maintenance requirements for the type of equipment installed under these specifications. Two person-days shall be included for installation oversight, start up and certification of equipment and system.

3.2 TRAINING

A. The Chlorination System manufacturer staff or their representatives will provide instruction on the safe and proper operation of the mixer to CONTRACTING OFFICER. This training will reference the operations manual provided with equipment, and show how to check the equipment to ensure it is operating properly. A minimum of 8 hours of training will be provided, not including travel to and from the site. As part of this training, the manufacturer shall instruct the CONTRACTING OFFICER to the optimal dosing for the system.

END OF SECTION

SECTION 11355

THM REMOVAL SYSTEM

PART 1 – GENERAL

1.01 SCOPE

A. These specifications provide the requirements to furnish, install and place into operation a trihalomethanes removal system (THMRS) consisting of floating spray equipment, submersible mixing equipment, and a forced-air injection blower for the Cherry Hill Tank in Durham, CT for the Middletown, CT Water Department. The system shall be designed to achieve a minimum of 40% reduction in total THM removal based on a maximum 750 GPM feed to the tank and a future design maximum flow through the tank of 440,000 gallons per day with 80 µg/L THM concentration.

B. The proposed Cherry Hill above ground concrete tank shall be 45’ diameter x 78’overall height with a capacity of 880,400 gallons. The tank will have two 48-inch by 48-inch hatches located on opposite ends of the domed roof. A 16" inlet and 16" outlet will be located on the tank floor. Initially the average flow rate will be 92,000 gallons per day with a maximum flow rate of 234,000 gallons per day and a maximum fill rate estimated at 750 gallons per minute from the Long Hill pump station in Middletown. A booster chlorination system to be provided under this Contract will be installed at the Long Hill pump station, approximately 8,800 feet upstream.

C. The Contractor shall provide all equipment and materials as specified and indicated on the drawings.

D. CONTRACTOR shall furnish and install concrete blower pad as shown on the Drawings.

E. CONTRACTOR shall furnish and install acoustical enclosure as specified in this Section.

F. CONTRACTOR shall furnish and install Sch 10 stainless steel 12-inch diameter ductwork and use flexible couplings at blower discharge and outlet at top of tank as shown on the Drawings.

1.02 REFERENCES

A. Occupational Safety and Health Administration, OSHA

B. Department of Transportation, DOT

C. Underwriters Laboratories Inc., UL 508

D. NSF / ANSI Standard 61

E. National Electrical Code, NEC

F. National Electrical Manufacturers Association (NEMA):

1. 250: Enclosures for Electrical Equipment (1000 Volts Maximum).

2. ICS 1: Industrial Control and Systems General Requirements.

3. MG1: Motors and Generators.

1.03 CONTRACTOR SUBMITTALS

A. NSF Certification

1. Copies of the NSF-61 certified listing for all material being placed inside the tanks and headspace, including the motor power cable and penetration fittings.

A. Installation, Operations, and Maintenance Manuals shall be obtained and submitted. The following sections shall be included:

1. General equipment specifications and data sheets

2. Installation, start-up, operation, and maintenance instructions

3. Factory-recommended maintenance schedule and list of recommended spare parts

4. Wiring diagrams of field connections with identification of terminations between local panel, junction boxes, equipment items, instrument devices and the like.

5. Electrical schematics and interconnection wiring diagrams.

6. Control Panels:

    a. Bill of materials.

    b. Front elevations, with and without door.

    c. Elementary wiring connection diagrams.

7. List of equipment or tooling necessary for diagnostics, trouble-shooting, repair or general maintenance

8. Shop drawings for the circulation equipment.

9. A copy of the warranty statement.

1.04 QUALITY ASSURANCE

A. The systems shall be tested prior to deployment. Certification of this completed testing shall accompany the equipment documentation.

B. The THMRS equipment shall be designed to operate continuously, all day and all night.

C. THMRS shall have no visual defects, and shall have high quality welds, assembly, and corrosion resistant finish.

D. The manufacturer of the equipment shall have extensive experience in the production of such equipment, and the equipment shall be manufactured in the continental United States.

E. For factory delivery and installation, services shall be performed by full time factory employees experienced in the operation of this equipment and who have completed OSHA safety trainings applicable to this type of installation.

1.05 ACCEPTABLE MANUFACTURERS

A. Medora Corporation, Dickinson, ND.

B. Or equal.

1.06 WARRANTY

A. From the period of substantial completion and ending on the time periods listed below, the THM Removal System and appurtenances are warranted to be free from defects in material and workmanship.

1. Minimum two (2) years on all supplied parts and labor.

1.07 FIELD SERVICES

A. Factory Personnel. The installation and startup shall be performed by full time factory employees trained in the operation of the THMR floating spray equipment.

B. Safety. Installation personnel shall have received job-specific safety training on (a) Working over Water, (b) Boating Safety, (c) Disinfecting Procedures, (d) Confined Space Entry, (e) Fall Protection, (f) Self Rescue, and (g) DOT Compliance.

C. Safety Equipment. Installation personnel shall be equipped with job-specific safety equipment to complete the installation of THMR floating spray equipment following all OSHA safety regulations. Safety equipment shall include confined space, fall protection, rescue, decontamination, and communication tools such as (air monitor, ventilation fan, tri-pod, winches, FBH's, retractables, ropes, lanyards, descenders, radios, hard hats, step pools, disinfectant sprayer, etc.)

PART 2 – PRODUCTS

2.01 SYSTEM PERFORMANCE AND FEATURES

A. Units Required. To meet the project objectives, the following equipment shall be installed:

Quantity	Equipment	Equipment Tag	Voltage	Horsepower	Location
One	Floating Spray Nozzle Equipment (Surface Aerator): Medora SN5 Model or Equal.	SN.P-1	240VAC, 60Hz	5 HP	45' diameter x 78' tall above ground concrete tank (880,400 gallons)
One	Submersible Mixer: Medora GS-12 Model or Equal.	MIX-1	120VAC, 60Hz	0.5 HP	45' diameter x 78' tall above ground concrete tank (880,400 gallons)
One	Forced Air Injection Blower: for 750 CFM at 5 w.c. inches, Spenser Single Stage Scroll Blower (as provided by Medora) or Equal.	BLW-1	240VAC, 60 Hz	2 HP	Pad installation

B. An unobstructed hatch opening of at least 24 inch diameter (61cm) round is required for installation of the floating spray and submersible mixing equipment.

C. The THMRS floating and submersible equipment shall be constructed primarily of Type 316 stainless steel, pickled or passivated. All equipment shall be of NSF/ANSI Standard 61 approved materials and rated for contact with potable water. The system shall include the following features:

1. The floating spray nozzle equipment and the mixer shall each be mechanically operated by a submersible motor that meets the following criteria:

    a. Direct Drive, with no gearbox and no lubrication maintenance required.

    b. Designed for submersible operation.

    c. Continuous Operation without overheating or compromising motor life expectancy.

    d. *deleted* Amendment 0006

    e. Provide motors rated at voltages specified in Section 2.01(A).

2. Provide BLW-1 motor in accordance with Section 16220.

3. The floating spray nozzle equipment shall be 316 stainless steel, supplied with a horizontal, low velocity intake capable of being positioned at the lowest elevation of the tank or reservoir floor. The intake level setting shall bring water into the floating spray equipment at a horizontal layer within 1 inch (2.5 cm) of the tank floor. The intake shall include a singular hose of adequate length to reach the required intake depth setting.

4. The floating spray equipment shall be equipped with a nozzle assembly sized specifically for the pump capacity output. Constructed of 316 stainless steel for optimal corrosion resistance and long wear life.

5. Forced Air Injection: The THMRS shall be provided with one turbine blower with TEFC motor capable of 750 CFM flow, CE, UL listed and CSA certified motor with NEMA Class F insulation. Blower to be mounted on type 316 stainless steel base and skid frame, adaptable to mounting on concrete pad next to the tank, as shown on the drawings, sized according to the blower manufacturer's recommendations. Appropriate ducting to connect the blower to the top of the tank shall be supplied by the general contractor as directed by the THMRS supplier.

D. Maintenance Requirements. The THMRS equipment shall operate normally with the following maintenance features.

1. No scheduled lubrication is required of any system components including motor.

2. No spare parts shall be required to be kept on hand.

2.02 CONTROL SYSTEM:

A. Provide BLW-1, MIX-1, and SN.P-1 each with a local control panel as specified and indicated.

1. Enclosure: NEMA 1.

2. Provide UL 508A listed control panels and components.

3. Provide enclosure with main circuit breakers, motor starters, reset buttons, fused control circuit transformer, relays, switches, contacts, indicating and alarm lights and all necessary appurtenances, completely factory wired to provide a coordinated and operating set of controls.

4. Provide magnetic motor starters with overload protection and manual reset.

5. Red running lights, green off/ready lights, and amber lights for alarms.

6. RUN-OFF-AUTO selector switches.

7. Run time meters.

8. Provide dry alarm contacts for remote indication of the following:

a. Not In Auto

b. Fault

c. Running

9. Provide terminal board for all external circuits.

10. Operation:

a. In AUTO the equipment shall operate continuously.

b. Provide shutdown of equipment on fault detection.

2.03 ACOUSTICAL BLOWER ENCLOSURE

A. Provide sound attenuated and weather-proof outdoor enclosure.

1. Rigidity wind test equal to 150 mph.

2. Roof load equal to 50 psf.

3. Rain test equal to 5 in. per hr.

4. Certified to meet Uniform Building Code.

B. Building to consist of roof, two (2) side walls, and two (2) end walls of prepainted steel stressed-skin construction, door and door frame, lifting rings, mounting frame, insulation, electrical package, louvers, exhaust fan, intake filter mounting bracket, and other appurtenances to make complete installation. Enclosure to be coordinated with blower manufacturer/supplier to include:

1. Roof:

a. One piece roof sheet, min. 0.040 in. thick steel alloy, with extruded recessed side and end rails.

b. Roof bows, extruded "I" beams, spaced as required to carry loads.

2. Walls:

a. Posts to be extruded steel sections, sized and spaced as required to carry loads.

b. Panels to be min. 0.045 in. thick steel sheet, mill-prepainted, inside and outside, and riveted to posts.

3. Panel Frame:

a. Provide welded frame of extruded alloy, riveted to side panels.

b. Provide removable maintenance panels to form weathertight seal, with stainless steel locks.

c. All panels, doors and other openings shall be tight fitting to prevent entry of mice or other rodents.

4. Mounting Frame:

a. Provide steel perimeter mounting frame for mounting onto concrete pad.

5. Insulation:

a. Provide semi-rigid fiberglass (thermoacoustic) insulation.

b. Provide sound attenuation for a 25 dBA noise reduction from the interior to the exterior of the enclosure.

6. Louvers:

a. Provide louvers and dampers for ventilation air. Provide insect screens.

b. Fixed louvers, all aluminum construction, riveted into aluminized steel frame to form rigid, water resistant assembly. Motorized dampers as specified hereinafter.

c. Properly size louvers and dampers to allow sufficient ventilation air with maximum 0.5 in. water restriction. Coordinate with fan manufacturer.

7. Intake Air Filter Mounting Bracket:

a. Provide suitable bracket to secure fan inlet air filter on the exterior of the enclosure.

b. Coordinate with fan manufacturer as required.

C. Access:

1. Large cable entry area for installation ease.

2. Panels located convenient to controls and service areas.

3. Double panels on both sides.

4. Vertically hinged doors allow 180º opening rotation.

5. Drains piped to exterior of enclosure and terminated with drain valves.

6. "Lift-off" hinges allow doors to be removed if required.

D. Security and Safety:

1. Lockable access doors with keys.

2. Roof outlet for fan intake filter.

3. Stub-up cover sheets for rodent proofing.

E. Transportability:

1. Lifting points on base frame.

2. Optional tested and certified single point lifting facility.

PART 3 – EXECUTION

3.01 INSTALLATION

A. The CONTRACTOR shall furnish services of a factory-trained installer or crew having experience with installation procedures as well as operation and maintenance requirements for the type of equipment installed under these specifications. Equipment must be able to be installed through a 48x48 inch hatch.

1. The THMR floating spray equipment manufacturer shall have capability to provide Installation, Startup, and On-Site Water Testing Services to insure (a) proper equipment spatial placement in the reservoir, and (b) proper pump placement and floating spray discharge setting.

2. The field services shall be performed by full time factory employees experienced in the operation of this equipment, and who have completed safety trainings required for this type of installation in compliance with OSHA regulations including (a) Working over Water, (b) Boating Safety, (c) Disinfecting Procedures, (d) Confined Space Entry, (e) Fall Protection, (f) Self Rescue, and (g) DOT Compliance.

3. Within 30 days following installation, the manufacturer shall provide an installation report detailing as described in submittal section.

4. The THMR floating spray equipment manufacturer shall provide the following support services to the Contracting Officer under this Contract:

a. A minimum of eight two-member factory crew service hours.

b. Customer service staff shall include engineers and science personnel that are trained for assistance in this application.

B. The Tank Supplier shall perform tank penetrations and securing any materials to the tank.

1. Cables will be run through a conduit which will be secured to the outside of the tank.

C. Tank penetrations shall conform to the following:

1. Fittings shall be water tight.

2. Fittings shall be sufficient in diameter to allow cable to pass through.

3. Strain relief for power cables shall be part of the CONTRACTOR-supplied fittings.

4. Coating around tank penetrations shall be recoated to match existing coating in both material and color on both the dry side and wet side of each tank.

5. Tank penetration will be performed adjacent to the hatch on the dome of the tank.

D. Installation of wet-side components shall be performed by experienced installation personnel with confined space training while the tank is full, but isolated from the system.

E. Before being placed back into service tank shall be chlorinated and tested in accordance with the provisions of SECTION 13225, PRESTRESSED CONCRETE TANKS. The

CONTRACTOR shall clean the floor of the tank and interior area of the tank wall where the penetration occurs as need for proper installation.

3.02 TRAINING

A. The THM Removal System manufacturer staff or their representatives will provide instruction on the safe and proper operation of the mixer to CONTRACTING OFFICER. This training will reference the operations manual provided with equipment, and show how to check the equipment to ensure it is operating properly. Training shall take place at the time of installation. As part of this training, the manufacturer shall instruct the CONTRACTING OFFICER to the optimal speed of mixer operation for mixing.

END OF SECTION

SECTION 11397

GAS ENGINE (LESS THAN 100KW) - GENERATOR SET
AND APPURTENANCES

PART 1 - GENERAL

1.01 SCOPE OF WORK:

A. Furnish, place in operation, and field test standby natural gas engine driven generator set, EPA Compliant, complete with enclosure, instrumentation and controls, and required supporting systems as specified herein. The unit shall be provided in an outdoor, weather proof, non walk-in, sound attenuated with sub base enclosure.

B. The unit shall have a minimum standby power rating as indicated on the contract drawings at 80 percent lagging power factor with three-phase, 60-Hertz, 480 volt, four-wire, alternating current generator.

C. The unit shall be arranged for automatic starting and stopping, and load transfer upon failure of the normal source of power through an automatic transfer system. The engine generator set shall exhibit less than 20% voltage dip and less than 5% frequency dip during starting of the loads identified in Attachment A to this Section.

D. The engine-generator package shall be complete in all respects and shall include all equipment and controls necessary for a fully operational standby power supply system.

1.02 RELATED WORK:

A. Division 1: General Requirements

B. Section 01784: Field Inspection and Acceptance Tests

C. Division 13: Utility Control and Instrumentation\

D. Division 15: Mechanical

E. Division 16: Electrical Work

1.03 REFERENCES

A. American Gear Manufacturers Association (AGMA)

B. American Institute of Steel Construction (AISC)

C. American Iron and Steel Institute (AISI)

D. American Society of Mechanical Engineers (ASME)

E. American National Standards Institute (ANSI)

F. American Society for Testing Materials (ASTM)

G. American Welding Society (AWS)

H. American Bearing Manufacturers Association (ABMA)

I. Institute of Electrical and Electronic Engineers (IEEE)

J. National Electrical Code (NEC)

K. National Electrical Manufacturers Association (NEMA)

L. Occupational Safety and Health Administration (OSHA)

M. Steel Structures Painting Council (SSPC)

N. Underwriters Laboratories, Inc. (UL)

O. National Fire Protection Association (NFPA)

1.04 SEISMIC REQUIREMENTS:

A. Contractor shall conform to the seismic requirements as indicated and as specified in Structural Drawing S-001.

1.05 DESIGN REQUIREMENTS:

A. Design Considerations:

1. Provide an EPA emissions standby certified generator and in compliance with Connecticut emissions regulations and standards.

2. Furnish to the Contracting Officer, within 15 working days of the date of any request, all documents and other information required to verify compliance with permit and applicable air pollution control laws and regulations, including EPA emission requirements in effect at the bid date of the project.

1.06 SUBMITTALS:

A. Shop Drawings:

1. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.

a. Failure to include a copy of the marked-up specification sections will result in rejection of the entire submittal without further review and consideration until the marked-up specification are resubmitted with the entire package.

2. Outline equipment drawings, equipment catalog cuts, internal wiring and ladder diagram schematics and other documents required to completely describe the systems and equipment being furnished. Elevation drawings with shipping splits and estimated weights identified.

3. Identification, description and dimensions.

4. Dimensional engine-generator skid base drawings, indicating size and location of anchor bolts, and conduit locations.

5. Performance specifications of all items of equipment.

6. Control panel layout drawings, dimensions, and component bill of materials. Outline drawings showing conduit entry areas and anchoring information. Description of control including operation of interface equipment.

7. Complete electrical, instrumentation, control and wiring diagrams in sufficient detail to allow installation of instrumentation and controls and electrical components.

8. Provide certificate of conformance to UL Standard 2200, Stationary Engine Generator Assemblies.

9. Attenuation curve for the silencing equipment as offered to accomplish the required silencing for this installation.

10. Information on the proposed jacket water treatment and procedures for flushing of the cooling systems.

11. Submit generator load calculation confirming compliance with specified engine capacity and operating parameters when operating loads provided in Attachment A of this Section based on rated kW specified.

12. Operations and Maintenance Manuals, covering all equipment furnished, annotated to reference only the specific model numbers supplied. Include parts lists and parts prices current to the date of submittal; include information relevant to part supply and ordering. Submit prior to the startup and testing of the engine/generator units.

13. Time-current characteristic curves for the generator circuit breaker.

14. Manufacturer's certified shop test record of complete engine driven generator unit.

15. As-built drawings and material summary shall be shipped with the equipment.

16. Data to be provided by engine generator system supplier:

    a. Submit the following manufacturer information:

        (1) Engine Data

            (a) Manufacturer

            (b) Model

            (c) Number and arrangement of cylinders

                1) RPM

                2) Bore X stroke

                3) Maximum power at rated RPM

                4) BMEP at rated kW (including any parasitic loads and generator efficiency)

                5) Piston speed, feet per minute

                6) Make and model of governor

                7) Make and model of overspeed shutdown device

            (d) Incoming Natural Gas Minimum Water Column (Pressure) Requirements.

(2) Generator Data

(a) Manufacturer

(b) Model

(c) Rated kVA

(d) Rated kW

(e) Voltage

(f) Temperature rise above 40 degrees C ambient. Stator by thermometer and field by resistance in degrees C.

(g) Class of insulation

(h) Generator efficiency including excitation losses at 80 percent PF

1) Full load

2) Three quarters load

3) Half load

(i) Generator subtransient reactance in ohms

(3) Generator unit and accessories

(a) Weight of unit

(4) Exhaust gas emissions data, maximum values at full load, 3/4 load, 1/2 load, and 1/4 load:

(5) Combustion air volume in CFM

(6) Cold cranking amperes rating of engine starting batteries (CCA).

17. Provide manufacturer's printed installation instructions including anchoring details to meet earthquake requirements as specified and indicated.

18. Performance Test Reports: Upon completion of installed system, submit in booklet form all field tests performed to prove compliance with specified performance criteria including final settings of devices.

19. Certificate of Delegated Design Services in accordance with Section 01300.

1.07 QUALITY ASSURANCE:

A. Contractor to ensure that conduit size and wire quatity, size, and type are suitable for the equipment supplied. Contractor to review the proper installation of the equipment and of each type of device with the equipment supplier prior to installation.

B. The engine-generator set shall be factory designed, certified prototype tested, and as specified. The manufacturer shall be regularly engaged in the production of this type of equipment and shall maintain a permanent service organization and supply of spare parts, of the types utilized for the equipment specified herein.

C. The manufacturer shall have testing facilities for performing the shop tests and inspections specified herein.

D. The enclosure shall be professionally designed and engineered to meet the seismic requirements specified and all the building code requirements for the state in which the building is to be located.

E. Provide services of Service Technician, specifically trained on type of equipment specified. Person-day requirements are listed exclusive of travel time:

1. Assist in location of devices, methods of mounting, field erection, inspection prior to energizing the equipment, etc.

a. 1 person-day

2. Start-up and testing.

a. 2 person-days

3. Person-day is defined as one 8-hour day, excluding travel time.

4. The manufacturer shall certify that equipment has been inspected and is ready to be placed into service.

1.08 UNIT PERFORMANCE:

A. The units shall be utilized to provide standby power service in the event the normal source is not available.

B. The voltage regulation shall be within plus or minus one percent from zero load to full-rated load. Upon application or removal of full-rated load in one step, the transient voltage dip and recovery to steady state operation shall be within five seconds.

C. Stable or steady state operation is defined as operation with the frequency variation not exceeding plus or minus 0.25 percent (0.15 Hertz) and voltage variation plus or minus one percent of their mean value for constant load from zero load to full rated load. A rheostat shall provide plus or minus five percent voltage adjustment from rated voltage.

1.09 REGULATORY REQUIREMENTS:

A. All applicable Federal Laws and Regulations.

B. State of Connecticut applicable Local Codes and Standards.

C. Furnish all documents and other information which the CT Department of the Environment requests to determine compliance with applicable Air Quality Control Laws and Regulations.

D. Stack Heights: Exhaust stacks shall be configured to discharge the combustion gases vertically and shall not be equipped with any part or device that restricts the vertical exhaust flow of the emitted combustion gases, including but not limited to rain protection devices such as “shanty caps” and “egg beaters”.

1.10 WARANTY AND SERVICE:

A. Provide in accordance with Section 01740.

B. Guarantee all components, parts, and assemblies supplied by manufacturer against defects in materials and workmanship for a minimum period of 24 months.

C. Ensure that equipment manufacturer has local branch office staff with trained, full-time employees who are capable of performing testing, inspecting, repair, and maintenance services.

1.11 ACCEPTABLE MANUFACTURERS:

A. Kohler

B. Cummins

C. Or equal.

1.12 DELIVERY, STORAGE AND HANDLING:

A. Provide in accordance with Specification Section 01610.

PART 2 - PRODUCTS

2.01 GENERAL:

A. Engine-generator set shall be a factory-assembled unit. The engine and generator shall be directly connected with a flexible coupling, shall be free from injurious torsional or other vibration and shall be mounted on a heavy steel sub-base.

B. The engine and generator shall be directly connected and shall operate at the same rotative speed. The use of gearing or other speed adjustment between the engine and the generator, such that the engine and generator operate at different rotative speeds will not be allowed.

C. The engine-generator set shall allow easy access to the various parts for maintenance purposes.

D. The engine-generator set shall be pre-piped and pre-wired.

E. The complete engine-generator unit shall be free from harmful torsional or other vibration throughout the entire operating range of speed and load. The engine manufacturer shall provide, an analysis of the complete engine-generator unit, which shall show where any critical speed will be encountered, together with the order, the frequency and magnitude of any critical speed.

2.02 GASEOUS ENGINE:

A. Heavy-duty spark ignition type, arranged for direct connection to an alternating current generator. It shall be a current model of a type in regular production by a manufacturer regularly engaged in building this type of gas engine. Engine shall have at least a published intermittent brake horsepower rating at specified generator speed required by the generator at rated full load output and shall operate without undue heating, vibration, or wear.

B. Engine shall be four cycle and naturally aspirated.

2.03 GASEOUS FUEL SYSTEM:

A. The gaseous fuel system shall consist of gas pressure regulators and carburetors. The carburetor shall be a diaphragm type which includes a load screw for air fuel ration adjustment, and throttle body to control the air-fuel mixture to the engine.

B. Fuel system shall include an electrically operated shutoff valve, in the supply line energized form battery circuit, that closes when engine shuts down.

2.04 GOVERNOR:

A. Provide isochronous solid state governor, capable of maintaining isochronous regulation from no load to full rated load within 0.25 percent of rated frequency.

B. The governor controller shall be mounted within the generator control panel. The governor shall have the capability for manual adjustment of speed setting and speed droop. Speed droop shall be adjustable from 0 to 5 percent from no load to full load. The controller shall eliminate all electromagnetic interference.

C. Provide a separate overspeed shutdown device which shall, in case of predetermined overspeed of the operation of various protective devices as later specified, instantly stop the engine without the fuel injection system losing its prime.

2.05 GENERATOR AND EXCITATION SYSTEM:

A. The generator shall be drip-proof, guarded, and be able to connect to the specified engine output and shall be 3-phase, 60-Hertz, 4-wire, 480 volt operation, "WYE" connected. The generator shall be mechanically and torsionally matched to the engine driver and shall be provided to withstand inherent pulsating torques of the engine. Full load efficiency of the combined generator, exciter and regulator shall be not less than 95 percent.

B. The generator shall conform to the applicable parts of the following standards, unless otherwise specified:

1. NEMA MG1, Motors and Generators
2. IEEE 43, Recommended Practice for Insulation Testing of Large AC Rotating Machinery
3. CSA C22.2-100 Designation ABL3
4. Testing shall be in accordance with IEEE-115 and NEMA MG-1 standards

C. The generator windings, insulation and excitation system shall be braced to withstand any possible short-circuit stresses.

D. The temperature rise of the generator windings, when operated at rated prime power load and under continuous duty conditions with cooling air inlet temperature of 40 degrees C, shall not exceed 130 degrees C when measured by the resistance method.

E. The stator frame shall be fabricated bar and plate steel construction.

1. All insulation materials used in the stator shall have a temperature rating of Class H per IEEE Standard 1. The coils shall be of a formed coil construction using a magnet wire meeting NEMA MW36-C specifications.

2. The complete stator shall be wound with a 2/3 stator winding pitch and processed in a vacuum pressure impregnation chamber. Encapsulation of the stator shall be accomplished with a two-part epoxy system.

F. The rotor shall be of the fully laminated, salient pole type. Cooling fans shall be an integral part of the rotor assembly. The rotor shall be dynamically balanced for all speeds up to 125 percent of rated speed per NEMA specification.

1. Insulation materials used on the rotor shall have a temperature rating of Class H. The poles shall be of a layer wound construction using a magnet wire meeting NEMA MW35-C or MW36-C specifications.

2. The complete winding and rotor pole assembly shall be in a vacuum pressure impregnation chamber. Encapsulation of the assembly shall be accomplished with a thixotropic, single component epoxy resin.

G. The exciter shall be a high frequency, direct connected, rotating brushless type, three phase, full wave rectified, and shall be matched with the generator rotor and control system. Both the armature and field windings shall be a vacuum pressure impregnated with epoxy resin.

H. The pilot exciter shall be permanent magnet generator type. The stator winding shall be vacuum pressure impregnated with epoxy resin. The permanent magnet generator shall have the ability to provide a nominal 300 percent of the 130 degrees C rise rated three-phase short circuit for ten seconds at the alternator terminals.

I. The digital voltage regulator shall be hermetically sealed, silicon controlled rectifier type and shall employ a zener reference and three phase sensing. The voltage regulator shall provide automatic protection of the entire unit on 3 phase short-circuits. The voltage regulator shall include automatic over-excitation and under-frequency protection. Input isolation transformers and filters shall be provided. Exciter shall be fast response type with a rotating rectifier and surge suppresser, 3-phase, full-wave bridge.

J. The voltage regulator and associated equipment shall be mounted in the generator terminal box. Manual voltage adjustment potentiometer shall be mounted in the Generator Control Panel.

K. Generator stator leads shall be connected to tinned copper bus bars in an oversize terminal box. The box shall allow bottom entry of cables and conduits shown on the contract drawings.

2.06 ENGINE GENERATOR SET ENCLOSURE:

A. Provide weatherproof, sound attenuated, factory installed enclosure with internally mounted silencer.

B. Features:

1. Corrosion Resistant Construction

a. Black zinc die cast hinges to withstand extreme conditions of corrosion.

b. Stainless steel fasteners.

c. Body made from aluminum components treated with polyester powder coating.

C. Access:

1. Large cable entry area for installation ease.
2. Doors located convenient to controls and service areas.
3. Double doors on both sides.
4. Vertically hinged doors allow 180 degree opening rotation.
5. Lube oil and coolant drains piped to exterior of enclosure and terminated with drain valves.
6. Radiator fill on outside of enclosure.
7. “Lift-off” hinges allow doors to be removed if required.

D. Security and Safety:

1. Lockable access doors with keys.
2. Cooling fan and battery charging alternator fully guarded.
3. Exhaust silencing system totally enclosed for operator safety.
4. Roof outlet exhaust with sealed roof aperture and rain-cap.
5. Stub-up cover sheets for rodent proofing.

E. Transportability:

1. Lifting points on baseframe.
2. Optional tested and certified single point lifting facility.

F. Sound Attenuation:

1. Provide Level 2 sound attenuation for a 25 dBA noise reduction up to 23 feet (7 m) from the enclosure.

G. Options:

1. Panel Viewing Window.
2. CSB2 External Emergency stop push button (red) mounted flush on exterior enclosure wall.
3. Junction box for all 120 volt and 208 volt circuits to power:
   a. Battery pad heater.
   b. Jacket water heater.
   c. Battery charger.
   d. Generator stator heater.

2.07 SYSTEMS:

A. General:

1. The Contractor shall comply with the generator manufacturer's requirement for installation of systems and components.

B. Electric (Battery) Starting System:

1. Starting shall be accomplished by a 24-volt, engine mounted, solenoid shift electric starter, capable of withstanding four consecutive continuous cranking periods of 15 seconds duration each separated by 15 seconds rest periods before shutting down completely and sounding the overcrank alarm.

2. The starting batteries shall be low maintenance, premium industrial grade, high-output, long-life, lead acid type especially designed for diesel engine cranking service, and of a capacity as recommended by the battery manufacturer for cranking the engine being furnished. The engine starting batteries shall be sized to also supply power to the generator control panel.

3. Furnish an engine starting battery charger for charging the starting batteries for the engine. The battery charger shall be U.L. listed, fully automatic, filtered, equalize and float-type, appropriate for wall or rack mounting. Supply voltage shall be 120 volts, AC, single phase, 60 Hz obtained from the generator electrical package. The DC output shall be not less than 20 amperes, regulated to within one percent with plus or minus ten percent fluctuations of the input voltage, and shall be current limited at 120 percent of rated output. Accessories shall include DC ammeter and voltmeter (panel type; 2 percent accuracy), adjustable float and equalize controls toggle switch, AC and DC circuit breakers, AC power failure alarm relay, low DC voltage alarm relay and DC ground fault relay. Fault relays shall operate individual alarm indicators on the face of the charger panel and shall also operate a common alarm relay for remote transmission of alarm. Charger shall have a continuous power rating sufficient to power all generator control devices in both the standby mode and the running mode.

C. Lubrication System:

1. The engine shall be provided with a full pressure lubricating oil system arranged to lubricate and cool the pistons and distribute oil to all moving parts of the engine including the turbocharger bearings. The system shall include a full flow oil filter of the replaceable element type, an appropriately sized shell and tube type oil cooler, and an automatic temperature regulator.

2. Furnish a low oil level float switch to alarm to the generator control panel.

D. Engine Cooling System Radiator:

1. General: Provide a unit mounted radiator complete with integral jacket water circulating pump, thermostatic central of cooling system, fan and drive motor sized to maintain full load operation continuously as specified herein for engine-generator set.

2. Provide radiator to operate engine at full rated generator load at 104 F ambient temperature.

3. Provide jacket water treatment for the prevention of both scale formation and corrosion in the engine water jackets and cooling system components which are in contact with the engine jacket water. This treatment shall be added to the cooling system prior to running the field acceptance test

E. Miscellaneous Equipment and Requirements:

1. Heaters:

a. Automatic thermostatically controlled heater(s), shall be provided to maintain not less than 90° F temperature for the engine jacket water system.

b. Heater shall be automatically deactivated when the engine-generator unit is in operation.

2. Emergency Stop Pushbuttons:

a. Furnish an emergency stop pushbutton external to the engine control panel. Provide a second emergency stop button, “push to stop”, for remote operation from the Talcott Ridge Booster Station. The emergency stop button shall be maintained type, red colored, push to stop, mushroom type with a hinged plastic Lexan cover, labeled as "Emergency Stop," "Push." Each pushbutton shall be wired to the engine-generator instrument/control panel and shall immediately stop the engine.

3. Control Power Fuses:

a. Fuses shall be mounted in locations where they are accessible. Pullout type fuses shall be provided.

4. Main Circuit Breaker

a. Provide generator with a service entrance rated, 65 KAIC rated, molded case circuit breaker to protect generator against overload and short circuit conditions. Circuit breaker position shall be located such that it can be viewed through generator enclosure viewing window. Circuit breaker shall conform to the provisions of NEMA Standard AB1 and UL Standard 489.

b. Provide circuit breaker with microprocessor-based rms sensing adjustable trip unit, rating plug, long-time, short-time and instantaneous protective relaying and ground fault protection. Provide arc reduction switch (ARS) where indicated.

5. Terminal Blocks:

a. Terminal blocks shall be one-piece, 20 AMP rated, with barriers appropriate for ring tongue terminals and provided with binding head screws. The terminal block rating shall be 600 V.

6. Solid State Circuitry:

a. Heavy-duty solid state controls, relays, timers or monitors shall meet the following specifications:

Accuracy:	+ 2% of set point
Temp Range:	- 40 C to +65 C (-40 F to 150 F)
Protection:	Transient overvoltage withstand of 1500 volts peak, 1 m sec. time constant
Ratings:	Current ratings to exceed application of devices. Devices shall be UL listed.

2.08 SYSTEM OPERATING SEQUENCE:

A. The engine generator unit shall be operated in the following manner:

1. The engine generator unit shall be arranged for automatic or manual starting and stopping.

2. The engine generator shall be brought up to rated voltage and frequency and closed onto the facility main panelboard DP-1.

B. Normal – system utility powered:

1. During normal system operation, the utility source shall power the electrical distribution system with loads as indicated.

C. Loss of utility power - standby operation:

1. Upon loss of utility power, automatic transfer switch ATS -1 shall sense loss of power and after an adjustable time delay the automatic transfer system shall initiate generator start.

2. When the generator is up to speed and capable of accepting load, loads indicated in Attachment A will be transferred to generator power.

3. Upon return of utility power, automatic transfer switch ATS-1 shall initiate transfer back to the utility after an adjustable time delay

4. After an adjustable cool-down period, the engine-generator shall shutdown.

2.09 ENGINE CONTROL PANEL:

A. The engine starting control logic shall be microprocessor based and shall automatically start, protect and monitor the engine-generator set. Electro-mechanical controls are unacceptable.

B. The following gauges shall be mounted within an engine mounted control panel. Gauges shall be digital:

1. Jacket water temperature cooler temperature into heat exchanger

2. Lube oil temperature

3. Lube oil pressure

4. Lube oil filter differential pressure.

C. An engine coolant level switch shall be furnished. Level switch shall shut down generator on low level.

D. The engine starting control logic shall be capable of controlling the following engine devices.

1. Starting motor magnetic switch.
2. Electrically operated fuel control.
3. Normally open protective switches that close for abnormal conditions of pressure, temperature, speed and liquid level.

E. The panel shall have the following controls:

1. Emergency stop
2. Lamp test
3. Cycle crank
4. Voltage control
5. Cool-down timer
6. Phase selector switch
7. Programmable relays 4 (std)
8. Stop/Auto/Test.

F. The panel shall be provided with the following indicating lights:

1. Low oil pressure
2. High coolant temperature
3. Over speed
4. Over crank
5. Emergency stop
6. Fault shutdown
7. 3 spare lights, programmable input.
8. Not in Auto
9. Low Gas Pressure

G. Protection shall include:

1. Over and under voltage
2. Over and under frequency
3. Low coolant level
4. Oil temperature.

H. Provide contacts to alarm the following functions:

1. Low oil pressure
2. Low Gas Pressure
3. Battery malfunction
4. Low battery voltage
5. Common fault alarm
6. Not in automatic
7. In exerciser mode
8. E-stop activated
9. Generator run status
10. Low coolant level

I. Provide control system with programmable generator unit exerciser.

J. Engine Start/Stop Operation: The automatic engine control logic shall initiate operation of the engine upon receipt of a signal from a 120VAC dry-contact at ATS-1 automatic transfer switch. The contact(s) shall close for engine run and open for engine stop.

K. If the engine fails to start after 4 adjustable cranking attempts (factory set at 10 seconds on, 10 seconds off, adjustable from 5 to 30 seconds) or if any protective device should operate while the engine is running, the engine shall be disconnected from service and immediately stopped. The engine control logic shall lock the failed set out of service and requires a manual reset. The engine control logic shall include a provision for conversion to single cycle cranking, adjustable from 35 to 210 seconds.

L. Three-position engine control switch:

1. **Stop/Reset:** In this position, the engine shall not be capable of starting and/or running. If the engine was shutdown due to the operation of a protective device, the shutdown malfunction shall be reset when the switch is moved to this position. If the engine is running when the switch is moved to this position, it shall be immediately shutdown.

2. **Automatic:** In this position, the engine control shall be in readiness for fully automatic operation upon receipt of a start signal.

3. **Test:** When placed in this position, the engine shall start and run as if a start signal were received except it shall not be connected to the bus unless a start signal is received. When returned to the automatic position, the engine will shut down.

2.10 SHOP PAINTING:

A. The engine-generator set shall be shop primed and factory finished coated in accordance with the manufacturer's standard practice prior to shipment. A 24 oz. supply of touch-up paint shall be supplied by the manufacturer.

2.11 SHOP TESTING:

A. The complete engine-generator set shall be shop tested to simulate a complete and integrated system prior to shipment. Shop test shall utilize a reactive load bank to simulate facility loads.

B. Provide all details of the proposed testing, including arrangements, test instruments and calibration, and procedures to be used to verify controls and alarms. Four copies of the complete certified test record shall be submitted within 30 days after the completed test.

C. Tests shall assure that unit will operate successfully and meet all specified operational requirements.

D. The shop test shall include four continuous hours of operation at full load and varying power factor. Voltage and frequency regulation and transient response shall be tested and recorded to show full compliance with this specification. During the shop test, readings shall be taken and recorded every thirty minutes for each of the following:

1. Time
2. Ambient temperature
3. Volts for each phase
4. Load:
    a. Amps for each phase
    b. KW
    c. Power factor
    d. Frequency
5. Engine jacket water temperature
6. Lubricating oil pressure
7. Exhaust gas temperature
8. Fuel consumption.

E. The procedure for the shop test of the gas engine shall cover the engine manufacturer's standard practice.

2.12 SPARE PARTS:

A. Provide a recommended spare parts list.

B. Provide one year supply of all filter types installed.

PART 3 EXECUTION

3.01 COORDINATION:

A. Equipment personnel and services required for load and performance testing of the engines shall be provided by the engine-generator set supplier.

3.02 INSTALLATION:

A. The generator unit shall be installed as indicated and in accordance with the manufacturer instructions.

B. Provide services of a qualified factory representative to inspect in detail the installation of the engine-generator units, and related auxiliary systems, prior to energizing any equipment to confirm manufacturer’s recommended installation.

C. The generator unit shall be mounted on a concrete pad provided by the Contractor under this contract.

D. The enclosure bottom shall be flashed or other means provided to prevent water entrance into the unit.

3.03 EQUIPMENT START-UP:

A. Operate the unit to demonstrate ability to operate continuously without vibration, jamming, leaking or overheating and to perform specified functions, after installation and after manufacturer's representative check of installed equipment.

B. Comply with manufacturer's operating and maintenance instructions during start-up and operation.

C. Make all final adjustments necessary to place the equipment in working order. Prior to any testing or operation of the units, the manufacturer's service representative shall inspect the installation, and shall certify, in writing, that the assemblies are, in all ways, ready for operation. Start-up shall not commence without the presence of the manufacturer's representative.

3.04 FIELD TEST:

A. Provide testing as specified herein and in accordance with specification section 16998 – Field Inspection and Acceptance Tests.

B. Upon completion of the installation and as soon as conditions permit, the diesel engine driven generator, including the engine, generator, electrical circuit controls, transfer controls other devices shall be tested in the presence of the Contracting Officer by the Contractor and the service representative for the manufacturer of the engine driven generator unit to assure that the system functions as specified.

1. Perform load bank tests with portable resistive load banks for a four-hour duration to verify loading and ratings. Take system data readings each 30 minutes.

2. Perform actual load test with the facility operating loads connected to the engine. Run the test for a duration of four hours.

3. During the test, system parameter readings, shall be taken and recorded at 30-minute intervals.

C. As part of the field test, each of the automatic shutdown devices shall be tested and the respective values recorded at which the devices will stop engine. Any adjustments required shall be made in the devices to make the operating values correspond to those recommended by the engine manufacturer and as recorded during the stop test.

D. Take and record octave band sound pressure level readings while the engine driven generator is operating using the station load. These readings shall be within the limits identified in the engine generator data submittals for acceptable sound revel.

3.05 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

ATTACHMENT A

Standby Generator Loads			
Equipment	**Total Connected Quantity**	**Quantity Operating on Generator**	**HP/AMPS/kVA/kW**
STEP 1			
TBS-1,2	2	1	2 HP**
MPC-1	1	1	12 kVA
EUH-4	1	1	5 kW
* Motor is powered by full voltage motor starter. ** Motor is powered with 6-pulse variable frequency drive with 5% input line reactor. *** Motor is provided with 18-pulse variable frequency drive.			

SECTION 13225

PRESTRESSED CONCRETE TANKS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Design, construct, test, disinfect, and warrantee, Type III wire-wound, prestressed concrete circular tank with steel diaphragm; cast-in-place reinforced concrete membrane floor; and precast or cast-in-place concrete roof in accordance with AWWA D-110 and as specified.

B. Excavate, grade, prepare subgrade for tank foundation, and backfill around completed tank structure and appurtenances.

C. Design, construct, test, and disinfect a hydrodynamic tank mixing system, supplemental recirculation pump, accessories, and appurtenances. The complete hydrodynamic mixing system including the recirculation pump system shall be supplied by the variable orifice nozzle manufacturer to maintain a single source of responsibility for the system.

1.02 REFERENCES:

A. American Concrete Institute (ACI):

1. ACI 301: Specifications for Structural Concrete

2. ACI 350.1: Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures and Commentary

3. ACI 350.3: Seismic Design of Liquid-Containing Concrete Structures and Commentary

4. ACI 506R: Guide to Shotcrete

B. American Society of Civil Engineers (ASCE)

1. ASCE 7-16: Minimum Design Loads and Associated Criteria for Buildings and Other Structures

C. ASTM International (ASTM):

1. ASTM A185/A185M: Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete

2. ASTM A312/A312M: Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes

3. ASTM A351/A351M: Standard Specification for Castings, Austenitic, for Pressure-Containing Parts

4. ASTM A416/A416M: Standard Specification for Low-Relaxation, Seven-Wire Steel Strand for Prestressed Concrete

5. ASTM A475: Standard Specification for Zinc-Coated Steel Wire Strand

6. ASTM A536: Standard Specification for Ductile Iron Castings

7. ASTM A615/A615M: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

8. ASTM A821/A821M: Standard Specification for Steel Wire, Hard-Drawn for Prestressed Concrete Tanks

9. ASTM C33/C33M: Standard Specification for Concrete Aggregates

10. ASTM C94/C94M: Standard Specification for Ready-Mixed Concrete

11. ASTM C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

12. ASTM C920: Standard Specification for Elastomeric Joint Sealants

13. ASTM C1116/C1116M: Standard Specification for Fiber-Reinforced Concrete

14. ASTM D471: Standard Test Method for Rubber Property – Effect of Liquids

15. ASTM D698: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))

16. ASTM D1056: Standard Specification for Flexible Cellular Materials – Sponge or Expanded Rubber

17. ASTM D1556/D1556M: Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method

18. ASTM D1557: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3(2,700 kN-m/m3))

19. ASTM D6938: Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

20. ASTM F593: Standard Specification for Stainless Steel Bolts

21. ASTM F594: Standard Specification for Stainless Steel Nuts

D. American Water Works Association (AWWA):

1. ANSI/AWWA C104/A21.4: Cement-Mortar Lining for Ductile-Iron Pipe and Fittings

2. ANSI/AWWA C110/A21.10: Ductile-Iron and Gray-Iron Fittings for Water.

3. ANSI/AWWA C111/A21.11: Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

4. ANSI/AWWA C151/A21.51: Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water

5. AWWA C651: Disinfecting Water Mains

6. AWWA C652: AWWA Standard for Disinfection of Water-Storage Facilities

7. AWWA D110: Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks

E. NSF International (NSF)

1. NSF/ANSI 60, Drinking Water Treatment Chemicals – Health Effects

For sealants, coatings, and repair materials only.

2. NSF/ANSI 61, Drinking Water System Components – Health Effect

For sealants, coatings, and repair materials only.

F. Occupational Safety and Health Administration (OSHA)

1. OSHA 1910 Subpart D – Walking-Working Surfaces

G. State of Connecticut

1. 2016 Connecticut State Building Code

H. SSPC: The Society for Protective Coatings (SSPC)

1. SSPC-10: Near-White Metal Blast Cleaning

I. U.S. Army Corps of Engineers (COE):

1. CRD C572: Handbook for Concrete and Cement Corps of Engineers Specifications for Polyvinylchloride Waterstop

1.03 TANK DESIGN REQUIREMENTS:

A. Conform to latest applicable recommendations, codes, and standards cited in Paragraph 1.02 and their latest amendments unless otherwise specified herein or shown on the drawings.

B. Minimum Loads: Use the following loads for tank design:

1. Dead load: Weight of all permanent construction, appurtenances, and fittings.

2. Internal fluid load: Weight of all water when tank is filled to overflowing.

3. Snow load: Minimum design load for snow shall conform to ASCE-7. The snow load need not be considered as acting concurrent with the live loads.

4. Live load: 40 pounds per square foot over entire roof of tank.

5. Backfill pressure: Earth loads determined by rational methods of soil mechanics. Backfill pressure shall not be used to reduce the amount of required prestressing.

6. Wind loads: Minimum design loads for wind shall conform to ASCE-7 and the 2016 Connecticut State Building Code.

7. Seismic loads: Minimum design loads for earthquake shall conform to ASCE-7 and to ACI 350.3.

8. Thermal differential loads: Provide for a minimum thermal differential of 50 degrees Fahrenheit in design of tank elements.

9. Loads on platforms and walkways: 60 pounds per square foot.

C. Design Parameters:

Design Criteria	Tank
Nominal Tank Volume (gallons):	797,000
Internal Tank Diameter (feet)	45.0
Floor Level at Perimeter (feet, NAVD88):	441 feet
Maximum Operating Water Level (feet, NAVD88):	508.0
Maximum Overflow Level (feet, NAVD88):	509.0
Finish Grade at Tank Perimeter (feet, NAVD88): (refer to site plan)	442.0
Inlet/Outlet Pipe Diameter (inches):	16
Maximum Overflow Rate (gallons per minute)	1,550
Vent Capacity (cubic feet per minute)	1,000
Roof Type:	Low Rise Dome
Floor Type:	Concrete membrane
Seismic Information:	
ASCE 7 Risk Category (Table 1.5-1)	IV
ANSI/AWWA D110 Importance Factor (Table 2)	1.5
ANSI/AWWA D110 Structural Response Coefficients (Tanks with an anchored flexible base) (Table 3)	
R_I	3.5
R_C	1.0
Ω_0	2.0
ANSI/AWWA D110 Soil Site Class Definition (Table 4)	C
Ground Snow Load (pounds per square foot):	30
MCE Spectral Accelerations (%g)	
S_S	0.180
S_1	0.063
Ultimate Design Wind Speeds, V_{ult} (mph)	
Risk Cat III-IV	135
Nominal Design Wind Speeds, V_{asd} (mph)	
Risk Cat III-IV	105

1.04 HYDRODYNAMIC TANK MIXING SYSTEM (HMS) DESIGN REQUIREMENTS

A. All design, modeling, hydraulic and mixing calculations pertaining to the HMS shall originate from the duckbill valve manufacturer. Modeling and calculations provided by parties other than the duckbill valve manufacturer are not allowed.

B. The duckbill valve manufacturer must include within the submittal package the following design calculations, curves, and reference information:

1. Calculations showing the fill time required, under isothermal conditions, for the HMS system to achieve complete mix of the reservoir volume at minimum, average and peak fill rates. Complete mixing defined as 95% homogenous solution. The theory and equations used in calculating the mixing times must be from a published AWWA reference manual or paper. The reference document(s) must be submitted with the equations and calculations.

2. Calculations showing the water level drawdown required to achieve complete mixing on the fill cycles at minimum, average, and peak flow rates.

3. Calculations of average storage tank water age for both fill-then-draw, and simultaneous fill and draw scenarios. Theory used in calculating water age must be submitted with the calculations.

4. A Computational Fluid Dynamics (CFD) model evaluation of the proposed HMS system configuration applied within the tank provided under this contract. Model output documentation shall include all design variables applied for the simulation, plot of the 3-D geometry showing the mesh definition, velocity magnitude vector and contour plots at different cross-sections throughout the water volume, simulated tracer animations showing the spatial and temporal distribution of inlet water in real time during the fill cycle.

5. Hydraulic calculations showing the resulting jet velocities of each inlet nozzle at minimum, average, and peak fill rates.

6. Hydraulic calculations showing the flow distribution among all inlet ports at minimum, average, and peak fill rates.

7. Manifold hydraulic calculations showing the total headloss of the HMS at minimum, average, and peak fill and draw rates. Headloss shall include all minor losses and headloss of nozzles and outlet check valves.

8. Hydraulic curves showing thrust vs. flow for the inlet nozzles.

9. Hydraulic curves for each outlet check valves showing headloss vs. flow.

10. Calculations showing the terminal rise height of the jets that discharge at an angle above horizontal. The terminal rise height shall be calculated assuming 10ºF and 20ºF colder inlet water and calculated at minimum, average and peak fill rates. The theory and equations used to calculate the terminal rise height shall be included.

11. Hydraulic curves for each inlet nozzle of Densimetric Froude number vs. flow

12. If the calculations and supporting data provided do not show compliance with the hydrodynamic requirements of the system as interpreted by the Contracting Officer then the submittal shall be rejected.

13. Design and calculations shall be signed and sealed by a Professional Engineer holding current registration in the jurisdiction where the HMS is to be located

1.05 TANK SUBMITTALS:

A. Submit the following shop drawings and product data in accordance with Section 01300.

B. Shop Drawings: Signed and sealed by professional engineer licensed in the State of Connecticut.

1. Submit certification signed and sealed by a Professional Structural Engineer holding current registration in the jurisdiction where the tank is to be located stating that the design conforms to the conditions specified and all applicable codes and standards.

2. Include details of reinforcing steel, wire-wound prestressing, joint design, and concrete mix design.

3. Include details of openings in wall diaphragm.

4. Include reinforcing steel identification marks for each bar.

5. Include precast concrete unit identification marks for each unit.

6. Submit horizontal and vertical loadings, overflow pipe connection details, anchor bolt sizes and locations, erection and settlement tolerances, maximum loads imparted to the foundation and estimated weight of tank.

7. Show details for foundation, base and roof joint, wall construction and prestressing, overflow, piping connections, ladders, roof hatch, walkways and railings, and other information as required by this and related specifications and as requested by the engineer, including certified reports on the manufacture and testing of prestressing wire and steel diaphragm.

C. Product Data: Submit manufacturer's product literature including catalog information, dimensions, materials, instructions for installation and use, and application rates for:

1. Waterstops.

2. Joint Filler.

3. Bond Breaker.

4. Curing Compound.

5. Coatings.

6. Vibration Equipment.

7. Bearing Pads.

8. Joint Sealant.

9. Roof Hatch.

10. Roof Ventilator.

11. Ladders, Platforms, and Railings.

12. Fall Protection Equipment.

13. Tank Mixing Systems

14. Wall Manhole.

15. Pipe, pipe fittings, joints, joint gaskets, hardware, and coatings.

16. Couplings.

D. Design Data:

1. Submit structural calculations for tank and tank foundation, signed and sealed by a Registered Professional Engineer holding current registration in the jurisdiction where the tank is to be located.

2. Submit design calculations and CFD modeling results for the tank mixing system, signed and sealed by a Professional Engineer currently licensed in the State of Connecticut.

E. Test Reports:

1. Submit reports of concrete slump tests, air content tests, and strength tests.

F. Manufacturer's Certificates: Certify products meet or exceed specified requirements for the following:

1. Non-prestressed reinforcing steel.

2. Non-prestressed welded steel wire fabric.

3. Concrete mix design.

4. Provide statement that all materials used in concrete mix design are consistant with the requirements of the Connecticut Department of Health, Guidelines for the Design and Operation of Public Water System Treatment, Works, and Sources, Chapter VI, Potable Water Storage Facilities.

5. Concrete mix ingredients, including admixtures.

6. Hydrodynamic mixing system

G. Concrete batch tickets in accordance with ASTM C94 with the following additional information:

1. Type, name, and quantity of admixtures.

2. Type, brand, and quantity of cement.

3. Total water content by producer.

4. Maximum size of aggregate.

5. Weights of fine and coarse aggregate.

6. Indicate ingredients are as previously certified.

H. Start of fabrication or construction prior to the Engineer's review and acceptance of drawings is prohibited.

I. Shop drawing review by the Engineer will not in any way relieve the Tank Contractor of full responsibility for the accuracy and completeness of his design and his drawings.

J. Exterior Finish: Furnish color charts of finish coat of exterior acrylic coating for Contracting Officer's selection.

K. Reports of wire stress readings and final report on total stresses applied to the tank walls and dome ring wall shall conform to AWWA D110.

1.06 HYDRODYNAMIC MIXING SYSTEM (HMS) SUBMITTALS

A. Submit the following shop drawings in accordance with Section 01300.

B. Provide engineering installation drawings of the complete manifold piping system. These drawings shall include plan view piping arrangement, sections and elevations as required, support bracket installation details, duckbill nozzle orientation details, and all dimensions required for locating the system within the tank.

C. Provide CFD modeling report for this project verifying that the proposed system design will achieve complete tank mixing.

D. Provide HMS component catalog data detailing materials, dimensions, parts lists, and assemblies.

E. Provide head loss characteristics for duckbills and check valves.

F. Provide system head calculations for the recirculation pump that include all pipe friction, velocity head, and fitting losses. Recirculation system shall turn tank volume over at least four times per day.

G. Provide a copy of the NSF61 Certified listing for the valves used in the Hydraulic Mixing System (HMS). The valves themselves must be NSF61 certified, not just the elastomer used in construction of the valves. NSF61 approved/certified materials will not be accepted in lieu of valve certification. The NSF61 Certification for the valves must be for a minimum volume of 2,000 gallons. Valves with NSF61 Certification for minimum volume of less than 2,000 gallons are not acceptable.

H. Provide a copy of test report from an accredited independent laboratory that confirmed there is no degradation in the HMS elastomers when exposed to chlorine and chloramine per ASTM D471 "Standard Test Method for Rubber Property – Effect of Liquids".

1.07 QUALITY ASSURANCE:

A. Provide in accordance with Section 01400 and the applicable provisions of AWWA D110 and as specified.

B. General requirements for materials, design, construction and testing shall conform to AWWA D110, Standard for Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks, except as otherwise noted or indicated herein.

C. Subgrade preparation shall conform to Specification Sections 02315 and 02317.

D. Design Responsibility:

1. It is the intent of this specification to require single party responsibility for the design and the construction of the tank. The tank design and construction shall be performed by an established Tank Contractor of recognized ability, having at least ten years of experience in the design and construction of tanks with an AWWA D110, Type III wire or strand wound prestressed concrete core wall as specified herein. The design and construction of all aspects of the foundation, floor slab, wall, prestressing, shotcrete and dome roof of the wire or strand wound circular prestressed tank shall be performed by the Tank Contractor. The tank contractor may subcontract labor for reinforcing steel installation and for concrete slab placement under the tank contractor's direct supervision.

2. Support Data: Submit the following:

a. Codes, standards, and specifications that the tank was designed in conformance with.

b. Type and strength of materials to be used.

c. Loading conditions considered in the design of the tank.

d. Allowable stresses used in design.

e. Foundation plan.

3. Calculations: Calculations will be returned without review or checking. A copy will be retained in the project file.

4. Qualifications and Experience:

   a. Acceptable Tank Contractors:

      (1) DN Tank, Wakefield, MA;

      (2) Preload LLC, Louisville, KY

      (3) Approved equal.

   b. Work shall be performed by a company that specializes in the design and construction of precast, wire-wound prestressed concrete tanks using the method of circumferential prestress wire reinforcing and with proven capability of meeting all the requirements of these specifications.

   c. No company is considered qualified unless it has designed and constructed in its own name at least 24 precast, wire-wound prestressed concrete tanks conforming to AWWA D110 of the type specified in the last 15 years of equal or greater size which have been in successful service for a minimum of five years. Five of the 24 constructed tanks shall have a sidewater depth of 50 feet or greater above the floor elevation.

   d. The tank contractor shall have in its employ a design engineer with a minimum of 10 years of experience in the design of AWWA D110 Type III tanks and who has been the engineer of record for a minimum of 10 AWWA D110 Type III tanks.

   e. The tank contractor shall have in its employ for this project a team consisting of a tank project manager/superintendent, shotcrete foreman, wire-winding foreman, and precast erection foreman, each of whom shall have constructed a minimum of five (5) AWWA D110 Type III tanks.

   f. Experience in the design and construction of AWWA D110 Type I, Type II or Type IV tanks is not acceptable and will not be considered.

5. Submittals: The general contractor shall state the name of the tank contractor proposed for the work in a submittal within 60 days of contract award. Tank contractors seeking approval as an "equal" shall provide the submittals listed below within 60 days of contract award. Bids that do not state the name of the tank contractor or include the required qualifications as shown below will be rejected.

   a. Tank contractors seeking approval as an "equal" shall submit preliminary design drawings and calculations showing the dimensions of the tank, details of the type of construction, wire-wound prestressing methods, and sizes of principal members. The drawings and calculations shall be of sufficient detail to show compliance with the specification and all required standards and shall be signed and sealed by

an Engineer registered in the state where the tank is to be constructed. The registered Engineer shall certify the design is in conformance with AWWA D110, Type III.

b. Tank contractors seeking approval as an "equal" shall submit a complete experience record for the tanks they have designed and built in their own company name, meeting the requirements of paragraph 1.05 D.4.c. The record shall include the contractor's experience in the design and construction of precast, wire-wound, prestressed concrete tanks conforming to AWWA D110, Type III. The record shall also indicate the capacity of each tank, the sidewater depth, the name and address of the Owner, the year of construction, and the name of the Engineer for each project.

c. Tank contractors seeking approval as an "equal" shall submit statements of qualifications to demonstrate compliance with the design and construction qualifications listed in paragraph 4, above. Tank contractors shall submit the name of the tank designer currently in its employ, and his/her experience as the designer of record for AWWA D110, Type III tanks.

d. Tank contractors seeking approval as an "equal" shall submit the resumes and experience records for each member of the project team including the tank superintendent, project manager, shotcrete foreman, wire-winding foreman, and precast erection foreman that will be used for this project, meeting the requirements of paragraph 1.05 D.4.e.

e. Tank contractors seeking approval as an "equal" must submit items identified in paragraph 1.05 D.5.a-d. at least ten (10) days prior to bid for Contracting Officer review. Five days prior to bid, the Contracting Officer will issue an addendum to confirm additional approved tank builders, if any.

f. The Contracting Officer reserves the right to reject the use of any and all tank contractors who, in the Contracting Officer's judgment, are unqualified.

1.08 OPERATION AND MAINTENANCE MANUALS

A. Provide 6 hardcopies in three ring archive quality binders and two electronic copies in pdf format of operation and maintenance manual for hydrodynamic mixing system (HMS).

B. Operation and maintenance manuals shall include:

1. Table of contents

2. Copy of design calculations for the manifold system as defined in the previous section.

3. Copy of complete set of the installation plans.

4. Copy of NSF61 Certified Listing for the valves.

5. Parts and equipment list with specification numbers for ordering of replacement parts.

6. Product specification sheets for nozzles, outlet valves, expansion joints, concrete anchors, and any other specialized items supplied with the system.

7. Installation guidelines for the HMS manifold system.

8. Operational procedures for the HMS manifold system.

9. Guidelines for repair of system components.

10. Schedule for suggested periodic maintenance of the manifold system.

1.09 SPARE PARTS

A. Provide one spare hydrodynamic mixing system recirculation pump, complete with motor packaged for long tem storage.

1.10 PRE-INSTALLATION MEETINGS:

A. Convene minimum one week prior to commencing work of this section.

1.11 DELIVERY STORAGE AND HANDLING:

A. Comply with the requirements specified in Section 01610.

B. Precast Units:

1. Transport and handle units with equipment designed to protect units from damage.

2. Do not place units in positions capable of causing overstress, warp or twist.

3. Separate stacked units with battens across full width of each bearing point.

4. Stack units with lifting devices accessible and undamaged, and identification marks discernible.

C. Reinforcing Steel:

1. For reinforcing steel fabricated on-site, ship from mill in bundles, limited to one size and length, tagged with waterproof tag showing name of mill, heat number, grade and size of bars, and identifying number.

2. For reinforcing steel fabricated off-site, deliver in bundles identified as to structure and shop drawing number; identify each individual bar with waterproof tag showing grade, size and bar mark from shop drawings.

3. Protect reinforcing steel and wire fabric from damage and from dirt, oil, grease, other foreign matter, and rust-causing conditions.

4. Do not store reinforcement in direct contact with ground.

D. Concrete Ingredients:

1. Handle, control and store concrete materials in accordance with ACI 301, paragraph 4.1.4.

E. Ductile Iron Pipe and Fittings:

1. During loading, transporting, unloading, and storage on-site, exercise care to prevent damage to piping materials.

2. Do not drop pipe or fittings.

3. Store materials on site in enclosures or under protective coverings.

4. Secure openings in pipe and fittings to prevent the entry of wildlife and pests.

5. Keep materials clean and dry.

6. Do not store materials directly on ground.

1.12 FIELD MEASUREMENTS:

A. Verify field measurements prior to fabrication.

1.13 WARRANTY:

A. Warrantee the structure and appurtenances against any defective materials or workmanship and to be and to remain watertight and not show wet spots on the exterior due to penetration of water from within under all conditions. Warrantee shall be for a period of three years after the date of substantial completion.

B. If a defect needing repair under the warrantee is identified, the tank Contractor must make all repairs promptly and at his own expense. The tank warrantee shall be extended from the time of the repair completion for a period of three years.

C. The complete HMS including all piping, inlet nozzles, outlet valves, recirculation pumps, pipe support brackets, joint connections, expansion joints, and anchors shall be warranted by the HMS manufacturer against failure under design conditions for a period of three years from the date of substantial completion. Elastomer components damaged because of maintenance activities, foreign debris, or excessive exposure to direct ultraviolet and thermal radiation shall be excluded warranted coverage.

PART 2 - PRODUCTS

2.01 TANK MATERIALS:

A. Concrete:

1. Concrete for walls and roof and mortar fill shall have a minimum compressive strength of 4,000 psi at 28 days and shall be air entrained.

2. Concrete for tank floor, footings and pipe encasement shall have a minimum compressive strength for 4,000 psi at 28 days and shall not be air entrained.

3. Proportioning of concrete and mortar shall be in accordance with ACI 301. Concrete for roof and walls shall be air entrained.

4. Concrete shall conform to Specification Section 03300 unless otherwise specified herein.

B. Shotcrete shall conform to ACI 506 applied by either the dry-mix or wet-mix process except as modified by the drawings and specifications. Shotcrete shall have a minimum compressive strength at end 28 days of 4,500 psi.

1. Shotcrete used for covering prestressed wire or strand shall consist of not more than three parts sand to one part Portland cement by weight.

2. Shotcrete in contact with prestressing steel shall have a maximum water soluble chloride ion concentration of 0.06 percent by weight of cement.

3. Additional coats of shotcrete shall consist of not more than four parts sand to one part Portland cement by weight.

4. Polypropylene fibers shall be included in the shotcrete used for the finish cover coat.

a. Fibers shall be Fibercast 500 by Propex, Fibermesh or equal.

b. Fibers shall be virgin polypropylene and comply with ASTM C-1116 performance level I.

c. Fiber length shall be ¼ inch.

d. The amount of the fibers added to the shotcrete used for the finish cover coat shall conform to the Manufacturer’s recommendations.

5. Fly ash may be incorporated into the tank exterior finish cover coat. Fly ash shall conform to ASTM C618, Type F. Shotcrete shall have a minimum strength of 4,500 psi at twenty-eight days and have a maximum water to cementitious ratio of 0.42.

C. Coarse and fine aggregate shall conform to ASTM C33.

D. Admixtures:

1. Concrete for walls and roof shall be air entrained in accordance with the requirements of Section 03300. Concrete for floor construction shall not be air entrained.

2. A water reducing admixture, a super plasticizer and reinforcing fibers shall be incorporated in the concrete mix used for the tank floor.

3. Admixtures containing calcium chloride or causing accelerated setting of concrete are NOT PERMITTED.

4. Use admixtures from the same manufacturer or compatible admixtures in any one batch of concrete. Provide a statement of compatibility form all manufacturers if admixtures are provided by more than one manufacturer.

E. Fiber Reinforcement:

1. Fiber reinforcing shall conform to ASTM C1116, Type III.

2. Fibers shall be macro fibers. Micro fibers are prohibited.

3. Fibers shall be 100 percent virgin polypropylene fibrillated fibers containing no reprocessed olefin materials and specifically manufactured to an optimum gradation for use as concrete secondary reinforcement

4. Dosage Rate: Volume of fibers shall be a minimum of 3 pounds per cubic yard (1,780 grams per cubic meter).

5. Physical Characteristics:

a. Specific gravity: 0.91

b. Tensile strength: 40,000 to 110,000 psi (275 to 758 MPa)

c. Fiber length: 1/2 inch (13 mm) to 3/4 inch (19 mm)

6. Fibrous concrete reinforcement materials provided in this section shall produce concrete conforming to the requirements for strength of concrete specified.

F. Reinforcement Steel:

1. Bar and welded wire fabric reinforcement shall conform to Specification Section 03200 unless otherwise specified herein.

2. Reinforcement shall conform to ASTM A615, Grade 60.

3. Welded wire fabric shall conform to ASTM A185.

G. Prestressing steel shall be uncoated, cold-drawn, Class II wire conforming to ASTM A821 with a minimum ultimate tensile strength 210,000 psi. Stranded prestressing wire, prestressing cable and horizontal tendons are NOT PERMITTED. .

H. Seismic base restraint cables shall be hot-dipped galvanized seven-wire strand and shall be manufactured in accordance with ASTM A416 prior to galvanizing, and ASTM A475 after galvanizing.

I. Neoprene sleeves for base restraint cables shall be closed-cell conforming to ASTM D1056, Type 2, Class A, and Grade 3. The sleeves shall have a compression deflection limited to 25% at 9 to 13 psi, hardness of 60 to 80 durometer, a minimum tensile strength of 175 psi, a minimum elongation of 180%, and a maximum compressive set of 35%.

J. Elastomeric Materials:

1. Waterstops shall be polyvinylchloride conforming to CRD-C572. Waterstop splices shall be in accordance with manufacturer's recommendations.

2. Bearing pads shall be neoprene or natural rubber in accordance with AWWA D110.

3. Sponge filler shall be in accordance with AWWA D110.

K. Steel Diaphragm: Provide an uncoated continuous steel diaphragm as the outside form of the core wall panels in conformance with the requirements of AWWA D110, except no horizontal joints will be permitted. Vertical seams shall be rolled seams containing PVC tape. Vertical seams between precast panels shall be sealed with a polysulfide or polyurethane sealant per AWWA D110. Air curing of sealants is NOT PERMITTED.

L. Polysulfide or polyurethane sealant will be a two or three component elastomeric compound meeting the requirements of ASTM C920.

M. Inserts:

1. Recess the lifting inserts embedded in the precast concrete from the panel surface a minimum of 1 inch.

2. Plug all insert holes solid when no longer needed with a non-shrink non-metallic grout. Grout shall be:

3. F-100 Grout made by Sauereisen Cements Co., Pittsburgh, PA;

4. Five Star Grout made by U.S. Grout Corp., Old Greenwich, CT;

5. Upcon made by Upcon Co., Cleveland, OH;

6. Or acceptable equivalent product.

7. Moisten the hole to be plugged immediately prior to grouting to prevent flash setting. Cure grout with plastic patches sealed on all sides. Remove the entire sealed patch after the curing period, which is the same as specified for concrete in Section 03300.

N. Exterior acrylic coating for above grade areas of tank exterior walls and roof shall be a two coat acrylic system conforming to the following:

1. Two coats of Tammscoat, DFT as recommended by manufacturer's written instructions, by Euclid Chemical Company, Cleveland, OH.

2. Color and texture to be selected by Contracting Officer from manufacturer's standard colors and textures.

3. If the coating application work is to be performed in hot or windy conditions, provide an additional primer coat in accordance with the coating manufacturer's written recommendations.

4. Cure concrete surfaces in accordance with AWWA D110.

O. Cover coat protection for below grade areas of tank exterior walls shall be a two-component, self-priming high build epoxy similar to:

1. Two coats of Series 46H-413 Hi-Build Tneme-Tar, DFT 14.0 to 20.0 mils per coat, by Tnemec Co., North Kansas City, MO or

2. Two coats of B69 Hi-Mil Sher-Tar Epoxy, DFT 16.0 to 24.0 mils per coat, by Sherwin Williams Co., Cleveland, OH or

3. Two coats of Amercoat 78 HB, DFT 12.0 to 16.0 mils per coat, by PPG Industries, Pittsburg, PA.

4. Cure concrete surfaces prior to application in accordance with coating manufacturer recommendations.

2.02 PIPING AND FITTINGS

A. Influent, Overflow, Mixing System, and Drain Pipe

1. Ductile-iron conforming to ANSI/AWWA C151/A21.51.

2. Laying length: 18 feet

3. Thickness: Thickness Class 54

4. Joint Type: Push-on or flanged type as indicated, conforming to ANSI/AWWA C111/A21.11.

5. Joint Gasket: SBR (Styrene Butadiene) conforming to ANSI/AWWA C111/A21.11. Flanged gaskets shall be Full Face Flange-Tyte gaskets as manufactured by U.S. Pipe and Foundry Co..

6. Interior Lining: Double-thickness cement mortar conforming to ANSI/AWWA C104/A21.4. Provide seal coat qualified in accordance with the requirements of NSF/ANSI 61.

7. Exterior Coating: Prepare surface to SSPC-SP-10 and coat with two coats of NSF61 compliant Tnemec Series N140 Pota-Pox Plus to a total dry film thickness of 10 to 16 mils.

8. Manufactured in the United States of America or Canada.

B. Influent, Overflow, Mixing System, and Drain Fittings

1. Ductile-iron conforming to ANSI/AWWA C110/A21.10.

2. Pressure Rating: 350 psi rated working pressure.

3. Joint Type: Mechanical Joint or Flanged as indicated.

a. Mechanical joints conforming to with ductile iron restrained glands. Grey-iron glands will not be acceptable.

b. Flanged joints conforming to ANSI/AWWA C111/A21.11, with ductile iron flanges.

4. Joint Gasket: SBR (Styrene Butadiene) conforming to ANSI/AWWA C111/A21.11. Flanged gaskets shall be Full Face Flange-Tyte gaskets as manufactured by U.S. Pipe and Foundry Co..

5. Interior Lining: Double-thickness cement mortar conforming to ANSI/AWWA C104/A21.4. Provide seal coat qualified in accordance with the requirements of NSF/ANSI 61.

6. Exterior Coating: Prepare surface to SSPC-SP-10 and coat with two coats of NSF 61 compliant Tnemec Series N140 Pota-Pox Plus to a total dry film thickness of 10 to 16 mils.

7. Manufactured in the United States of America or Canada.

C. Tank Level sensor piping shall be Ductile Iron conforming to ANSI/ AWWA C110/A21.10.

D. Restrained Glands: Ductile-iron gland with multiple gripping wedges providing mechanical joint restraint. Restrained glands shall conform to the following requirements:

1. Acceptable Products:

   a. Series 1100 Megalug with Mega-Bond coating, as manufactured by EBAA Iron Sales, Inc.

   b. Contracting Officer approved equivalent.

2. Restrained glands shall be Listed by Underwriters Laboratories (3" through 24" inch size) and Approved by Factory Mutual (3" through 12" inch size).

3. Restrained glands shall have a working pressure rating of 350 psi for 3-16 inch diameter, and 250 psi for 18-48 inch diameter. Ratings are for water pressure and must include a minimum safety factor of 2 to 1 in all sizes.

4. Restrained gland body, wedges and wedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536.

5. Ductile iron gripping wedges shall be heat treated within a range of 370 to 470 BHN.

6. Restrained glands shall be processed through a phosphate wash, rinse, and drying operation and then coated with an epoxy or polyester based heat cured coating.

7. Proper actuation of the gripping wedges shall be ensured with torque limiting twist off nuts.

E. Mechanical Joint Bolts and Nuts: Cor-Ten T-bolts and nuts conforming to the requirements of ANSI/AWWA C111/A21.11 with minimum 1.2 mil thick blue, resin-bonded, thermally cured, fluoropolymer coating.

F. Flanged Joint Bolts and Nuts: Type 316L stainless steel, hex head conforming to ASTM F593 or ASTM F594 as applicable.

2.03 TANK HYDRODYNAMIC MIXING SYSTEM (HMS)

A. Mixing system to be as designed and manufactured by Tideflex Technologies, Carnegie, PA. The design, sizing, and spacing of the inlet/outlet riser manifold and mixing system valves shall be performed by the HMS manufacturer. Manufacturer's and/or contractors submitting an alternative to the named Tideflex Technologies mixing system shall be responsible for obtaining any and all proprietary rights, license fees, royalties, technology licenses, and/or permissions required to provide such a system. The Manufacturer shall indemnify and hold harmless the Contracting Officer against all claims, damages, losses, and expenses arising out of any infringement of patent rights or copyright incident relating to this system

B. Mixing system pipe and fittings to conform to the requirements of specification paragraph 2.02.

C. Variable Orifice Duckbill Inlet Nozzles

1. Inlet ports/nozzles shall be duckbill-style check valves that allow fluid to enter the tank during fill cycles and prevent flow in the reverse direction through the nozzle during draw periods. Inlet ports/nozzles may not be fixed-diameter ports or pipes.

2. The duckbill valves shall be NSF61 Certified. NSF61 approved/Certified materials will not be accepted in lieu of valve certification.

3. Inlet ports/nozzles shall have a variable diameter vs. flow hydraulic profile that provides a non-linear jet velocity vs. flow characteristic and a linear headloss vs. flow characteristic. The hydraulic characteristics of the duckbill valves shall be defined by "Hydraulic Code".

4. The inlet ports/nozzles shall discharge an elliptically shaped jet. The nozzle must have been modeled by an independent laboratory using Laser Induced Fluorescence (LIF).

5. Manufacturer shall have conducted independent hydraulic testing to determine head loss and jet velocity characteristics on a minimum of eight (8) sizes of duckbill valves ranging from 2" through 48". The testing must include multiple constructions (stiffness) within each size and must have been conducted for free discharge (discharge to atmosphere) and submerged conditions.

6. Manufacturer shall have conducted an independent hydraulic test where multiple valves (at least four) of the same size and construction (stiffness) were tested to validate the submitted headloss characteristics and to prove the repeatability of the manufacturing process to produce the same hydraulic characteristics.

7. Manufacturer shall have conducted independent hydraulic testing to study the flow distribution characteristics of duckbill valves installed on multiport manifolds.

8. Manufacturer to have conducted Finite Element Analysis (FEA) on various duckbill valves to determine deflection, stress, and strain characteristics under various load conditions. Modeling must have been done for flowing conditions (positive differential pressure) and reverse differential pressure.

9. Manufacturer must have conducted in-house backpressure testing on duckbill valves ranging from ¾" to 48".

10. Manufacturer shall have at least fifteen years experience in the manufacturing of "duckbill" style elastomeric valves.

11. The duckbill style nozzles shall be one-piece elastomer matrix with internal fabric reinforcing designed to produce the required discharge velocity and minimum headloss requirements as stipulated in the Submittals section. The flange portion shall be an integral portion of the nozzle with fabric reinforcing spanning across the joint between the flange and nozzle body.

12. The elastomer used in construction of the duckbill valves must have been tested by an accredited independent laboratory that confirmed there is no degradation in the elastomer when exposed to chlorine and chloramine per the ASTM D471-98 "Standard Test Method for Rubber Property – Effect of Liquids."

13. The manufacturer's name, plant location, serial number and product part number which designates nozzle size, material and construction specifications shall be bonded onto the surface of the nozzle.

D. Outlet Check Valves

1. The outlet flow valves shall be perforated disc type with elastomeric membrane.

2. The valves shall be NSF61 Certified. NSF61 approved/Certified materials will not be accepted in lieu of valve certification.

3. The perforated disc shall be fabricated of stainless steel plate with welded support gussets. The disc shall be flanged and drilled to mate with ANSI B16.1, Class 125/ANSI B16.5 Class 150 flanges. The disc shall have three (3) tapped holes used for fastening the membrane and support rod to the disc with stainless steel bolts, nuts, and lock washers. The top of the disc shall be tapped and supplied with lifting eyebolt for installation.

4. The membrane shall be circular, one piece rubber construction with fabric reinforcement. The diameter of the membrane shall allow adequate clearance between the membrane O.D. and the pipe I.D. The membrane shall be vulcanized with a specified convex radius to produce a compression set to allow the membrane to seal against the perforated disc at low reverse differential pressure.

5. The support rod shall be stainless steel and drilled with three (3) longitudinal holes to allow fastening of rod to membrane and perforated disc.

6. When line pressure inside the valve exceeds the backpressure outside the valve, the line pressure forces the membrane to open, allowing flow to pass through the perforations in the disc. When backpressure exceeds the line pressure, the membrane seats on the perforated disc preventing backflow.

7. The valve shall allow flow out of the reservoir during draw cycles and prevent flow into the reservoir during fill cycles.

8. The elastomer used in construction of the membrane must have been tested by an accredited independent laboratory that confirmed there is no degradation in the elastomer when exposed to chlorine and chloramine per the ASTM D471 "Standard Test Method for Rubber Property – Effect of Liquids."

9. The manufacturer's name, plant location, serial number and product part number which designates membrane size, material and construction specifications shall be bonded onto the surface of the membrane.

E. Hydrodynamic Mixing System Recirculation Pump

1. System to include recirculation pump as shown on drawings located inside Altitude Valve Vault and include all required piping, valves, controls and appurtenances to operate fully.

2. Pump Characteristics: Inline, vertical, flanged end connections, cast iron casing, bronze impeller, silicon carbide mechanical seal, stainless steel bolting hardware. Refer to drawings for pump performance characteristics.

3. Motor Characteristics: TEFC, 1775 maximum RPM, 1.15 S.F., 1 phase, 60 Hz, 115/230 volts with thermal winding protection.

F. Mixing system pipe and fitting supports shall be adjustable and fabricated from Type 316L stainless steel pipe or structural shapes with Type 316L hardware. Supports shall be attached to the tank structure with Type 316L stainless steel epoxy anchor bolts.

2.04 ACCESSORIES:

A. Inserts:

1. Recess the lifting inserts embedded in the precast concrete from the panel surface a minimum of 1 inch.

2. Plug all insert holes solid when no longer needed with a non-shrink non-metallic grout. Grout shall be:

a. F-100 Grout made by Sauereisen Cements Co., Pittsburgh, PA;

b. Five Star Grout made by U.S. Grout Corp., Old Greenwich, CT;

c. Upcon made by Upcon Co., Cleveland, OH;

d. Or acceptable equivalent product.

3. Moisten the hole to be plugged immediately prior to grouting to prevent flash setting. Cure grout with plastic patches sealed on all sides. Remove the entire sealed patch after the curing period, which is the same as specified for concrete in Section 03300.

B. Roof Hatch:

1. Manufacturers:

a. Bilco Co., New Haven, CT;

b. Babcock-Davis Hatchways, Inc., Arlington, MA;

c. Halliday, Orlando, FL;

d. Inland-Ryerson Construction Products Co., Milwaukee, WI;

e. Or Contracting Officer approved equivalent product.

2. Provide roof hatch with location and minimum dimensions as indicated on the drawings. Secure to raised concrete curb with Type 316L stainless steel epoxy anchor bolts. Cover shall be 0.097 inch thick sheet aluminum with a 3 inch beaded flange neatly welded and ground smooth. Provide 1 inch thick fiberglass insulation protected by 0.040 inch thick sheet aluminum liner.

3. Provide completely assembled roof hatch with heavy pintle forged brass hinges, stainless steel pins, compression spring operators enclosed in telescopic tubes, positive snap latch with turn handles, suitable hasp for padlocking and neoprene draft seal. Provide automatic hand-open arm complete with vinyl grip handle. All hardware shall be Type 316L stainless steel.

4. Installed hatch shall be completely sealed against water and air intrusion.

5. Prepare exterior surface of roof hatches to SSPC-SP-10 and coat with two coats of NSF61 compliant Tnemec Series N140 Pota-Pox Plus to a total dry film thickness of 10 to 16 mils. Coating color to match concrete tank finish coating.

C. Vent:

1. Provide complete heavy grade aluminum vent assembly including vent cap, 24 mesh Type 316 stainless steel insect screen and security angles. Secure the vent to a 6 inch wide concrete curb projecting not less than 6” above the roof line with Type 316L stainless steel epoxy anchors set into the concrete curb. Provide a minimum roof opening of 2 feet in diameter.

2. Provide sufficient vent capacity to allow net inflow or withdrawal rates of the specified rate without creating positive or negative pressures inside the tank and in accordance with AWWA D110.

3. Roof vents shall be located as indicated on drawings.

4. Prepare exterior surface of roof vents to SSPC-SP-10 and coat with two coats of NSF61 compliant Tnemec Series N140 Pota-Pox Plus to a total dry film thickness of 10 to 16 mils. Coating color to match concrete tank finish coating.

D. Overflow:

1. Provide an overflow weir length and overflow pipe diameter sized for the maximum overflow rate with not more than 4-inches rise in water surface above the overflow weir elevation.

2. Use minimum of thickness class 54 cement-lined ductile iron pipe for overflow pipe. Use mechanical joints or flanged joints unless otherwise indicated on drawings.

3. Prepare exterior of pipes not encased in concrete to SSPC-10 and coat with two coats of NSF61 compliant Tnemec Series N140 Pota-Pox Plus to a total dry film thickness of 10 to 16 mils instead of the standard exterior bituminous coating.

4. Use cast iron sleeve couplings on overflow pipes inside reservoirs as indicated on the drawings. Coat sleeve couplings with a fusion bonded epoxy coating compliant with NSF61 and suitable for use in potable water. Use Type 316L stainless steel bolts and hardware for assembly of sleeve couplings and drain connections.

5. Design the concrete overflow pipe support to be a rigid structure suitable to withstand forces imposed by the overflow and to be undamaged by ice formation inside the reservoir.

6. Overflow exit to include ductile-iron elbow with 24 mesh stainless steel screen, and Tideflex duckbill outlet valve as manufactured by Red Valve Company, Inc., Carnegie, PA and as shown on drawings. Valve shall be fabricated of UV resistant EPDM elastomer with Type 316 stainless steel retaining ring and bolting hardware.

E. Tank Silt Stop:

1. Silt stop shall be a piece of thickness class 54 cement lined ductile iron pipe projecting 6” above the finished floor.

F. Exterior Ladder:

1. Exterior ladders shall be fabricated from 6061-T6 aluminum with a mill finish. Fasten with Type 316 stainless steel attachment hardware providing for temperature expansion and galvanic isolation of dissimilar metals.

2. Outside ladders shall begin 8 feet above the level of the finished ground surface at the ladder location and terminate at the roof platform.

3. Outside ladders shall be provided with an OSHA approved safety and access security cage. Access security cage shall utilize perforated aluminum sheet with perforation size and spacing as selected by Contracting Officer. Provide cage with a padlock hasp lockable access door plate. Roof ladders and stairs shall be provided with OSHA approved handrails.

4. Tank ladder shall be equipped with a fall prevention system consisting of a ladder mounted notched rail, rung clamps, shuttle, 54” removable aluminum dismount extension, and safety harness system as manufactured by Miller – Honeywell Industrial Safety, Smithfield, RI . Provide a complete system with aluminum rail,

aluminum rung clamps, aluminum dismount extension, two shuttles, one harness with large belt, one harness with extra-large belt, two lanyards with sofStop, and one storage box.

5. Prepare exterior ladder and appurtenances to SSPC-SP-10 and coat with two coats of NSF61 compliant Tnemec Series N140 Pota-Pox Plus to a total dry film thickness of 10 to 16 mils. Coating color to match concrete tank finish coating.

G. Interior Ladders

1. Interior ladders shall be designed and fabricated so that they may be assembled, installed, or removed via the tank wall manways without the need for cutting or welding. Ladders shall conform to all OSHA and Connecticut Building Code requirements.

2. Interior ladders shall be fabricated from Type 316L stainless steel structural shapes, gratings, railings, and treads.

3. Ladder hardware, fasteners, and bolting shall be Type 316L stainless steel. Fasteners for anchoring the ladder to the tank structure shall be Type 316L epoxy anchors.

H. Walkways and Railings:

1. Roof Safety Railing System: A 6061-T6 Schedule 40 anodized aluminum roof safety railing system shall be provided as shown on drawings to enclose the roof access hatches, the vent, and access between them.

2. Roof Safety Cable System: Stainless Steel safety cable system including anchorages, supports and additional D-Ring tie-off points shall be provided as shown on drawings.

3. Prepare railings and appurtenances to SSPC-SP-10 and coat with two coats of NSF61 compliant Tnemec Series N140 Pota-Pox Plus to a total dry film thickness of 10 to 16 mils. Coating color to match concrete tank finish coating.

I. Wall Manways:

1. Provide a circular wall manway with a hinged cover. Manway and cover shall be Type 316 stainless steel. A Type 316 stainless steel grab bar and Type 316 stainless steel platform and ships ladder shall be installed at the manway locations. Locate access manways as shown on drawings.

2. Manway covers shall open into tank and be provided with wall mounted davit designed to support full weight of the cover.

3. Manway frames, covers and appurtenances shall be of Type 316 stainless steel construction. Field welding is NOT PERMITTED.

4. Manway frames, covers and appurtenances shall be designed for reservoir loading at manway elevation with 1.5 safety factor.

5. An interior landing platform with ships ladder or ladder to the floor as shown on the drawings shall be installed at each manway location. Locate access manway as shown on drawings.

J. Padlocks: Permanent padlocks shall be provided by Contracting Officer. Contractor shall supply required temporary padlocks until final completion of construction.

K. Sleeve Couplings: Sleeve-type couplings shall be as made by Dresser Mfg. Div., Bradford, PA; Rockwell International, Municipal & Utility Div., Pittsburgh, PA; or R. H. Baker & Co., Inc., Los Angeles, CA; or equal.

L. Floor Sump and Drain

1. An 8" diameter drain within a 2'- 0" square x 6" deep sump shall be provided in the tank floor. The drain pipe shall include a removable silt stop. Location of the drain pipe and sump as shown on the drawings.

M. Shotcrete Antenna Pads:

1. Two shotcrete antenna pads per tank shall be provided at the top of the tank wall, under the dome ring, location to be as directed by the Contracting Officer.

N. Air Duct and Conduit Sleeves:

1. Provide Type 316L stainless steel air duct sleeve with watertight welded water-stop at the top of the tank and a cast in place concrete curb.

2. Provide air duct support pads and Type 316L stainless steel air duct support brackets to support the air duct on the side of the tank.

3. Air duct pipe shall be schedule 10S, Type 316L stainless steel conforming to ASTM A-312. Air duct fittings shall be Type 316L stainless steel conforming to ASTM A-403. Plate flanges shall be Type 316L stainless steel.

4. Expansion joint to be Style 9394 flanged, reinforced nitrile, with a minimum pressure rating of 3 psi, as manufactured by Garlock Sealing Technologies or Contracting Officer approved equivalent.

5. Conduit sleeves to be Type 316L stainless steel with water stops and conduit-cable sealing bushings. Provide conduit support pads and Type 316L conduit support hangars and hardware for tank supported conduits.

6. Conduit Sealing Bushings shall be type CSBG as manufactured by OZ Gedney or Contracting Officer approved equivalent.

PART 3 - EXECUTION

3.01 GENERAL:

A. Clear the area to be excavated for the tank construction. Remove and dispose of debris, vegetation and topsoil. Excavate to such depths and widths as will provide adequate room for construction of the tank and preparation of the subgrade. Dispose of or store excavated materials as directed by the Contracting Officer.

B. Prepare subgrade in accordance with the contract drawings and construct and compact the required structural backfill to the specified percent of maximum density in accordance with ASTM D1557.

C. Prepare surface of foundation for construction of tank floor and footings. Subgrade compaction shall achieve a density of at least 95 percent of the maximum laboratory density determined by ASTM D1557 or at least 98 percent of the maximum laboratory density determined by ASTM D698. Field tests for measurement of in-place density shall be performed in accordance with ASTM D1556 or ASTM D6938.

D. Construct tank in accordance with applicable provisions of AWWA D110.

E. Construct concrete membrane floor in one continuous placement with no construction joints. Reinforcement shall have a concrete cover of not less than 1-inch between the bars or wires and the top surface of the concrete. The cover between the bottom of the slab and the reinforcement shall not be less than 2-inches. Thicken concrete membrane floor as required to accommodate tank wall and construction loads and to accommodate epoxy anchor minimum depths of embedment.

F. Horizontal construction joints shall not be allowed in walls.

G. Sandblast all concrete surfaces to receive shotcrete to remove material which may prevent bonding. Steel to be covered with shotcrete shall have a bondable surface and may require light sandblasting as directed by Contracting Officer.

H. Water jet cleaning may be used if demonstrated to Contracting Officer's satisfaction that the result is the same as sandblasting and water runoff will not undermine tank foundation.

I. No curing compounds shall be applied to surfaces to be covered with shotcrete.

J. Temporary wall openings may be provided for access to and removal of construction materials from the tank interior subject to the approval of the Contracting Officer. Prestressing wires shall not be "bunched" at the opening, but shall be banded by displacing the number of wires required at the opening into circumferential bands immediately above or below the opening.

K. Prestressing wire shall be placed in accordance with AWWA D110.

L. Provide continuous waterproof steel diaphragm within the tank wall between the water and the prestressing wire.

1. No form tie holes will be allowed.

2. Provide a minimum concrete cover on the inside face of the diaphragm of four inches.

3. Provide a minimum shotcrete cover on the outside face of the diaphragm of one and one-half inches.

M. Tank finishes:

1. Floor slab: Bull float or Fresno finish.

2. Precast wall panels: Broom finish. Finished interior walls shall have a smooth finish.

3. Roof: Light broom finish.

4. Finish exterior shotcrete to receive waterproofing as required by manufacturer of waterproofing material.

N. Tank Accessories:

1. Install in accordance with approved shop drawings.

3.02 QUALITY CONTROL:

A. Contractor shall engage and pay for the services of an independent National Voluntary Laboratory Accreditation Program (NVLAP) accredited construction materials testing laboratory to perform field quality assurance testing. Contractor shall engage and pay for NVLAP testing laboratory for all services required to demonstrate compliance of materials submitted for shop drawing review.

B. Testing of materials for compliance with the technical requirements of the specifications shall be in accordance with those standards listed herein.

C. A set of four test cylinders shall be made for each 50 cubic yards of concrete, or fraction thereof, placed in one day. One cylinder shall be tested at seven days, two at twenty-eight days, and one held as a spare.

D. Testing of shotcrete shall be in accordance with ACI-506. Test panels shall be made from shotcrete as it is being placed, and shall be representative of the material being applied. The method of making a test sample shall be as follows: A frame of 4-mesh wire fabric, 1 foot square, 3 inches in depth, shall be secured to a plywood panel and hung or placed in the location where shotcrete is being placed. This form shall be filled in layers simultaneously with the nearby application. After twenty-four hours, the fabric

and plywood backup shall be removed and sample slab placed in a safe location at the site. The sample slab shall be moist cured in a manner identical to the regular surface application. The sample slab shall be sent to an approved testing laboratory and tested at the age of seven days and twenty-eight days. Nine 3-inch cubes shall be cut from the sample slab and subjected to compression tests in accordance with current ASTM Standards. Three cubes shall be tested at the age of seven days, three shall be tested at the age of twenty-eight days, and three shall be retained as spares.

E. The tank contractor shall furnish a calibrated stress recording device, which can be easily recalibrated. This device shall be used in determining wire stress levels on the wall during and after the wrapping process. At least one stress reading per foot of wall height or one stress reading per coil of wire, whichever is greater, shall be taken immediately after the wire has been applied on the wall. Readings shall be recorded and shall reference the applicable height and layer of wire for which the stress is being taken. A written record of stress readings shall be kept. All stress readings shall be made on straight lengths of wire. If applied stresses fall below the design prestress in the steel, additional wire shall be provided to bring the prestressing up to the design prestressing force. If the prestress in the steel is more than 7 percent over the design prestress, the wrapping operation shall be discontinued.

F. Leakage testing shall be carried out in accordance with AWWA D110 and ACI 350.1 prior to tank backfilling. Tank shall not be backfilled until it has successfully passed leakage testing.

3.03 INSTALLATION

A. Install hydrodynamic mixing system in accordance with manufacturer's written installation instructions.

B. Install THM removal system in accordance with manufacturer's written installation instructions.

3.04 PROTECTION:

A. Protect surfaces of completed installations to prevent damage during construction activities.

B. Aluminum surface shall be isolated from contact with concrete. Protect with a minimum 4-mil dry thickness coat of zinc chromate primer on the aluminum surfaces and a minimum 2 mil dry thickness coat of all-metal primer followed by one coat of minimum 3 mil dry thickness aluminum paint to the dissimilar metal.

3.05 REPAIR OF DEFECTIVE WORK:

A. Remove stained or otherwise defective work and replace with no additional cost to Contracting Officer.

3.06 WATERPROOFING:

A. Preparation of the exterior wall and roof surfaces to be coated shall be in accordance with the coating manufacturer's written recommendations.

3.07 BELOW GRADE PROTECTIVE COATING:

A. Apply cover coat protective coating to all areas of walls below finish grade and extending out over the top of the cast-in-place floor or base.

B. Apply in strict accordance with coating manufacturers installation specifications.

3.08 MANUFACTURER'S FIELD SERVICES:

A. Furnish field representative experienced in installation of tank to supervise installation.

1. Furnish Installation Certificate attesting foundation, and tank are properly installed and conform to all specification requirements and all warrantees are in full force and effect.

B. Hydrodynamic mixing system (HMS) manufacturer shall provide a minimum of two days start up services of a factory-trained service representative for system startup and operator training.

1. Following installation of the complete HMS manifold piping system, the contractor shall open the upstream isolation valve to allow flow into the tank through the manifold system. The isolation valve must be opened slowly to prevent surge or over-pressurization of the manifold system. The isolation valve must be fully opened to inspect the flow characteristics of the manifold system.

2. The contractor and factory-trained representative shall visually inspect the entire piping system for leakage.

3. The contractor and factory-trained representative shall visually inspect all of the inlet nozzles to ensure flow is being discharged into the tank through all nozzles.

4. The contractor and factory-trained representative shall visually inspect and verify proper operation of the recirculation pump system.

5. Provide one two hour operator training session for the HMS. Training shall be video recorded and provided to the Contracting Officer in DVD format.

3.09 TANK DISINFECTION:

A. Disinfect tank and connecting piping with chlorine not sooner than seven days after completion all work but before tank is placed in operation. City of Middletown Water and Sewer Department will furnish water for disinfection and testing. Contractor shall furnish all labor, chlorinating agent, hoses and water-injecting apparatus for delivering

chlorine-bearing water into the tank and for the satisfactory completion of tank disinfection.

B. Method of tank disinfection shall conform to AWWA C652, Chlorination method 3, and to the requirements of the City of Middletown Water and Sewer Department, except as otherwise specified herein. Chemicals used in the disinfection process shall comply with NSF/ANSI 60.

C. Close the valve nearest to the tank. Thoroughly hose down the interior of the tank with water containing 50 ppm chlorine content. Solution shall be pumped into the tank to a depth that when the remainder of the tank is filled with water the resulting chlorine content will be 2 ppm. The 50 ppm solution shall be held in the tank for 6 hours prior to the addition of water to fill tank. The 2 ppm solution shall be held in the tank for 24 hours at which point the tank shall be placed directly into service without draining the tank provided that the piping downstream of nearest valve has been properly disinfected.

D. City of Middletown Water and Sewer Department will collect all water quality samples with Contractor assistance and will perform all required water quality testing. Contractor shall provide at least 72 hours advance notice for scheduling testing.

E. Contractor shall not place any portion of the tank in service unless authorized by the City of Middletown Water and Sewer Department.

3.10 PIPING DISINFECTION

A. Method of piping disinfection shall conform to AWWA C651, continuous feed method, and as required by the City of Middletown Water and Sewer Department. Chemicals used in the disinfection process shall comply with NSF/ANSI 60.

B. City of Middletown Water and Sewer Department will collect all water quality samples with Contractor assistance and will perform all required water quality testing. Contractor shall provide at least 72 hours advance notice for scheduling testing.

C. Contractor shall not place any portion of the piping in service unless authorized by the City of Middletown Water and Sewer Department.

3.11 CLOSEOUT ACTIVITIES:

A. Provide in accordance with Section 01700.

END OF SECTION

DIVISION 13

SPECIAL CONSTRUCTION

SECTION 13300

UTILITY CONTROL INSTRUMENTATION SYSTEM

PART 1 – GENERAL

1.01 DESCRIPTION:

A. Provide, calibrate and test the instrumentation and control systems specified. Provide equipment, installation services and appurtenances required to achieve a complete, integrated and fully operational system.

B. Provide instruments as specified herein and as indicated on the Contract Drawings.

C. Provide control panels and components as specified herein and as indicated on the Contract Drawings.

D. Provide programming and system operation in accordance with loop descriptions indicated on the Contract P&ID's.

E. All equipment shall comply with the electrical Area Classification schedule indicated on the electrical drawings.

F. Provide materials and equipment which are listed, labeled or certified by Underwriters Laboratories (UL) Inc. or equivalent, where such standards have been established.

G. In order to standardize SCADA controls for the Cherry Hill Tank, Water Meter Vault, Talcott Ridge Booster Station, and Waterline RD project, obtain the services of Knapp Engineering, Prospect, CT.

H. The SCADA system provided shall include the following components:

1. Changes to Existing Components

a. Long Hill Pump Station

1. Modify the existing Station Monitoring Control Panel to accept new from new devices as shown on the Contract P&IDs.

2. Modify the existing Station Monitoring Control Panel to provide monitoring and control of new equipment at the Cherry Hill Storage Tank and Altitude Valve Vault as shown on the Contract P&IDs.

3. Modify the existing remote communication system to include new monitoring signals as shown on the Contract P&IDs.

b. Expand the system network to include new devices as shown on the Contract P&IDs.

c. Higby and Roth Filter Plants

1. Modify existing SCADA systems as shown on the Contract P&IDs.

2. SCADA Control Panels

a. Cherry Hill Storage Tank:

1. Provide the Cherry Hill Control Panel (CH-CP) and Cherry Hill PLC (CH-PLC) at the Cherry Hill Storage Tank as shown on the Contract P&IDs and as specified herein.

2. Expand the system network to include new devices as shown on the Contract P&IDs.

b. Water Meter Vault:

1. Provide the Water Meter Vault PLC/Control Panel (WMV.PLC/CP) at the water meter vault as shown on the Contract P&IDs and as specified herein.

c. Talcott Ridge Booster Station:

1. Provide the Talcott Ridge Booster Station PLC/Control Panel (TBS.PLC/CP) at the Talcott Ridge Booster Station as shown on the Contract P&IDs and as specified herein.

1.02 RELATED WORK:

A. Division 1: General Requirements

B. Division 11: Equipment

C. Division 16: Electrical

1.03 REFERENCES:

A. National Fire Protection Association (NFPA)

B. Connecticut Electrical Code (CEC)

C. Underwriters Laboratories (UL)

D. National Electrical Manufacturers' Association (NEMA)

E. International Society of Automation (ISA)

F. The Institute of Electrical and Electronics Engineers (IEEE)

G. The American Society for Testing and Materials (ASTM)

H. National Institute of Standards and Technology (NIST)

1.04 SUBMITTALS:

A. Submit the following in accordance with Section 01300:

1. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.

a. Failure to include a copy of the marked-up specification sections will result in return of the entire submittal without further review until marked-up specification are resubmitted with the entire package.

2. Wiring diagrams, control panel elevations, catalog cut sheets and descriptive literature. Annotate information to clearly identify the proposed items and options.

3. Submit documentation that all control panels are constructed in conformance with UL 508A and bear the UL seal confirming the construction.

4. Control Panel Submittal:

a. Submit control panel loop diagrams on 11 inch by 17 inch sheets. Show all loops in their entirety including control wiring within and between all field devices including those devices furnished under other Divisions. Clearly identify the selector switch contact states in each selector switch position. Identify normally open or normally closed status for all relay and switch contacts. Assign each wire a unique wire number. Show all power sources, grounding, isolation and lightning protection. Show both analog and discrete signals on a single loop diagram.

b. Submit equipment outline drawings showing exterior and interior elevations, front panel arrangement, internal panel wiring and internal panel layout.

c. Provide complete Bill of Materials indicating manufacturer's part

numbers.

d. Certified shop test, field test and inspection reports.

e. Identify where exceptions are being taken or an “or equal” piece of hardware is being proposed.

f. Submit electrical load data used for UPS sizing calculations.

5. Instrument Submittal:

a. Instrument manufacturing data sheets indicating pertinent data. Identify each instrument submitted with applicable loop numbers and nomenclature as indicated on the Contract Drawings and specifications.

b. Instrument drawings indicating dimensions, mounting and external connection details.

1.05 QUALITY ASSURANCE:

A. Calibrate all instrumentation. Provide calibration tag to all calibrated instruments. The calibration tag shall have the name and phone number of the SI who performed the calibration with the date of calibration. Provide calibration records to the Contracting Officer prior to substantial completion.

B. The SI shall coordinate with the mechanical and electrical system suppliers to identify any signal isolation or auxiliary relays that may be required to complete the system.

C. Protect materials and equipment against damage during shipping, storage and construction.

PART 2 – PRODUCTS

2.01 GENERAL:

A. Equipment, cabinets, instruments and other devices furnished under this section shall be suitable for continuous use in the intended application.

B. The system shall consist of current production products.

C. I/O points required are identified by type on the Contract Drawings.

2.02 INSTRUMENTS:

A. Provide instruments in accordance with the data sheets attached to this specification as 13300-A.

B. Data sheets specify minimum requirements.

C. Provide all brackets, hangers, and miscellaneous metals for mounting of equipment. Mounting hardware shall be installed in accordance with the manufacturers printed recommendations and not interfere with any other equipment.

D. All equipment shall be tested at the factory prior to shipment.

2.03 CONTROL PANELS:

A. Control Panel Enclosure

1. Panels furnished under this section shall be of the design, arrangement and size as shown on the Contract Drawings and specified herein.

2. Provide control panels with NEMA rating in accordance with the electrical area classification indicated on the electrical drawings.

3. Provide panels doors extending the full width for full access to panel-rear mounted components. Doors shall open 180° and be provided with drawing pocked to hold as-built and service documentation.

B. Surge Protection

1. Provide Surge Protection Devices (SPDs) for panel as follows:
   a. For each power feed into the control panel.
   b. Rated a minimum of 10 kilo amps (kA)
   c. With light indicating fault
   d. Mount SPD inside control panel
   e. Minimize lead length of SPD
   f. SPD manufactured by Joslyn, Dehn, MTL, Harger or equal

2. Provide surge protection for analog signals as follows:
   a. For signals originating in a structure outside the one housing the control panel or greater than 200 feet from the control panel.
   b. Surge protection shall be: two-stage common-mode protection by means of arrestor reactor and varistor in combination and differential mode protection by means of gas arrestor, reactor and zener diode in combination.
   c. Rated a minimum of 10 kilo amps (kA)
   d. Manufactured by Dehn, Harger, MTL or equal.

C. Power Supplies

1. Provide provisions for two separate external 120VAC circuits. One circuit shall be utilized for the UPS, PLC, I/O cards, etc. The second circuit shall be utilized for 120VAC power to remote instruments and courtesy equipment indicated below. Provide a local disconnecting circuit breaker for each circuit.

D. Courtesy Equipment

1. Provide a 120VAC duplex service receptacle and switchable light fixture within each control panel.

E. Power to Remote Instruments

1. Provide provisions for power to field instruments from the same panel that receives the signal. Feed each instrument from an individual fused disconnect or circuit breaker.

F. Mounting

1. Mount all panel components to allow easy access for servicing, calibration, adjustments, testing and removal, without the removal of other equipment.

2. Provide internal panel components mounted directly on removable plates made of the same material and finish as the panel, of a thickness to provide rigid support for mounted components.

3. Mount all equipment on wall of panel enclosure. Loose equipment on the floor of enclosure is not acceptable.

G. Labeling

1. Attach identification labels to all internal components.

2. All control panel wiring shall be numbered at both ends with type written heat shrinkable wire markers. Number wiring in accordance with the numbering system used on the instrument submittal drawings.

3. Terminal strip labeling shall be identical to the wire numbers.

H. Switching

1. Pushbuttons shall be of oil-tight, heavy-duty momentary contact pushbuttons, rated for 10A at 120VAC unless specified otherwise.

2. Rotary selector switches shall be oil-tight, heavy-duty, maintained contact type rated for 10A at 120VAC.

I. Indicating Lights

1. Provide oil-tight, heavy-duty, LED cluster type pilot lights, with average life of 40,000 hours, minimum, unless otherwise specified.

J. Control Relays

1. Provide sealed relays DIN rail mounted with indicating light to indicate its' operation. Contacts shall be rated for 10A at 120VAC.

2. Provide electronic timer delay of the plug-in, digital type with output contacts rated for 10A at 120VAC.

3. Provide all relays from a single manufacturer.

K. Termination Points

1. Terminate all wiring at a central terminal array consisting of rigid terminal strips with numbering identical to the wire numbers.

2. Arrange the terminal blocks into functional groups indicated below:

   a. 120VAC power wiring
   b. DC power wiring
   c. Discrete signals
   d. Analog signals

3. Provide 25% spare terminal blocks for each functional group.

4. Use only one side of each terminal block row for internal wiring. Use the other side for field wiring. Do not locate terminal blocks within 6 inches of any right angle panel surface.

5. Provide terminal blocks of corrosion proof material such as nickel plated copper. Provide AC and DC control terminals suitable for 12 AWG or larger wire. Provide terminals for DC analog signals suitable for 16 AWG wire.

L. Wires

1. Power and control wire shall be 600 Volt class, Type THHN/THWN insulated stranded copper and shall be of the sizes required for the current to be carried, but not smaller than 14 AWG.

2. Provide 16 AWG shielded cable pairs for all analog signals internal to the panels.

M. Wiring Methods

1. Grounding

   a. Provide a grounding terminal strip bonded to the panel enclosure with 20 percent spare terminals.

   b. Individually connect ground wires between control panel components to grounding terminal strip.

2. Wire Troughs

   a. Provide internal wiring troughs of the plastic, open-side type with snap-on covers.

   b. Wiring troughs shall not be filled to greater than 60% capacity. Provide snap-on covers marked to identify their locations.

3. Wire Path

   a. Group wiring within the panel according to function. Harness groups together or place within ducts which are secured to the panel structure.

   b. Remote instrument power shall not be commingled with panel power for other panel devices.

   c. Crossings of the two system's wires shall be at right angles. Parallel runs of the two system's wires shall be separated by a minimum of 12 inches.

   d. Partition intrinsically safe wiring separately from all other wiring. Provide a protective cover with labeling to cover the intrinsically safe wires.

4. Wire colors shall be assigned as follows:

AC Power	Black
AC Neutral or Common	White
AC Control	Red
DC Control	Blue
Equipment or Panel Ground	Green
Externally Powered Circuits	Yellow

5. Wire connectors shall be the hook-fork type, with non-insulated barrel to allow easy inspection of crimp integrity.

N. Signal Management

1. Design all instrumentation equipment to operate on 120VAC, +/-10%, at 60Hz, except as specifically noted. Provide power supplies, regulators and constant-voltage transformers to allow compliance with the above.

2. Provide electronic type solid-state instrumentation utilizing linear transmission signals of 4-20mADC, (milliampere direct current), except as specifically noted.

3. Provide 4-20mADC outputs capable of driving a 750 ohm load from all transmitters, controllers, and signal processing devices. Inputs to controllers, recorders, indicators, signal processing devices shall be 4-20mADC.

4. Convert nonstandard signals into compatible standard signals at their source. Zero based signals are not acceptable.

5. Direct interlock of equipment without auxiliary relaying shall not be allowed.

6. For all signals to be transferred to/from another panel, provide current isolators (analog) or dry relay contacts (discrete) wired out to terminal blocks.

O. Human Machine Interface (HMI)

1. Provide HMI as specified in the data sheet in Attachment A (13300-A).

P. Uninterruptable Power Supply (UPS)

1. Provide UPS as specified in the data sheet in Attachment A (13300-A).

Q. Programmable Logic Controller (PLC)

1. Provide PLC as specified in the data sheet in Attachment A (13300-A).

2.04 SHOP TESTING

A. Provide a shop, factory and field test plan outlining the SI's procedures for testing all field primary devices, final control elements, local control panels, the control system and termination cabinets at the factory prior to shipment. This plan shall demonstrate the system performs as specified and as indicated. Submit the shop test plan with the shop drawings as specified. Submit results of test to Contracting Officer.

PART 3 – EXECUTION

3.01 GENERAL INSTALLATION

A. Instrumentation and accessory equipment shall be installed in accordance with the manufacturer's printed instructions and approved shop drawings.

B. The locations of equipment, transmitters, alarms and similar devices are diagrammatic only. Exact locations shall be determined by the SI during development and fabrication of systems.

C. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded as directed by the instrument manufacturer , but in no case shall more than one ground point be employed for each shield.

D. All work shall be executed in full accordance with codes and these contract documents. Should any work be performed contrary to said rulings, ordinances and regulations, the SI shall bear full responsibility for such violations and at no additional cost to the Contracting Officer.

E. All equipment used in areas designated as hazardous shall be designed for the Class, Group and Division as indicated in the area classification schedule on the electrical drawings.

F. Unless specifically indicated, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or stands as detailed on the installation detail drawings. All instrumentation connections shall be provided with shutoff and drain valves. For differential pressure transmitters, valve manifolds for calibration, testing and blowdown service shall also be provided. For slurries, chemical or corrosive fluids, diaphragm seals with flushing connections shall be provided.

G. All piping and tubing to and from field instrumentation shall be provided with unions, calibrations and test tees, couplings, adaptors, and shut off valves. Process tubing shall be installed to slope from the instrument toward process for gas measurement service and from the process toward the instrument for liquid measurement service. Provide drain/vent valves or fittings at any process tubing points where the required slopes cannot be maintained.

3.02 FACTORY TESTS:

A. The SI shall test all equipment provided by the SI at the factory prior to shipment unless otherwise specified.

B. Each test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and upon the system's or subsystem's producing the correct result (effect), the specific test requirement will have been satisfied. The SI shall provide a detailed step by step test procedure for review and approval by the Contracting Officer.

C. All tests shall be conducted in accordance with prior Contracting Officer approved procedures, forms and checklist. Each specific test to be performed shall be described and a space provided after it for sign off by the appropriate party after its satisfactory completion.

D. No equipment shall be shipped until the Contracting Officer has received all test results and approved the system is ready for shipment.

3.03 INSTRUMENT INSPECTION AND CALIBRATION:

A. Calibrate instrument with calibration tools that conform to NIST traceability chain. Calibration instruments shall be twice as accurate as the instrument being calibrated but as a minimum the calibration instrument shall have a measurement uncertainty of 0.02 percent.

B. Provide calibration of instruments at 10%, 50%, 80% and 100% of measured span. Provide calibration tag for all calibrated instruments. Provide calibration tag with name, phone number, date and signature of the person and company performing the calibration. Provide calibration documentation and records to the Contracting Officer prior to substantial completion.

3.04 FIELD TESTS:

A. Perform field testing in accordance with equipment manufacturer recommend instructions.

B. The test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and upon the system's or subsystem's producing the correct result (effect), the specific test requirement will have been satisfied. The SI shall provide a detailed step by step test procedure for review and approval by the Contracting Officer prior to testing. Each specific test to be performed shall be signed off by the appropriate party after its satisfactory completion.

C. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment and data, provide suitable means of simulation. Define these simulation techniques in the test procedures.

D. Signed copies of the test procedures prepared by the SI, forms and checklists will constitute the required test documentation.

E. The SI shall furnish the services of field service engineers, all special calibration and test equipment and labor to perform the field tests.

F. A witnessed Functional Acceptance Test shall be performed on the complete system to demonstrate that it is operating and in compliance with these specifications. Each specified function shall be demonstrated on a paragraph by paragraph, loop by loop, and site by site basis.

3.05 START-UP TESTING:

A. After completion of the Field Tests indicated above, the acceptance testing period shall begin. All furnished hardware and software shall operate for a period of 30 consecutive days, under conditions of full plant process operation, without a single non field repairable malfunction.

B. During this test, operations personnel and SI personnel shall be present as required. The SI shall have staff available, within 4 hours of notification, who have an intimate knowledge of the hardware and SI furnished systems.

C. While the start-up testing is proceeding, the Contracting Officer shall have full use of the system.

D. Any malfunction to the SI' system during the tests shall be analyzed and corrected by the System Integrator. The Contracting Officer shall determine whether any such malfunctions are sufficiently serious to warrant a repeat of this test.

E. Any malfunction attributed to the SI during the Start-up Testing which cannot be corrected within 24 hours of occurrence by the SI's personnel, or more than two similar failures of any duration, will be considered as a non-field repairable malfunction.

F. Upon completion of repairs by the SI, the associated test shall be repeated as specified herein.

G. In the event of rejection of any part or function, the SI shall perform repairs at no additional cost to the Contracting Officer.

H. Upon successful completion of the 30 day startup operation test and subsequent review and approval of complete system final documentation, the system shall be considered Substantially Complete, after approval by the Contracting Officer.

3.06 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 13300 – ATTACHMENT A

PROCESS INSTRUMENT DATA SHEETS

MAGNETIC FLOW METER SPECIFICATION

DATA SHEET NO. 416.1

GENERAL

1.	Tag No.	:	FE/FIT-604
2.	Service	:	TALCOTT RIDGE BOOSTER STATION FLOW
3.	P & I D No.	:	DI-6
4.	Location	:	SEE ELECTRICAL DRAWINGS

CONNECTIONS

5.	Line Size	:	4 INCH
6.	Line Material	:	DUCTILE IRON
7.	Conn. Type	:	FLANGED
8.	Conn. Materials	:	CARBON STEEL

PROCESS CONDITIONS

9.	Fluid	:	DRINKING WATER
10.	Maximum Flow	:	80 GPM
11.	Max. Flow Velocity	:	2.0 FPS
12.	Minimum Flow	:	0 GPM
13.	Min. Flow Velocity	:	40 – 65 FPS
14.	Operating Temp.	:	40 TO 70 °F.
15.	Operating Pressure	:	80 - 100 PSI

METER

16.	Meter Size	:	4 INCH
17.	Tube Material	:	BADGER 316 STAINLESS
18.	Housing	:	WELDED STEEL
19.	Liner Material	:	INJECTION MOLDED HARD RUBBER OR EQUIVALENT, NSF LISTED
20.	Electrode Type	:	FLUSH MOUNT
21.	Electrode Material	:	316 STAINLESS OR EQUIVALENT
22.	Terminal Box	:	DIE CAST ALUMINUM
23.	Enclosure Class	:	NEMA 4
24.	Power Supply	:	120 VAC, 60 HZ
25.	Grounding Type	:	STRAP AND RING

TRANSMITTER

26.	Type	:	INTELLIGENT, MICROPROCESSOR BASED
27.	Mounting	:	WALL MOUNTED
28.	Transmitter Range	:	BASED ON INSTRUMENT SPAN
29.	Enclosure Class	:	NEMA 4
30.	Power Supply	:	120 VAC, 60 HZ
31.	Analog Output	:	4 - 20 mADC
32.	Elect. Class	:	SEE ELECTRICAL DESIGN FOR AREA CLASSIFICATION
33.	System Accuracy	:	+/- 0.5% OF FLOW RATE AT VELOCITIES ABOVE 1 FOOT PER SECOND
34.	Sys. Repeatability	:	+/- 0.1% OF FULL SCALE
35.	Empty Pipe Detect.	:	REQUIRED
36.	Local Display	:	MULTI-LINE LC FOR MEASURED VARIABLE, DIAGNOSTICS PLUS BAR GRAPH AND KEY PAD
37.	Local Totalizer	:	REQUIRED, 6 DIGIT, NON RESET
38.	Cable Length	:	APPROX. 50 FEET PROVIDED BY METER MANUFACTURER

MISCELLANEOUS

39.	Manufacturer(s)	:	FOXBORO, E+H, KROHNE OR SIEMENS
40.	Model No.	:	2000 SERIES, PROMAG W, ENVIROMAG OR MAG 5100

NOTES.

a. Provide grounding ring from meter manufacturer. Fabricated grounding rings from a third party shall not be accepted.
b. Provide meter manufacturers cable between the meter and the transmitter.
c. Wet calibrate all meters (at 3 points over the specified flow range) by gravimetric or volumetric methods that are traceable to NIST (National Institute Standard Testing).
d. Provide certificate of wet calibration to the engineer/owner prior to meter installation.
e. Provide, by the meter manufacturer, insitu calibration of all meters prior to system acceptance. Submit written calibration report from the manufacturer to the engineer.
f. Provide 316 stainless steel mounting hardware including all nuts and bolts connecting the meter to the process pipe.
g. Contractor to provide all power and signal cable in rigid conduit or liquid-tight conduit. See electrical specification for product specifications.
h. Contractor to provide grounding from ground rings to meter and meter to ground, using green size 10 AWG (6mm) ground wire. The Contractor shall install ground as directed by the meter manufacturer or to nearest water pipe. Contractor is responsible for all connections.
i. Remote communication must not interfere with the analog output signal. Use frequency shift keying (FSK) technique for communication.

PROGRAMMABLE LOGIC CONTROLLER SPECIFICATION

DATA SHEET NO. 567.1

GENERAL

1.	Tag Number	: CHERRY HILL-PLC, WMV.PLC, TBS.PLC
2.	P & I D No.	: DI-1, DI-2, DI-3, DI-4, DI-6, DI-7
3.	Location	: EE-1 AND OTHER LOCATIONS, SEE ELECTRICAL DRAWINGS

CONTROLLER

4.	Discrete Inputs	: 120 VAC 7mA WETTING CURRENT
5.	Analog Inputs	: INTO 250 OHMS MAXIMUM LOAD
6.	Discrete Outputs :	120 VAC ON CURRENT 2 A CONTINUOUS
7.	Contact Rating	: 120 VAC @ 10 AMPS -- PROVIDE INTERPOSING RELAYS
8.	Analog Outputs	: INTO 500 OHMS MINIMUM
9.	Memory	: AS NECESSARY TO OPERATE
10.	Functions	: AND, OR, NOR, COMPLEMENTS, TIMERS, COUNTERS, SEQUENCERS, ARITHMETIC OPERATIONS, COMPARATORS, AND LATCHING RELAYS
11.	Hot Backup	: NOT REQUIRED
12.	Program Scan Time	: LESS THAN 0.9 MILLISECONDS/K WORD
13.	Memory Protection	: MULTIPLE LEVELS OF PASSWORD PROTECTION
14.	Communications	: PROVIDE OPEN NETWORK TO SUIT THE PROJECT APPLICATION. PROVIDE FOR FUTURE MIGRATION TO OTHER AUTOMATION EQUIPMENT. PROVIDE UPWARD MIGRATION TO PERSONAL COMPUTERS AND MAINFRAMES.
15.	Network Features	: OPEN SYSTEM, CONFORMING TO OSI ISO SEVEN LAYER MODEL. PROVIDE FOR REMOTE I/O COMMUNICATION, PLC PEER TO PEER COMMUNICATION AND COMMUNICATION TO FIELD DEVICES OVER FIELD BUS. PROVIDE COMMUNICATION TO HIGHER LEVEL COMPUTING OR PROCESS CONTROL SYSTEM.
16.	Ports	: PROVIDE PORTS REQUIRED TO CONNECT TO REMOTE I/O, DATA HIGHWAY, LAPTOP PC, AND MODEM. EACH MODEM CONNECTION SHALL HAVE AN INDIVIDUAL PORT FROM THE PLC MASTER. MULTIPLEXING FROM A SINGLE PLC PORT SHALL NOT BE ALLOWED.
17.	Mounting	: CHASSIS SYSTEM IN BACK OF PANEL
18.	Connections	: PROVIDE INDIVIDUALLY FUSSED TERMINAL BLOCKS. PROVIDE GAS TIGHT WAGO TYPE CAGE CLAMP TERMINAL BLOCKS FOR FIELD INPUT WIRING. PROVIDE AMP TYPE HOODED CONNECTOR FROM THE TERMINAL BLOCK TO THE I/O MODULE. THE I/O MODULE SHALL BE REPLACEABLE W/OUT REMOVING FIELD WIRING. FIELD WIRE CONTINUITY AND CURRENT LOOP TESTING MAY BE PERFORMED FROM THE TERMINAL BLOCK W/OUT DISRUPTION OF OTHER I/O W/ THE REMOVAL OF THE INDIVIDUAL I/O FUSS.
19.	Diagnostic Ind	: DC POWER OK, PC RUN, CPU FAULT, BATTERY LOW, FORCED I/O, I/O STATUS

POWER SUPPLY

20.	Nominal Volts	: 120 VAC 60 HZ
21.	Min Supply Volts	: 85 VAC

22.	Max Supply Volts	: 132 VAC
23.	Power Loss Duration	: WITHSTAND POWER LOSS FOR A MINIMUM OF 20 mSEC
24.	Battery Back-up	: SEE DATA SHEET 702.1.

SERVICE CONDITIONS

25.	Environmental	: OPERATE AT 0-140°F (0-60°C) AND 5-95% HUMIDITY, NON-CONDENSING

HUMAN MACHINE INTERFACE (HMI)

26.	HMI	: SEE DATA SHEET 575.1.

MISCELLANEOUS

27.	Connection	:PROVIDE HIGHEST DATA-THROUGHPUT LEVEL POSSIBLE TO PROVIDE UPDATES FOR ALL SYSTEM POINTS AT A FREQUENCY TO SUPPORT A REAL-TIME CONNECTION.
28.	Documentation	:PROVIDE ALL DISTRIBUTION MEDIA AND DOCUMENTATION
29.	Model (s)	:CONTROLWAVE
30.	Manufacturer(s)	:EMERSON
31.	Operating Sequence	:SEE DI-2 AND SPECIFICATIONS
32.	Documentation	:PROVIDE HARD COPY AND CD WITH LADDER DIAGRAMS.

NOTES.

a. Provide preliminary ladder diagram with PLC submittal.
b. Provide 15% active spare I/O. Provide as a minimum one spare card of each I/O type.
c. Provide PLC spares to include; one each power supply, processor, network card and I/O of each type.
d. Provide true PID algorithm for continuous control like temperature, and pressure.
e. The Contractors Control System Integrator shall provide all PLC and HMI hardware and software.
f. The Contractors Control System Integrator shall provide all foreign device gateways and interfaces to PLCs provided with process equipment and I/O interfaces to receive pulse interfaces from electric utility provided pulse type meters.
g. Provide all wire and cable as shown on the system block diagram except for discrete instrument wiring provided by electrical. The contractor shall provide installation of all cable through the electrical contractor.

HMI FOR PLC SYSTEMS SPECIFICATION

DATA SHEET NO. 575.1

GENERAL

1.Service	: CHERRY HILL STORAGE TANK, WATER METER VAULT, TALCOTT RIDGE BOOSTER STATION
2. Location	: EE-1 AND OTHER LOCATIONS, SEE ELECTRICAL DRAWINGS
3. Certified	: UL

DISPLAY

4. Size	: 10-INCH,
5. Type	: LCD
6. Min Resolution	: 640x480
7. Color	: YES
8. Touch Screen	: YES

ENCLOSURE

9. Rating	:IN ACCORDANCE WITH AREA CLASSIFICATION SCHEDULE ON ELECTRICAL DRAWINGS
10. Material	: N/A

ENVIRONMENTAL

11. Operating Temp	: 0°-55°C (32°-131°F)
12. Humidity	:5-95% NONCONDENSING @55°C
13. Rating	: IN ACCORDANCE WITH AREA CLASSIFICATION SCHEDULE ON ELECTRICAL DRAWINGS

ELECTRICAL

14. Power Supply	: 120VAC, PROVIDE POWER ISOLATION TRANSFORMER
15. Power Consumption	: 100 WATTS MAX

COMMUNICATIONS

16. Connection Type	: ETHERNET, 2 EACH RS-232 & 2 EACH USB

MISCELLANEOUS

17. Manufacturer(s)	: C-MORE

NOTES

a. Provide software and configuration so an operator can monitor and control a unit process from any HMI.

b. Provide all hardware, software and ancillary network devices so HMI shall be seamlessly integrated with total plant control system.

UNINTERRUPTIBLE POWER SUPPLY SPECIFICATION

DATA SHEET NO. 702.1

GENERAL

1.	Tag No.	: UPS-1, UPS-2, UPS-3
2.	Service	: BACKUP POWER FOR PLC SYSTEMS
3.	Location	: IN CHERRY HILL PLC, WMV.PLC, TBS.PLC
4.	Input Voltage	: 120 VAC @ 60 HZ +/- 20%
5.	Output Voltage	: 120 VAC @ 60 HZ +/- 3% SINE WAVE LESS THAN 5% THD
6.	Operating Temp.	: 32 TO 105 DEG. F.
7.	Surge Protection	: 6000 VOLT AND MEET IEEE C62.41 CATEGORIES A AND B
8.	Backup Time	: 15 MINUTES MINIMUM AT 125% OF FULL LOAD
9.	Low Battery Ind.	: REQUIRED
10.	Brownout Protection	: REQUIRED AT 95 VAC
11.	UPS Type	: LINE INTERACTIVE
12.	Efficiency	: 92% MINIMUM ON-LINE
13.	Transfer Time	: LESS THAN 1 MILLISECOND
14.	Digital Disp. Param.	: VOLTAGE IN, VOLTAGE OUT, BATTERY VOLTAGE, PERCENT LOADING, ALARMS
15.	Alarms	: LOW BACKUP TIME, OVERLOAD, REPLACE BATTERY, LOW BATTERY
16.	Audible Noise	: LESS THAN 50 dB @ 3 FT

BATTERY

1. Type	: SEALED GEL-CELL OR SEALED LEAD ACID
2. Battery Protection	: THERMAL, OVERVOLTAGE AND OVERCURRENT
3. Battery Enclosure	: PROVIDE BATTERIES MOUNTED IN SEPARATE ENCLOSURE FROM UPS

MISCELLANEOUS

4. Manufacturer(s)	: BEST, SOLA, APC OR EQUAL

NOTES.

a. Provide UPS system such that upon failure of the UPS feeder, batteries provided with UPS immediately take over as the power source.

b. Provide external bypass switch with Make-Before-Break. Provide bypass to isolate the UPS equipment for maintenance. Provide bypass with switch test so the switch may be tested without the risk of dropping the load caused by static switch failure.

c. Provide static transfer switch to transfer load upon loss of power at the output of the UPS. Transfer switch shall complete transfer within 1/4 cycle.

d. Provide UPS sizing calculations in the shop drawing submittal. UPS shall supply power to PLC, data logging and communications equipment in control panel. Provide sizing calculations which are based on required load plus 25%.

LEVEL SWITCH (FLOAT TYPE) SPECIFICATION

DATA SHEET NO. 853.1

GENERAL

1.	Tag Number	: LSH-103, LSH-600, LSH-700
2.	Service	: HIGH SUMP LEVEL
3.	P & I D No.	: DI-4, DI-6, DI-7
4.	Location	: SEE ELECTRICAL DRAWINGS

FLOAT

5.	Dimensions	: APPROX. 6 INCH DIAMETER
6.	Material	: POLYPROPYLENE

SWITCH

7.	Type	: MICRO SWITCH STEEL BALL ACTIVATED, NO MERCURY
8.	Contact	: SPDT
9.	Rating	: 5 AMPS AT 120 VAC
10.	Enclosure	: ENCAPSULATED
11.	Open/Close	: CLOSE
12.	On Level Incr/Decr	: INCREASING
13.	Mounting	: ADJUSTABLE CLAMP ON 1 INCH STAINLESS PIPE
14.	Elec. Classification	: NEMA 4X, NEMA 6, SEE AREA CLASSIFICATION SCHEDULE ON ELECTRICAL DRAWINGS

PROCESS CONDITIONS

15.	Operating Temp.	: 40 TO 75 DEG. F.
16.	Operating Pressure	: ATMOSPHERE TO 10 FT SUBMERGED

MISCELLANEOUS

17.	Interconn. Cable	: AS REQUIRED APPROX. 200 FEET
18.	Manufacturer(s)	: COX OR KARI NO OR EQUAL
19.	Model No.(s)	: OPTI-FLOAT OR KA SERIES NO OR EQUAL

NOTES

a. Provide 1-inch diameter SCH 40 316L SS pipe to mount the float switch(s).
b. Provide COX or KARI level switches as specified. Other manufacturers shall not be accepted based on performance.
c. Provide detailed instructions for proper installation of switches, enclosures and mounting hardware.
d. Provide 316 SS brackets and hardware to attach pipe to side of well or tank.
e. Provide a minimum of 3 brackets spaced a maximum of 10'-0" OC.
f. Provide all 316 SS mounting hardware to mount float switch(s) to 1-inch pipe. Mounting hardware shall allow for float level adjustment with hand tools.
g. Provide single sealed well/tank penetration for float switch(s) cables.
h. Provide 316 SS NEMA 4X or cast aluminum termination enclosure (based on area electrical classification). The enclosure shall provide termination for the float(s) and include isolation relays and intrinsic safety barriers.
i. Provide termination enclosure mounted on 316 SS UNISTRUT® supports for wall or floor mounting.

ACCESS HATCH INTRUSION SWITCH SPECIFICATION

DATA SHEET NO. 1110.1 1

GENERAL

1.	Tag Number	: ZS-101
2.	Service	: ALTITUDE VALVE VAULT HATCH ALARM OPEN
3.	P & I D No.	: DI-4
4.	Location	: SEE ELECTRICAL DRAWINGS

SWITCH

5.	Type(Single/Dual)	: SINGLE
6.	Head Type	: BEST SUITED FOR HATCH. SEE NOTE b.
7.	Mounting	: ON HATCH FRAME. SEE NOTE c
8.	Matrl of Const	: 316 SS CAST BODY, 316 SS ACTUATOR & OPERATING HEAD, FLUOROCARBON SEALS
9.	Enclosure	: NEMA 4X, SEE AREA CLASSIFICATION SCHEDULE ON ELECTRICAL DRAWINGS
10.	Form	: DPDT
11.	Contact Rating	: 10 AMPS @ 120 V
12.	Output Signal For	: HATCH OPEN ALARM

MISCELLANEOUS

13.	Manufacturer(s)	: HONEYWELL MICRO SWITCH OR EQUAL
14.	Model No.(s)	: HDLS SERIES OR EQUAL

NOTES

a. Provide w/ sealed cable pre-wired connection

b. Provide written recommendation from hatch manufacturer on switch head type.

c. Provide details of mounting w/ hatch assemble w/ written approval of the hatch manufacturer.

DOOR ALARM SWITCH ASSEMBLY SPECIFICATION

DATA SHEET NO. 1111 . 1

GENERAL

1.	Tag Number	: ZS-600, ZS-700
2.	Service	: DOUBLE DOOR INTRUSTION ALARM
3.	P & I D No.	:DI-6, DI-7
4.	Location	: WATER METER VAULT, BOOSTER STATION

SWITCH

5.	Type	:MAGNETIC CONTACT
6.	Housing	:ABS PLASTIC
7.	Mounting	:SURFACE W/ SS SCREWS W/ TAMPER-PROOF HEAD
8.	Terminals	:RECESSED
9.	Test Pts	:EXTERNAL
10.	Form	:SPDT
11.	Voltage	:30 V AC/DC
12.	Output Signal For	:DOOR ALARM SEE NOTE a

MISCELLANEOUS

13.	Manufacturer(s)	:SENTROL OR EQUAL
14.	Rating	:SEE AREA CLASSIFICATION SCHEDULE ON ELECTRICAL DRAWINGS

NOTES.

a. Provide switch wired for both doors, on the double door, to the PLC so the PLC can determine an opened door.

GAUGE PRESSURE TRANSMITTER SPECIFICATION

DATA SHEET NO. 1451.1 1

GENERAL

1. Tag Number	: PT/PIT-201A & PT/PIT-201B, PIT-600A & PIT-600B
2. Service	: TANK LEVEL, PRESSURE
3. P & I D No.	: DI-4, DI-6, DI-7
4. Location	: SEE ELECTRICAL DRAWINGS

TRANSMITTER

5. Type	: INTELLIGENT, MICROPROCESSOR BASED
6. Element	: CAPACITANCE CELL, RESONANT WIRE OR PIEZORESISTIVE SENSOR
7. Remote Calibration	: ZERO AND SPAN VIA HANDHELD TERMINAL, WITHOUT ADDITIONAL HARDWARE, AT ANY TERMINATION POINT IN LOOP
8. Transmittal/Terminal	: TWO WAY COMMUNICATION VIA LOOP WIRING SEE NOTE a
9. Self-Diagnostics	: CONTINUOUS
10. Ambient Temp. Comp.	: AUTOMATIC
11. Power Supply	: 24 VDC
12. Output Signal	: 4 - 20 mADC OR DIGITAL
13. Dir/Rev Acting	: DIRECT
14. Turn Down	: 6:1
15. Span	: 0 - 100 FT WATER
16. Accuracy	: +/- 0.1% OF CALIBRATED SPAN
17. Repeatability	: +/- 0.05%
18. Local Indicator	: REQUIRED
19. Indicator Display	: DIGITAL; ENGINEERING UNITS, SIGNAL OUTPUT AND DIAGNOSTICS
20. Bypass Manifold	: REQUIRED, 2 VALVE TYPE, 316 SS SEE NOTE b
21. Span (Elev/Suppr)	: UP TO 500% OF CALIBRATED SPAN
22. Enclosure	: NEMA 4X, 4
23. Elec. Class	: SEE AREA CLASSIFICATION SCHEDULE ON ELECTRICAL DRAWINGS
24. Mounting	: WALL OR PEDESTAL
25. Process Connections	: ½ INCH NPT

MATERIALS OF CONSTRUCTION

26. Body	: LOW COPPER ALUMINUM
27. Wetted Parts	: 316 SS. FOR CORROSIVE CHEMICALS PROVIDE TANTALUM DIAPHRAGM AND TEFLON GASKETS AND HASTELLOY BODY, PROCESS FLANGE AND SENSOR WITH TEFLON GASKETS.
28. Fill	: SILICON OIL. FOR OXYGEN SERVICE USE FLUORINERT.

SERVICE CONDITIONS

29. Fluid	: DRINKING WATER
30. Specific Gravity	: APPROX. 1.0
31. Max. Static Pressure	: SEE TABLE
32. Operating Temp.	: -20 TO 180 DEG. F. SEE NOTE d
33. Ambient Temp.	: 0 TO 100 DEG. F.

MISCELLANEOUS

34. Manifold Manufact.	: ANDERSON GREENWOOD, NOSHOK, PGI OR APPROVED EQUAL
35. Manufacturer(s)	: E+H, FOXBORO, SIEMENS OR APPROVED EQUAL
36. Model No.(s)	: CERABAR, IGP25, SITRANS OR APPROVED EQUAL

DISPLAY

37. Input	: 4-20 mADC
38. Power	: 120 VAC
39. Display Type	: LED OR BACKLIT LCD
40. Accuracy	: 0.05% OF CALIBRATED SPAN
41. Enclosure	: NEMA 12

NOTES.

a. Remote communication must not interfere with the analog output signal. Use frequency shift keying (FSK) technique for communication.
b. Provide standard manifold mounting bracket. Mount the manifold not the transmitter such that the transmitter may be removed for service by removing the four transmitter bolts and disconnecting the signal leads. Provide block/bleed/vent/drain and equal to AGCO M4TP.
c. Provide block/bleed/vent/drain equal to AGCO M4TP SS body, AMS SS mount and H5VIS-22 drain valve.
d. Provide 316 SS ½-inch rigid tubing for connection between process measurement primary and process transmitter/manifold. All tubing shall be cut and bent with tube manufacturer approved tools
e. Provide SS tubing connectors
f. Provide cleaning and preparation for oxygen service as required based on process application.
g. Temperature required for LOX service.

AIR TEMPERATURE SENSOR AND TRANSMITTER SPECIFICATION

DATA SHEET NO. 1662.1 1

GENERAL

1. Tag Number	: TE/TT-102, TE/TT-600, TE/TT-700
2. Service	: WATER METER VAULT, ALTITUDE VAULT, AND TALCOTT RIDGE BOOSTER STATION TEMPERATURE
3. P & I D No.	: DI-4, DI-6, DI-7
4. Location	: SEE ELECTRICAL DRAWINGS

SENSOR

5. Type	: PLATINUM RTD W/ ALUMINUM SENSING TIP
6. Leads	: 3 LEADS FOR RTD
7. Lead Wires	: 100mm (4") LONG 22 AWG, PTFE INSULATED
8. RTD Length	: 75mm (3") MINIMUM
9. Housing	: NEMA 4X, NEMA 6
10. Material	: CAST ALUMINUM

TRANSMITTER

13. Type	: ELECTRONIC
14. Power	: 120 VAC
15. Output Signal	: 4 - 20 mADC INTO 550 OHMS
16. Range	: -40° TO 80°C 176 °F)
17. Linearity	: +/- 0.1% WITH SPAN
18. Calibration	: MATCH RTD
19. Enclosure	: NEMA 4X OR AS REQUIRED BY AREA CLASSIFICATION SCHEUDLE ON ELECTRICAL DRAWINGS
20. Mounting	: INTEGRAL WITH WELL

PROCESS CONDITIONS

22. Fluid	: AIR

MISCELLANEOUS

23. Manufacturer(s)	: MICON, WEED, PYROMATION OR EQUAL

NOTES

a.	Provide complete temperature monitor assembly w/ all hardware for wall mounting.

DIVISION 15

PLUMBING - MECHANICAL

SECTION 15101

PROCESS PIPING, VALVES, AND APPURTENANCES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide and install all process piping, valves, and appurtenances as indicated and in compliance with Contract Documents.

1. Provide sizes and capacities as indicated or specified.

2. For water main piping and appurtenances not specified herein, refer to Section 02510.

1.02 RELATED WORK

A. Division 1: General Requirements

B. Section 02510 Water Utilities.

C. Section 13225 Prestressed Concrete Tanks

D. Section 15105 Pipe Supports for Process Piping

1.03 REFERENCES:

A. American Society of Mechanical Engineers (ASME):

1. B1.20.7: Hose Coupling Screw Threads.

2. B16.1: Standard for Cast Iron Pipe Flanges and Flanged Fittings, 125 lb.

3. B16.4: Cast-Iron Threaded Fittings, Class 125 and 250.

4. B16.10: Face-to-Face and End-to-End Dimensions of Ferrous Valves.

B. American Society for Testing and Materials International (ASTM):

1. A48: Standard Specification for Gray Iron Castings.

2. A126: Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.

3. A536: Standard Specification for Ductile Iron Castings.

C. American Water Works Association (AWWA):

1. C500: Metal-Seated Gate Valves for Water Supply Service.

2. C504: Rubber-Seated Butterfly Valves.

3. C509: Standard Specifications for Resilient-Seated Gate Valves for Water and Sewage Systems.

4. D102: Coating Steel Water-Storage Tanks.

D. NSF International (NSF):

1. 61: Drinking water system components Health effects.

1.04 SUBMITTALS:

A. Submit the following in accordance with Section 01300:

1. Data, regarding valve characteristics and performance including Cv.

2. Shop drawing data for accessory items.

3. Manufacturer's literature as needed to supplement certified data.

4. Operating and maintenance instructions and parts lists.

5. Valve shop test results.

6. Shop and Field inspections reports.

7. List of manufacturer’s recommended spare parts.

8. Recommendations for short and long term storage.

9. Shop and field testing procedures and equipment to be used.

10. Number of service technician days provided and per diem field service rate.

11. Manufacturer’s product data and specifications for shop painting.

12. Provide a layout drawing, plan and section showing orientation of gate, check, ball valves and actuators and nearest obstructions for each valve.

13. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.

14. The most recent ISO 9000 series certification or quality system plan.

15. Material Certification:

a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Contracting Officer.

b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

1.05 SPARE PARTS:

A. Comply with requirements specified in Section 01610.

1.06 QUALITY ASSURANCE:

A. Comply with the requirements specified in Section 01400.

B. Provide enclosures for the area classifications specified and indicated.

C. Contractor responsible for verifying outside diameter of pipe to be tapped.

D. Services of Manufacturer's Representative as stated in Section 01400 and specified herein.

E. Manufacturer of valve shall have a minimum of five (5) similar installations and in the same service as specified operating for not less than five (5) years.

F. If equipment proposed is heavier, taller, different laying length or requires more operating space than specified and indicated; provide all structural, architectural, mechanical, electrical and plumbing revisions at no additional cost to the Contracting Officer.

1. If equipment is heavier than specified, the Contractor shall provide all hoisting equipment sized to maintain the minimum safety factor between the specified maximum equipment weight and the lifting capacity of the hoisting equipment indicated and specified.

1.07 DELIVERY, STORAGE AND HANDLING:

A. Comply with the requirements specified in Section 01610 and as specified.

B. Requirements of Regulatory Agencies:

1. All Work shall be in conformance with federal, state and local codes, statutes, and regulations, and shall also conform to National Standards Institute, the American Water Works Association, and the National Fire Protection Association Standards, as applicable. Provide certification, with shop drawing submittals, that all paint or other coating systems that are to be in contact with potable water, are acceptable to the National Sanitation Foundation (NSF) Standard 61.

PART 2 - MATERIALS

2.01 PIPE

A. DUCTILE IRON PIPE AND FITTINGS

1. Ductile iron pipe shall be the sizes indicated on the Contract Drawings and shall be grade 60-42-10. The pipe shall be centrifugally cast and manufactured in accordance with AWWA/ANSI C151/A21.51. Wall thickness and tolerances shall be in accordance with AWWA/ANSI C150/A21.50.

    a. The interior of all ductile iron pipe shall be cement lined to twice the thickness specified in ANSI A21.4 (AWWA C104) and asphalt seal coated. Asphalt seal-coat shall not impart taste or odor, or toxic or carcinogenic compounds to the water contained therein. Asphalt seal coat shall be a product acceptable to the National Sanitation Foundation (NSF) for use in potable water and shall be so listed in the most current NSF summary of approved products (ANSI/NSF Standard 61). The asphalt seal coat shall be applied and cured in strict conformance with the coating manufacturer's cautions and instructions. The seal coat shall be applied by the pipe manufacturer under controlled factory conditions and field application is strictly prohibited.

    b. Pipe of various sizes shall have a minimum wall thickness as follows:

Pipe Diameter (inches)	Minimum Thickness (inches) Class of Pipe	
	53	54
4	0.32	0.35
6	0.34	0.37
8	0.36	0.39
10	0.38	0.41
12	0.40	0.43
14	0.42	0.45
16	0.43	0.46

(1) Cement mortar lining minimum thickness shall be as follows:

Pipe Size (inches)	Minimum Lining Thickness (inches)
3-12	1/8
14-24	3/16

2. All interior ductile iron pipe shall be a minimum Class 53, working pressure 250 psi, and shall be designed and manufactured in accordance with AWWA/ANSI C115/A21.15.

3. Interior ductile iron pipe joints shall be flanged with gaskets, bolts and nuts conforming to AWWA/ANSI C115/A21.15. Flanges shall be flat faced and gaskets shall be full face.

4. All fittings associated with interior ductile iron pipe shall be ductile iron conforming to AWWA/ANSI C110/A21.10. Refer to the Contract Drawings for special bolt hole drill patterns for certain fittings. Fittings shall have flat-faced flanges, full face gaskets, and be complete with nuts and bolts.

5. All nuts, bolts, and washers for flanged pipe located in subterranean concrete vaults and/or manholes, wet process basins, or other subterranean and/or submerged locations shall be 300 series stainless steel.

6. The outside surface of all interior, flanged ductile iron pipe with the exception of flange faces shall be factory prime coated with a rust inhibitive primer compatible with the appropriate finish coating systems specified in Section 09941. Finish paint shall be field applied in strict accordance with Section 09941 and/or the paint manufacturer's written instructions.

7. Connections – Tapped: Provide service saddles for all taps for lines 24-inch and smaller.

   a. Body: Ductile iron ASTM A395 or Bronze.

   b. Straps and Hardware: Type 316 stainless steel.

B. PVC PIPE AND FITTINGS:

1. Schedule 80

2. Material: Type I, Grade I Polyvinyl Chloride (PVC) compound with a Cell Classification of 12454 per ASTM D1784.

3. Provide pipe and fittings manufactured in compliance to ASTM D1785 meeting and/or exceeding the Quality Assurance test requirements of this standard with regard to material, workmanship, burst pressure, flattening, and extrusion quality.

4. Provide pipe and fittings manufactured in the USA, using domestic materials, by an ISO 9002 certified manufacturer. Store all pipe shall be stored indoors after production at the manufacturing site until shipped from factory.

5. Provide standard lengths of pipe sizes 10-inch (250 mm) and larger beveled each end by the pipe manufacturer.

6. Provide pipe and fittings with the National Sanitation Foundation (NSF) seal of approval for potable water applications.

7. Joining:

   a. Solvent cementing process.

   b. Provide flanges at valves, pumps and equipment only or as indicated and specified.

   c. Provide Type 316 stainless steel flange bolting and hardware for all piping system except sodium hypochorite use titanium.

2.02 STAINLESS STEEL PIPE AND FITTINGS ½-INCH [15 MM] TO 2-INCH [50 MM]:

A. Provide either Pressfit or a socket welded system.

   1. Provide a sufficient number of unions to allow removal of all valves and inline devices.

   2. Provide threaded connections only where required.

B. Pressfit System:

   1. Pressfit system, ½-inch [15 mm] through 2-inch [50 mm] Sch 5S comprised of stainless steel Pressfit fittings, couplings and pipe.

   2. Type 316 stainless steel Pressfit couplings and fittings and Type 316 stainless steel Pressfit pipe UL classified to ANSI/NSF 61 for cold +86 degrees F (+30 degrees C) and hot +180 degrees F (+82 degrees C) potable water service.

      a. Maximum working pressure of 300 psi [20.6 bar] for water, oil, gas, chemical, air and vacuum services.

   3. Couplings, Fittings: Pressfit products formed of Type 316/316L stainless steel tubing including a self-contained o-ring seals molded of synthetic EPDM rubber.

4. Valves ½-in [15 mm] through 2-in [50 mm]: ball valves with Type 316 stainless steel plain ends for Pressfit assembly.

   a. Pressure Rating: 300 PSI [20.6 bar]

   b. CF8M stainless steel body and ball

   c. Type 316 stainless steel stem

   d. PTFE seats.

5. Pipe: Type 316/316L ASTM A-312 stainless steel

   a. 0.065 wall [1.65 mm]

   b. Provide pipe fully finished annealed with polished O.D.

C. Socket Welded System:

1. Schedule 40 Type 316L stainless steel pipe and fittings with socket welded connections.

2.03 EXPANSION JOINTS-ELASTOMERIC FLEXIBLE CONNECTION:

A. General: Provide flexible connectors as indicated, specified and as required for ductile iron and steel piping

1. At equipment connection: To eliminate vibration and stress on equipment.

B. Manufacturers:

1. Mercer Rubber Co.

2. General Rubber Co.

3. Garlock, Inc.

4. Or acceptable equivalent product.

C. Products:

1. Straight-through or tapered design as required.

2. Furnish control rods for test pressures as indicated or required.

3. Materials: Suitable for service specified and indicated.

4. Flanges: 125 lb. drilling.

5. Provide enamel coated ductile iron or galvanized carbon steel retaining rings.

D. Install joints in their neutral position.

2.04 RESILIENT SEAT GATE VALVES 3-INCH AND LARGER:

A. Resilient Seat Gate Valves:

1. Manufacturers-OS&Y Type Valves:

a. Kennedy Valve/ American RD.

b. Mueller.

c. Seguro Valve.

2. Manufacturers-NRS Type Valves:

a. US Pipe.

b. American Cast Iron Pipe.

c. Kennedy Valve.

d. Mueller.

e. Seguro Valve.

B. General:

1. Provide valves that conform to NSF Standard 61.

2. Non-potable water service: Provide resilient seat gate valves for all sizes indicated. If resilient seat valves are not available provide solid wedge gate valves.

3. Potable water service: Provide resilient seat gate valves for all sizes indicated. If resilient seat valves are not available provide double revolving disc gate valves.

4. Provide metallic seated valves conforming to AWWA C500 except as herein modified. (Valves larger than 48-inch, size shall comply with the intent of AWWA C500.)

5. Provide resilient seated valves conforming to AWWA C509 except as modified herein.

C. Materials:

1. Body and Bonnet: ASTM A536 ductile iron.

2. Wedge: ASTM A536 ductile iron encapsulated with EPDM.

3. Provide all other materials as specified in AWWA C500 and C509. Working water pressure:

Size	Pressure
3 to 16-inch	250 psi
18-inch and larger	150 psi

4. Exposed Valves: Flanged OS&Y valves. Face-to-face dimensions to comply with ANSI B16.10, flanges to comply with ANSI B16.1.

5. Buried Valves: Mechanical joint or push-on joint ends, non-rising stem valves with operating nut in lieu of hand wheel. Provide gate boxes, steel extension stems or universal-joint operating rods with 2-in square operating nuts at upper end with coupling connected to valve stem to bring to operating nut to within 6 inches of ground surface.

6. Provide counterclockwise rotation to open valves.

7. Provide handwheels with arrow and word "open" to indicate open direction.

8. Provide geared operators for all valves 16-inch and larger. Gearing shall be steel with enclosed cases.

    a. Provide spur gears for buried valves with stems vertical

    b. Provide bevel gears where required by position of valve.

    c. Provide buried valves with totally enclosed gear cases to enclose both the gears and valve stuffing box and provide gasketed Type 316 stainless steel removable cover plates with Type 316 stainless steel fasteners to allow access to the stuffing box.

9. Chainwheels: Provide where required as specified herein. Provide beveled gear operator to mount chainwheel in vertical position. Provide valve mounted so that the arrow indicator will be visible from the floor level.

10. Provide conventional packing in OS&Y valves.

11. Provide conventional packing or double O rings in non-rising stem valves.

12. Valves capable of being repacked or O ring replaceable while under pressure.

13. Provide Type 316 stainless steel bolts and bronze nuts for stuffing box follower.

14. Provide bypass valves for valves 16-inch and larger where required for opening under pressure with a maximum 40-b rim pull at the valve pressure rating.

D. Provide all gate valves with all internal and external wetted parts coated with a fusion bonded epoxy in accordance with ANSI/AWWA C550.

2.05 GATE VALVES – NONMETALLIC:

A. Manufacturers:

1. ASAHI America, Inc.

2. Chemline.

B. Pressure Rating at 30 to 120 degree F.

1. 1.5-inch through 8-inch: 150 psi

2. 10-inch: 110 psi

3. 12-inch: 75 psi

4. 14-inch: 75 psi

C. Materials:

1. Body and Disc: PVC ASTM D-1784, Type 1, Grade 1, Cell Classification 12454 for valves in PVC piping systems and CPVC Type IV Cell Classification 23447 for valves in CPVC piping systems.

2. Gate: CPVC, SBR lined or polypropylene for valves in PVC piping systems and CPVC for valves in CPVC piping systems.

3. Stem: PVC

4. Seals, O-rings and gaskets: EPDM

5. Handwheel: Polypropylene

6. Hardware and all metallic components: Type 316 stainless steel

D. Fabrication:

1. Non–rising stem design.

2. Solid thermoplastic construction with no metal to media contact.

3. Provide tapered cylindrical plug design for bubble-tight shutoff.

4. Provide a sealed position indicator.

E. Ends:

1. Flanged, 150 lb Rating.

2. Hardware: Type 316 stainless steel.

F. Operator:

1. Handwheel: Provide chainwheels where required as specified herein.

2. Manual operator for buried valve: provide 2-inch square operating nut and Type 316 stainless shaft extension.

2.06 BUTTERFLY VALVES – LIQUID SERVICE (AWWA):

A. Manufacturers:

1. DeZurik.

2. Val-Matic.

3. Rodney Hunt.

B. Provide valves that conform to NSF Standard 61.

C. Provide valves conforming to AWWA Standard C504 for Rubber Seated Butterfly Valves except as modified herein.

D. Provide valves larger than 72-inch in accordance with the requirements of AWWA C504.

E. Valves utilizing: Continuous rubber lining on the internal body surfaces and extending over the flanges, or a disk which sits at an angle to the axis of the pipe are acceptable.

F. Valve Bearings: Self-lubricating, nonmetallic material to effectively isolate the disc-shaft assembly from the valve body. Cast or ductile iron thrust or journal bearing surfaces are NOT acceptable.

G. Class 150B valves except as specified or indicated.

H. Valve Body: ASTM A126 Class B cast iron or ductile iron.

1. Exposed or submerged service: Flanged short body valve.

2. Buried service: Mechanical joint body.

3. Wafer, lug wafer or tapped wafer valves may be used only as specified or indicated.

I. Valve Seats:

1. Potable Water Service: Molded new natural rubber or synthetic rubber.

2. Wastewater or Sludge Service: Molded neoprene, Buna-N or other synthetic elastomer resistant to oil and grease.

3. Provide seat mounted on disc or in body.

4. Provide seats offset from shaft and field replaceable for all valves 24-inch and larger.

5. Provide seats mounted on disc, mechanically fastened to disc with Type 316 stainless steel hex head screws. Provide rubber seat reinforced with stainless steel retaining ring. Seats vulcanized or bonded to the disc are not acceptable.

J. Mating surfaces for valves with seat on disc: Type 316 stainless steel.

1. Provide mating surface mechanically retained in body and sealed with O-ring.

K. For valves with seats mounted on body provide the seats clamped or mechanically secured with Type 316 stainless steel fasteners.

L. Mating surfaces for valve with seat in body: Type 316 stainless steel or plasma applied nickel-chromium material containing 80 percent nickel, 20 percent chrome.

M. Plated or sprayed on mating surface material not acceptable.

N. Seat Placement:

1. If seat on disc provide disc of ASTM A126 Class B cast iron or ductile iron.

2. If seat in body, provide disc of ASTM A126 Class B cast iron, ductile iron or Type 316 stainless steel. Type 316 Stainless steel edge on cast or ductile-iron discs secured with Type 316 stainless steel threaded fasteners, heat shrunk on disc, a welded-on overlay, or a plasma applied nickel-chrome material.

O. Shaft: Type 316 stainless steel. Either one piece extending completely through disc or stub shafts inserted into valve disc stubs.

P. Shaft seal of the split-V type or O-ring type. Seal replaceable without disassembly of valve.

Q. Manual Operators:

1. Operator capable of valve operation at rated pressure with a maximum 80 lb (36 kg) pull on actuator. Operator to be self-locking.

2. Valves 8-inch (200 mm) and smaller, provide lever operator, 18-inch maximum length.

3. Valves 10-inch and larger, or where chain wheels are required, provide traveling nut operator. Provide position indicator.

4. Chainwheels: Provide where required as specified herein.

R. Buried or submerged valves: Provide gear operator with operating nut and valve box or handwheel operated floorstand as shown. Gear operator to be totally enclosed with gasketed Type 316 stainless steel covers with Type 316 stainless steel fasteners for access to valve packing.

2.07 BALL VALVES – GENERAL SERVICE:

A. Manufacturers:

1. Jamesbury

2. KF

3. Inline

4. Kitz

B. Valves 1/2-inch (15 mm) thru 4-inch (100 mm)

1. Materials:

a. Body and End Cap: Three piece, ASTM A351 Grade CF8M.

b. Body Seal: PTFE.

c. Seat: RTFE.

d. Ball: Type 316 stainless steel.

e. Stem: Type 316 stainless steel.

2. Pressure Rating:

a. 1/2-inch thru 2-inch: 1000 psi at 100 degree F

b. 2-1/2-inch thru 4-inch: 800 psi at 100 degree F

3. Ends:

a. 2-inch and Smaller: Screwed or flanged.

b. 3-inch and larger: Flanged.

C. Valves 4-inch thru 12-inch.

1. Materials:

a. Body and Adaptor: Two piece, ASTM A351 Grade CF8M.

b. Seat: TFE.

c. Ball: Type 316 stainless steel.

d. Stem: Type 316 stainless steel.

2. Pressure Rating: ANSI Class 150.

3. Ends: Flanged.

D. Actuators:

1. Manual:

a. 4-inch and Smaller: Lever.

b. 6-inch and Larger: Gear operator.

c. Provide chainwheels where required as specified herein.

2. Electric Motor Actuators: Provide in accordance with Section 15109.

2.08 BALL VALVES - NON-METALLIC:

A. Manufacturers:

1. Spears

2. ASAHI

3. NIBCO/Chemtrol

4. Hayward

B. Materials:

1. Body: Material as specified or indicated.

a. PVC: ASTM D-1784, Type 1, Grade 1, Class 12454B.

2. Ball: Same material as valve body.

3. Seats: Teflon, concave design to absorb expansion.

a. Triangular seat design is not acceptable.

b. Provide Viton or EPDM back up cushions to absorb expansion.

4. Seals: Viton, all Viton shall contain a minimum of 55 percent viton.

5. Provide vented ball valves for sodium hypochlorite and caustic services.

C. Ends: Type as specified or indicated:

1. Provide ends flanged in accordance with ANSI B16.1 150 lb. standard drilling.

2. True union design with integral union nuts on both ends of valve.

a. Threads between union nuts and valve body: Provide Buttress threads to protect against pipeline expansion and water hammer stresses.

D. Machine the following to final tolerances:

1. Exterior of ball

2. Interior of socket and threaded connections

3. Teflon seat recesses

4. Stem

5. Neck I.D.

6. Both end connectors

7. Both carriers

E. Valve Port:

1. 2-inch and smaller valves: full port.

F. Valve Ratings:

1. PVC: 150 psi at 120 degree. F.

2. All valves rated for 29.92 inch mercury vacuum.

G. Physical Properties:

1. Tensile stress, psi; per ASTM D638 Test Method:

    a. PVC: 7800

2. Flexural Stress, psi; per ASTM D790 Test Method:

    a. PVC: 15650

3. Compressive Strength, psi; per ASTM D695 Test Method:

    a. PVC: 14220

4. Hardness, Rockwell R, per ASTM D785 Test Method:

    a. PVC: 115

5. Water Absorption, percent, 24 hr., 1/8-inch thickness, per ASTM D570 Test Method:

    a. PVC: 0.07 percent

H. Operators:

1. Lever, with retaining screw.

2.09 RUBBER FLAPPER CHECK VALVES:

A. Manufacturers:

1. Cla-Val Co.

2. Crispin Valve Co.

3. Valmatic

B. Materials:

1. Body and Cover: Ductile Iron ASTM A536 Grade 65-42-12.

    a. Valves 8-inch (200 mm) and Smaller: ASTM A351 CF8M.

2. Rubber Flapper: Buna N 70 Durometer ASTM 2000-BG encapsulating an ASTM A36 steel plate.

3. Hinge Pin: AISI 1018.

C. Provide valves with a full pipe size flow area.

D. Provide valves 4-inch (100 mm) and larger capable of passing a 3-inch (76 mm) sphere.

E. Provide a threaded connection with bronze plug on cover and on the bottom of the valve.

F. Working Pressure:

1. 2-inch (50 mm) through 24-inch (600 mm): 250 psi (1750 kPa).

2. 30-inch (750 mm) and 36-inch (900 mm): 150 psi (1050 kPa).

G. Ends: Flanged ANSI B16.1, Class 150.

H. Provide seating surface at a 45 degree angle such that the flapper travels a maximum of 35 degrees from full closed to full open position.

I. Provide valve with cover designed for removal of the valve internals without removing the valve from the pipeline.

J. Position Indicator:

1. Provide a mechanical indicator to provide disc position for valves 4-inch (100 mm) and larger.

2. Provide the indication with continuous contact with the disc.

K. Provide all check valves with all internal and external wetted parts coated with a fusion bonded epoxy in accordance with ANSI/AWWA C550.

2.10 SWING CHECK VALVES – 3-INCH (75 MM) AND SMALLER:

A. Valves 1/2-inch (13 mm) to 2-inch (50 mm):

1. Working Pressure: 200 psi (1400 kPa)

2. Type: Y-Pattern

3. Ends: Threaded ASME 1.20.1

4. Materials:

a. Body, Cap Disc and Hinge Arm: ASTM A351 CF8M

b. Hinge Pin, Disc Nut Disc Washer and Plug: ASTM A276 Type 316 stainless steel

c. Seal and Gaskets: PTFE

B. Valves 1/2-inch (13 mm) to 3-inch (75 mm):

1. Working Pressure: ANSI Class 150
2. Type: Swing check with bolted cover
3. Ends:
    a. 1/2-inch (13 mm) through 2-inch (50 mm): Threaded ASME 1.20.1
    b. 1/2-inch (13 mm) thru 3-inch (75 mm): Flanged
4. Materials:
    a. Body, Cap Disc and Hinge Arm: ASTM A351 CF8M
    b. Hinge Pin and Plug: ASTM A276 Type 316 stainless steel
    c. Plug Seals and Gaskets: PTFE

2.11 SWING CHECK VALVES – NON METALLIC:

A. Manufacturers:
1. Spears.
2. ASAHI/America, Inc.
3. NIBCO/Chemtrol Inc.
4. Hayward Industrial Plastics.

B. Materials:
1. Body and Disc: PVC, ASTM D-1784, Type 1, Grade 1.
2. Seats and Seals: EPDM.

C. Fabrication:
1. Solid thermoplastic construction with no metal to media contact.
2. Single disc design.
3. Provide integral top entry to valve body.
4. Machine finish all seat surfaces.
5. Provide outside level and weight.

D. Pressure Rating at 30 to 120 degree F:

1. 3/4–inch thru 2.5-inch: 100 psi.

2. 3-inch thru 6-inch: 75 psi.

3. 8-inch: 45 psi .

E. Ends: Flanged, 150 lb rating.

2.12 DUCK BILL CHECK VALVES:

A. Manufacturers:

1. Proco

2. Tideflex

3. Flowrox

B. Service:

1. Chemical Tank Overflow:

a. Chemical: 10 to 15 percent sodium hypochlorite.

b. Material: Hypalon.

(1) Provide slip on type valve with Type 316 stainless steel clamps.

2. Process Drains:

a. Material: EPDM.

(1) Provide flanged or slip on type valve with Type 316 stainless steel clamps as indicated.

(2) Provide inline type with flanged connection or insertable as indicated.

2.13 MUD VALVES:

A. Manufacturers:

1. Trumbull.

B. Type: Non-rising stem with plug guided through the entire length of travel.

1. One piece with an integral thrust collar and be cast or machined.

2. Resilient seated.

C. Minimum Stem Diameter:

Valve Size inch	Minimum Stem Diameter inch
4	1-3/16
6	1-3/16
8	1-7/16
10	1-7/16
12	1-7/16
16	1-1/2

D. Pressure Capability: 100 psi unseating.

E. Provide valves capable of withstanding a minimum input torque of 490 foot pounds (664 N-m) without damage to the valve.

F. Provide the valve to leak a maximum of one quart per hour, when the valve is closed to a stem torque of 35 foot pounds.

1. Provide leakage and torque testing with a report from an independent test laboratory.

G. Provide valves with stem coupled to the extension stem with a Type 316 stainless steel machined coupling or a cast Type 316 stainless steel 2-in square operating nut and retained with a 1/4-in Type 316 stainless steel spring pin.

1. Stainless steel welded components are not acceptable for this connection or to the valve stem.

2. Provide stems retained with fasteners assembled through holes drilled in the valve guide and yoke and retained with hex nuts. Valve designs which retain the valve stem by threading stainless screws into tapped holes are not acceptable.

3. Provide stems with a permanently bonded coating to prevent galling with other stainless components.

a. Provide the coating safe for potable water use and capable of enduring a minimum of 15,000 open-close cycles without galling.

b. Provide cycle testing report from an independent test laboratory.

4. Provide adjustable stem guides with support spacing not to exceed 7 feet (2.1 meters).

H. Provide the base flange drilled in accordance with ANSI 125 pound standard with a minimum thickness of 3/4-inch.

1. Machine the base flange seating surface.

I. Position Indication:

1. Provide either a Position Indicator or Indicating Floorstand as shown.

2. Provide indication of the position of the mud valves, from fully open to fully closed, visible at the operating level.

3. Position Indicator:

   a. Where there is a floor directly over the valve and extension stem, install the position indicator in a cast iron floor adapter. Provide the adapter with a bronze bushing to support and center the extension stem.

   b. Where a floor is not directly over the valve and extension stem, support the position indicators, bench stands and floorstands by a wall bracket mounted to the side wall.

4. Position Indicator:

   a. Planetary gear design.

   b. Provide the sun gear, planet gear, ring gears and scale plate constructed of Delrin.

   c. Hardware: Type 316 stainless steel.

   d. Housings of carbon steel or aluminum are not be acceptable.

   e. Provide the top scale plate with recessed markings representing the number of turns, contain the word “Closed”, and a directional arrow.

   f. Provide the “open” line marked on a transparent polycarbonate window, which can be field adjusted for the number of turns of each valve size.

   g. Provide the position of the adjustable “open” window secured to the top surface of the scale plate.

J. Materials:

1. Body flange: Type 316 cast stainless steel.

2. Yoke: Type 316 cast stainless steel.

3. Guides: Type 316 cast stainless steel.

4. Gate: Type 316 cast stainless steel.

5. After machining, passivate all castings in accordance with ASTM A-380.

6. Valves including components welded from stainless steel are not acceptable.

7. Resilient Seat: Viton and mechanically retained.

8. Hardware: Type 316 stainless steel.

9. Stem: Type 316 stainless steel.

10. Extension Stem: Type 316 stainless steel, either schedule 40 pipe or solid round bar.

11. Top Nut and Bottom Couplings: Cast or machined from Type 316 stainless steel.

12. Stem guides and supports: Type 316 cast stainless steel.

13. Stem Guide Bushings: Bronze, NSF 61.

14. Seat: Viton O-rings.

15. Hardware: Type 316 stainless steel.

K. Operator:

1. Provide a Type 316 stainless steel handwheel operated floor stand or benchstand as shown and as specified herein.

2. Provide a 2-inch (50 mm) square operating nut with floor box and cover.

3. Provide an electric actuator as specified in Section 15109.

2.14 SOLENOID VALVES:

A. Manufacturers:

1. JD Gould.

2. ASCO.

3. Berkert.

B. Type:

1. Size: 1/8-inch (3 mm) to 2-inch (50 mm).

2. Globe type.

3. 2-way, internal piston pilot operated.

4. Energize to open.

5. Operating Pressure Differential: 150 psi (10 bar).

C. Materials:

1. Body: Type 316 stainless steel.

2. Seat Discs: PTFE.

3. Piston Assembly: Type 316 stainless steel.

4. Pilot Assembly: Type 316 stainless steel jacket welded on steel core.

D. Coil: Class F.

E. Electrical: 120 V, 1 phase, 60 Hz (220 V, 1 phase, 50 Hz).

F. Ends: Threaded.

G. Enclosure: NEMA 4X for locations in non-classified areas and NEMA 7 for use in classified areas.

2.15 AIR RELEASE VALVES – CLEAN WATER SERVICE:

A. Manufacturers:

1. Val-Matic.

2. Cla-Val Co.

3. Crispin.

B. Valves: Provide air release valves of the automatic float operated type designed to release accumulated air from a piping system while the system is in operation and under pressure.

C. Provide valves manufactured and tested in accordance with AWWA C512.

D. Provide valves used in potable water service certified to ANSI/NSF 61 Drinking Water System Components - Health Effects.

E. Valve manufacturer must have a quality management system that is certified to ISO 9001:2000 by an accredited, certifying body.

F. Provide valves with the cover bolted to the valve body and sealed with a flat gasket.

G. Provide replaceable resilient seats.

H. Provide drop tight shut off to the full valve pressure rating.

I. Provide floats guaranteed against failure including pressure surges.

J. Mechanical linkage to provide sufficient mechanical advantage so that the valve will open under full operating pressure.

1. Simple lever designs: Provide valves consisting of a single pivot arm and a resilient orifice button.

2. Compound lever designs: Provide valves consisting of two levers and an adjustable threaded resilient orifice button.

K. Provide valve body with threaded NPT inlets and outlets.

1. Inlet Connection: Provide hexagonal for a wrench connection.

2. Working Pressure: 175 psi.

3. Provide valves with two (2) additional NPT connections with ball valves as specified herein, one connection with a plug and one with a hose coupling for the gauges, testing, and draining.

4. Provide a vacuum check on the outlet to prevent air from re-entering the system during negative pressure conditions.

L. Provide valves with an inflow preventer to prevent the introduction of contaminated water through the air valve outlet.

1. Provide the inflow preventer to allow the admittance and exhausting of air while preventing contaminated water from entering during normal operating conditions.

a. Provide the inflow preventer flow tested by an independent testing lab approved by the American Society of Sanitary Engineers.

M. Materials:

1. Valve Body, Cover and Baffle:

a. ASTM A536 Grade 65-45-12 Cast Ductile Iron. For working pressures 300 psig (2100 kPa) and greater.

2. Floats, Orifice and linkage: Type 316 stainless steel, non-metallic components are not acceptable.

3. Orifice Button: Viton for simple lever valves and Buna-N for compound lever designs.

4. Hardware: Type 316 stainless steel.

5. Screened Hood: Type 316 stainless steel.

N. Testing:

1. Test valves at 1.5 times the rated working pressure.

2.16 MECHANICAL SEALS AT WALL PENETRATIONS:

A. Provide modular, mechanical type seals, consisting of inter-locking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening.

B. Provide the elastomeric elements sized and selected per manufacturer's recommendations and have the following properties as designated by ASTM. Coloration shall be throughout elastomer for positive field inspection. Each link shall have a permanent identification of the size and manufacturer's name molded into it.

1. Temperature Range: -40 to +250ºF

2. Material: EPDM, ATSM D2000 M3 BA510

3. Color: Black

C. Modular seal pressure plates: Molded of glass reinforced Nylon Polymer with the following properties:

1. Izod Impact - Notched: 2.05ft-lb/in. per ASTM D-256

2. Flexural Strength @ Yield: 30,750 psi per ASTM D-790

3. Flexural Modulus: 1,124,000 psi per ASTM D-790

4. Elongation Break: 11.07% per ASTM D-638

5. Specific Gravity:1.38 per ASTM D-792

D. Hardware: Type 316 stainless steel.

2.17 SHOP PAINTING:

A. Coat internal and external ferrous surfaces of valves with NSF Certified Epoxy in accordance with ANSI/NSF Std. 61, and in conformance to AWWA D102 Inside System No. 1 for all valves not specified to have a fusion bonded epoxy coating. The coatings shall be applied by the valve manufacturer under controlled factory conditions and field application is strictly prohibited.

B. Process Valve Color: Red.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Prior to installation, protect stored pipe, valves and appurtenances from damage due to exposure to sunlight, heat, dirt, debris, freezing and thawing, vandalism, etc.

B. Clean all debris, dirt, gravel, etc, from inside of piping before placing valves in place.

C. Erect and support valves in respective positions free from distortion and strain on appurtenances during handling and installation. Inspect material for defects in workmanship and material. Clean out debris and foreign material from valve openings and seats, test operating mechanisms to check functioning, and check nuts and bolts for tightness. Repair, valves and other equipment which do not operate easily or are otherwise defective at no additional cost to the Contracting Officer.

D. Set plumb and support valves in conformance with instructions of manufacturer. Shim valves mounted on face of concrete vertically and grout in place. Install valves in control piping for access.

E. Provide bolted split sleeve coupling or flexible type grooved coupling on downstream side of buried valves to assist in valve removal.

F. Where indicated provide Type 316 stainless steel stem extension to operating floor elevation as shown and provide the bevel gear operator with a fabricated steel floorstand and handwheel.

3.02 GATE VALVES:

A. Install gate valve stem as shown or with stems between vertical and 45 degrees above the horizontal. Valves installed with stems below horizontal are not acceptable.

3.03 CHECK VALVES:

A. Install swing check valves horizontally in pipelines unless otherwise indicated.

3.04 FIELD TESTING:

A. Pressure test valves with pipeline pressure testing.

B. Test functions of each valve.

C. Make all adjustments necessary to place valves in specified working order at time of above tests.

D. Remove all replace valves and appurtenances at no additional cost to the Contracting Officer with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Contracting Officer that valves will perform the service specified, indicated and as submitted and accepted.

3.05 FIELD TOUCH-UP PAINTING:

A. After installation and accepted testing by the Contracting Officer, apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

3.06 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 15105

PIPE SUPPORTS FOR PROCESS PIPING

PART 1 - GENERAL

1.01 DESCRIPTION

A. All Products to be provided and Work to be completed in accordance with NSF 61 and AWWA requirements specified for potable water supply installations.

B. Design, and provide a complete system of pipe supports with inserts, bolts, nuts, restraining and hanger rods, washers, miscellaneous steel, sliding Teflon plates, and accessories as indicated and specified. The term pipe support includes hangers, guides, restraints, anchors and saddles.

C. Provide all support systems and the design of all support systems for all piping as specified herein. The Contractor shall provide pipe support locations, configurations and details through accepted shop drawing submittals stamped by a Registered Professional Engineer as specified herein.

D. The Contractor shall be responsible for the proper design, fabrication, location, shop drawings and installation of all pipe supports in accordance with the specified requirements.

E. Pipe support locations and types for piping 1/2-inch and larger shall be determined by the Contractor using the guidelines for support spacing specified herein and other criteria contained in this pipe support specification. Guidelines for pipe supports may need to be adjusted based upon field coordination, field routing, or other considerations outlined herein such as structural load limits. The Contractor may revise the pipe support locations and details through accepted shop drawing submittals stamped by a Registered Professional Engineer as specified herein. The Contractor is responsible for the proper design, installation and fabrication of all pipe supports in accordance with the specified requirements. For pipe supports 1/2-inch and larger pipe support shop drawings together with a marked up piping drawing showing support number, location and typical type shall be submitted by the Contractor for acceptance.

1. The Contractor shall be responsible for coordinating all pipe support designs for all trades to ensure compliance with all of the requirements of this specification, including but not limited to the total limitations specified herein.

F. Design and provide all temporary pipe supports required during installation and testing.

1.02 REFERENCES

A. The American Society of Mechanical Engineers (AMSE):

1. B31.1: Power Piping.

B. American Society for Testing and Materials (ASTM):

1. A36: Standard Specification for Carbon Structural Steel

2. A307: Standard Specification for Carbon Steel Externally Threaded Standard Fasteners

3. A312: Seamless and Welded Austenic Stainless Steel Pipe

4. A500: Cold Formed Welded and Seamless Carbon Steel Structural Tubing.

5. A572: Specification for Steel Plate.

6. E165: Practice for Liquid Penetrant Inspection Method.

7. E709: Practice for Magnetic Particle Examination.

8. American Welding Society (AWS):

9. D1.1: Structural Welding

10. Fluid Sealing Association: Technical Handbook.

C. Manufacturers' Standardization Society (MSS):

1. SP-58: Pipe Hangers and Supports - Materials and Design.

2. SP-69: Pipe Hangers and Supports - Selection and Application.

3. SP-89: Pipe Hangers and Supports - Fabrication and Installation Practices.

4. SP-90: Guidelines on Terminology for Pipe Hangers and Supports.

D. National Association of Expansion Joint Manufacturers: Standards of the Expansion Joint Manufacturers Association, Inc.

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01300.

1. Pipe support drawings specified herein and including data for accessory items for acceptance prior to fabrication. Including:
   a. A table of applied forces and moments.

   b. A complete bill of materials.

   c. A unique identification and revision level.

   d. Stamp of a Registered Professional Engineer, registered in the state where this project is being constructed, experienced in pipe support design and pipe stress analysis as specified herein.

   e. Detailed connections to existing structure.

f. Indicate all welds, both shop and field, by Standard Units of Measurement as specified in AWS D1.1.

2. Welding Procedure: Submit description required to illustrate each welding procedure to be performed in the specified work.

3. Welding Equipment: Submit descriptive data for welding equipment, including type, voltage and amperage.

4. Qualification for Welders: Provide certification that welders to be employed in work have satisfactorily passed AWS or ASME qualification tests. If recertification of welders is required, retesting is the Contractor's responsibility at no additional cost to the Contracting Officer.

5. Pipe support manufacturers' qualifications as specified herein.

   a. List of at least five (5) successful pipe support projects with references and Owner contact information for those construction projects during the time of pipe support design, fabrication and installation.

   b. Qualification of manufacturers' Registered Professional Engineer, registered in Connecticut, who stamps and seals shop drawings and designs.

6. Coordination drawings for pipe supports shall include as a minimum the following information.

   a. Coordination drawings shall include all pipe supports covered by specifications.

   b. These coordination drawings will be used by the Contractor to ensure that the pipe supports do not obstruct access, access for equipment operation or removal including all mechanical and electrical equipment, panels, valves, gauges, and instrumentation.

   c. The Contractor shall be responsible for including and coordinating the work of all subcontractors into the coordination drawings.

   d. Prepare reproducible coordination drawings, indicating equipment, piping, valves, expansion joints, ductwork, conduit, cable trays, junction boxes, lighting fixtures, sleeves, inserts, embedments, supports, hangers and appurtenances at not less than 1/4-inch scale. Drawings shall show beams, columns, ceiling heights, wall, floors, partitions and structural features as indicated on the contract drawings. Individual pipes and conduit 2-in. or less in diameter that will be field routed need not be shown on coordination drawings.

   e. Coordination drawings shall include large-scale details as well as cross and longitudinal sections required to fully delineate all conditions. Particular attention shall be given to the location, size, and clearance dimensions of equipment items, shafts, operators and necessary maintenance access.

f. Make all minor changes in duct, pipe or conduit routings that do not affect the intended function, but items may not be resized or exposed items relocated without the approval of the Contracting Officer. No changes shall be made in any wall locations, ceiling heights, door swings or locations, window or other openings or other features affecting the function or aesthetic effect of the building. If conflicts or interferences cannot be resolved, the Contracting Officer shall be notified. Any problems of coordination that require architectural or structural changes of design shall be submitted to the Contracting Officer for resolution.

g. After the reproducible drawings have been coordinated and all changes have been made, the drawings shall be signed by the Contractor and all subcontractors indicating that all work on that drawing has been coordinated with all associated vendors and subcontractors and all conflicts have been resolved.

h. Relocation of any duct, pipe, conduit or other material that has been installed without proper coordination among all trades shall be performed at no additional cost to the Contracting Officer.

7. Written notification of any deviations from the requirements of this specification.

8. Support documentation and justification as specified.

9. Certificates of Design signed by a Registered Professional Engineer for all pipe supports.

10. Manufacturer's product data and specifications for shop painting.

11. Material Certification:

a. Provide certification from the manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Contracting Officer.

12. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

13. A copy of the contract mechanical process, and structural drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.

14. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

15. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

16. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

    a. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

1.04 QUALITY ASSURANCE

A. Provide in accordance with Section 01400 and as specified.

B. Provide manufacturer's certification in writing, that materials meet or exceed minimum requirements as specified.

C. Welder Qualifications:

1. Quality and certify welding procedures, welders, and operators in accordance with ANSI B31.1, paragraph 127.5 for shop and project site welding of piping work.

D. Pipe supports: All supports and parts shall conform to the latest requirements of the Code for Pressure Piping ASME/ANSI B31.1 and Manufactures Standardization Society (MSS) Standard Practice SP-58, SP-69, SP-89 and SP-90 except as supplemented or modified by the requirements of this specification.

E. Structural Concrete: Conform to the requirements of Section Concrete strength: 4,000 PSI unless noted otherwise.

F. Conform to the requirements of the latest edition of the AISC Manual of Steel Construction for miscellaneous and supplementary steel. Tube steels are ASTM A500 Grade B, structural shapes A36, plates A-572 or equal. Stainless steel structural members shall conform to ASTM requirement Type 316L.

G. Pipe Support Manufacturer Qualifications:

1. Must possess a written quality assurance program.
2. Have a minimum of 5 years experience in the design and fabrication of pipe supports.
3. Have completed the design and fabrication of at least 5 successful pipe support projects of equal size, complexity, and systems as this project within the past 10 years.

4. Retains the services of a Registered Professional Engineer, registered in the state where this project is being constructed, with a minimum of ten years experience in the design of piping systems and pipe supports.
5. Manufacturers' Standardization Society (MSS) Member.
6. Have a field service technician on staff with at least 5 years experience in resolving field installation, interference and interface problems associated with the design, installation and manufacture of pipe supporting components.

H. Hanger inspections shall be performed in accordance with MSS-SP-89 and ASME B31.1.

1.05 DELIVERY, STORAGE AND HANDLING

A. Comply with the requirements specified in Section 01600 – MATERIALS AND EQUIPMENT.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Provide Type 316L stainless steel for pipe supports, hangers, guides, restraints, and anchors.

B. Provide only new material. Previously used and/or scrap material is not acceptable.

C. Provide tube steels that are ASTM A500 Grade B, Structural shapes A-36, plates A-572 or equal.

D. Provide sliding Teflon plates. The sliding surfaces shall be a nominal 3/8-inches glass filled Teflon bonded to stainless steel backup plate with a 10 gauge minimum thickness. The bearing pad upper and lower units shall be as follows: Conslide Type CSA elements as manufactured by Con-Serv. Inc., Balco TFE Slide Bearing Plates 10N-cs as manufactured by Balco Inc., or Dynalon Slide Bearings as manufactured by JVI, Inc. or acceptable equivalent product.

E. Concrete anchor bolts - Hilti Kwik-Bolt II Stud Anchors, Rawl Bolt, Phillips Wedge Anchors, or equal.

2.02 DESIGN, LOCATION, AND TYPE OF PIPE SUPPORTS

A. Design and provide pipe supports for piping 1/2-inch and larger to include the following loads:

1. Gravity Force: This force includes the weight of pipe, pipe contents (hydro load), valves, in-line equipment, insulation and any other weight imposed on the piping and/or pipe support.

2. Thermal Expansion Force: This force is developed by the restraint of free end displacement of the piping due to thermal growth.

3. Hydrostatic/Dynamic Forces: These forces are developed due to the internal pressure (positive and negative) during operation of the piping system. These forces include the

forces due to water hammer, pressure pulses due to rapid valve closure, fluid discharge resulting from pump startup, operation of positive displacement pumps, etc.

B. Provide supports, guides, anchors, flexible couplings and expansion joints in accordance with the coupling and joint manufacturers' specifications and requirements.

C. Where possible, provide pipe supports, which are the manufacturers' standard products.

1. Provide pipe supports with individual means of adjustment for alignment.

2. Provide pipe supports complete with appurtenances including locking and adjusting nuts.

3. Hanger rods shall be subjected to tension only.

4. Where lateral or axial pipe movement occurs, provide hangers for the necessary swing without exceeding 4 degrees. Provide base supports designed using pipe slides. The bearing surfaces: 0.06 coefficient of friction or less.

5. Provide concrete inserts capable of supporting the design loads.

6. Metal framing systems will be acceptable to support piping 2 inch (50 mm) and smaller.

7. Provide insulated piping supported using rigid load bearing insulation (baton board type) with 16 gauge (1.5 mm) shields to fit between the insulation and the support. Shields to encompass a minimum 1/3 of the pipe circumference and be 12 inch (300 mm) in length.

8. Provide load-bearing insulation capable of supporting the load, as a minimum on the bottom 60 degrees of the pipe support. Cope insulation and adjust to avoid interference of steel structures.

9. Provide supplementary steel as needed.

10. Do not support pipes from other pipe, conduits or metal stairs.

11. Chain, strap, T-bar, perforated bar and/or wire hangers are not acceptable.

12. Contact between piping and dissimilar metals such as hangers, building structural work or equipment subject to galvanic action is not acceptable.

13. All pipe supports located in fluid flow shall be supplied with double nutting.

D. Provide thrust anchors to resist thrust where required. Wall pipes may be used as thrust anchors if so designed. Welded attachments shall be of material comparable to that of the piping, and designed in accordance with governing codes.

E. Provide expansion joints where indicated and where required based on Contractor's design of the pipe support system. Indicate expansion joints on submittal drawings.

F. For piping 2-inch and smaller provide manufacturer's standard supports and standard spacing guidelines

G. Pipe supports connected to structural framing and slabs are subject to the following limitations:

H. All outside above ground supports shall be Type 316L stainless steel as specified herein.

I. Provide pipe supports that do not overload or over stress the piping, equipment, or structure that they are supporting or to which they are attached. Allowable pipe stress to be within ANSI B31.1 code allowable.

J. The Contractor shall provide the services of a field service technician (preferably from the pipe support manufacturer) to field coordinate the locations of supports and resolve interferences and conflicts encountered during installation.

2.03 FABRICATION

A. Provide pipe supports formed in accordance with paragraph 5.1 of MSS-SP-58.

B. Providing welding in accordance with Structural Welding Code.

C. Provide dimensional tolerances as specified in MSS-SP-89.

D. Provide threading and tapping in accordance with MSS-SP-89.

2.04 SHOP PAINTING

A. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with Section 09900 - PAINTING.

B. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

C. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install items in accordance with manufacturers' printed instructions and as indicated and specified herein.

B. Perform welding in accordance with Structural Welding Code:

1. Visually inspect welding while the operators are making the welds and again after the work is completed in accordance with AWS D1.1 Section 6.0. After the welding is completed, hand or power wire brush welds, and clean them before the Qualified Inspector makes the check inspection. The Qualified Inspector shall inspect welds with magnifiers under light for surface cracking, porosity, and slag inclusions; excessive roughness; unfilled craters; gas pockets; undercuts; overlaps; size and insufficient throat

and concavity. The Qualified Inspector shall inspect the preparation of grove welds for throat opening and for snug positioning for back-up bars.

2. Nondestructive evaluation of welds connecting structural steel members subjected to critical stresses: Perform in accordance with the weld quality and standards of acceptance in AWS D1.1.

3. Magnetic Particle Inspection: Perform in accordance with ASTM E709.

4. Liquid Penetrant Inspection: Perform in accordance with ASTM E165.

5. For weld areas containing defects exceeding the standards of acceptance in accordance with AWS D1.1, Section 3.7. Provide additional testing of the repaired area at no additional cost to the Contracting Officer.

6. Test Locations: As selected by the Contracting Officer.

7. Correct any deficiencies detected as directed by the Contracting Officer's Representative at no additional cost.

C. Proceed with the installation of the pipe supports only after required building structural work has been completed and concrete support structure has reached its 28-day compressive strength as specified in Division 3 .

D. Install pipe supports to comply with MSS-SP-89. Group parallel runs of horizontal piping to be supported together on trapeze type hangers.

E. Install pipe supports to provide indicated pipe slopes. Do not exceed maximum pipe deflection allowed by ANSI B31.1.

F. For exposed continuous pipe runs, install pipe supports of same type and style as installed for adjacent similar piping.

G. Install pipe supports to allow controlled movement of piping systems. Permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

H. Piping to be free to move when it expands or contracts except where fixed anchors are indicated or required by the Contractor's pipe support systems. Where hanger rod swing length cannot be provided or where pipe movement based on expansion of 1 inch/100 feet, for each 100 degrees F change in temperature exceed 1/2-inch, provide sliding supports.

I. Prevent contact between dissimilar metals. Where concrete or metal support is used, place 1/8-inch thick Teflon, neoprene rubber, or plastic strip under piping at point of bearing. Cut to fit entire area of contact between pipe and pipe support.

J. Prevent electrolysis in support of copper tubing by use of pipe supports which are plastic coated. Electrician's tape is not an acceptable isolation method.

K. Apply an anti-seize compound to nuts and bolts on all pipe supports.

L. Locate reinforcing steel in concrete structure with x-ray prior to drilling for embedment plates and anchor bolts. Avoid contact or interference with reinforcing steel.

3.02 SUPPORT PIPING FROM STRUCTURAL FRAMING, UNLESS OTHERWISE INDICATED.

A. Concrete Inserts:

1. Use existing embedded concrete items whenever possible.

2. Use expansion anchors only when existing embedded attachment points are not available or unsuitable. Attach to hardened concrete or completed masonry.

3.03 THRUST ANCHORS AND GUIDES

A. Thrust Anchors:

1. Center thrust anchors between expansion joints and between elbows and expansion joints for suspended piping. Anchors must hold pipe rigid to force expansion and contraction movement to take place at expansion joints and/or elbows and to preclude separation of joints.
2. Restraining rod size and number shall be as indicated and adhere to manufacturers recommendations as a minimum.

B. Pipe guides: Provide adjacent to sliding expansion joints in accordance with recommendations of the National Association of Expansion Joint Manufacturers and the specific joint manufacturer.

3.04 PIPE SUPPORTS

A. Where piping of various sizes is to be supported together, space supports for the largest pipe size and install intermediate supports for smaller diameter pipes.

B. Provide minimum of two pipe supports for each pipe piece.

C. Where pipe connects to equipment, support pipe independently from the equipment. Do not use equipment to support piping.

D. Provide pipe supports so that there is no interference with maintenance or removal of equipment.

E. Unless otherwise indicated or authorized by the Contracting Officer's Representative place piping running parallel to walls approximately 1-1/2 inch out from face of wall and at least 3 in. below ceiling.

F. Pedestal pipe supports: adjustable with stanchion, saddle, and anchoring flange. Provide grout between baseplate and floor.

G. Piping supports for vertical piping passing through floor sleeves: use hot dipped galvanized steel riser clamps.

H. Support piping to prevent strain on valves, fittings, and equipment. Provide pipe supports at changes in direction or elevation, adjacent to flexible couplings, adjacent to non-rigid joints, and where otherwise indicated. Do not install pipe supports in equipment access areas or bridge crane runs.

I. Stacked horizontal runs of piping along walls may be supported by metal framing system attached to concrete insert channels.

J. Do not support piping from other piping.

K. Designs generally accepted as exemplifying good engineering practice, using stock or production parts, shall be utilized whenever possible.

L. Whenever possible, pipe attachments for horizontal piping shall be pipe clamps.

M. All rigid rod hangers shall provide a means of vertical adjustment after erection.

N. Where the piping system is subjected to shock loads, such as disturbances due to pump discharge or thrust due to actuation of safety valves, hanger design shall include provisions for rigid restraints or shock absorbing devices.

O. Hanger rods shall be subject to tensile loading only. At hanger locations where lateral or axial movement is anticipated suitable linkage shall be provided to permit rod swing.

P. Hanger spacing shall not exceed the spacing listed below:

1. In the case of concentrated loads the supports shall be placed as close as possible to the load to reduce the bending stress.
2. Where changes in direction of the piping system occur between supports, the total length between supports shall be kept to less than three-fourths of the full span. When practical, a support shall be placed immediately adjacent to any change in direction of the piping system.

Q. Where practical, riser piping shall be supported independently of the connected horizontal piping. Pipe support attachments to the riser piping shall be riser clamp shear lugs. Welded attachments shall be of material comparable to that of the piping, and designed in accordance with governing codes. If friction is relied upon to support riser piping proper justification and documentation shall be submitted to ensure that enough friction force is provided to resist the applied loading.

R. Hanger components shall not be used for purposes other than for which they were designed. They shall not be used for rigging and erection purposes.

S. All threads shall be UNC unless otherwise specified.

T. TFE slide bearing plates with steel backup plates shall be stitch weld attachments to the structure. A 1/8-inch fillet weld, 1/2-inch long every 3 inches on center each side of an element shall be used unless otherwise indicated or specified by the manufacturers' written recommendations. Bearing elements with slots or holes shall be stitch welded in place for

location. The TFE surfaces of the bearings shall be maintained clean and free from grit, dirt or grease.

3.05 INSULATED PIPING

A. Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed allowable pipe stresses.

B. Where vapor barriers are indicated on water piping, install coated protective shields.

3.06 CONTRACT CLOSEOUT

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 15112

SELF-CONTAINED AUTOMATIC CONTROL VALVES AND APPURTENANCES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide and test self-contained automatic control valves and appurtenances as indicated and specified.

1. Provide sizes and capacities as indicated or specified.

1.02 REFERENCES:

A. American Society of Mechanical Engineers (ASME):

1. B16.1: Standard for Cast Iron Pipe Flanges and Flanged Fittings, 125 lb.

2. B16.4: Cast-Iron Threaded Fittings, Class 125 and 250.

B. American Society for Testing and Materials International (ASTM):

1. A48: Standard Specification for Gray Iron Castings.

2. A126: Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.

3. A536: Standard Specification for Ductile Iron Castings.

C. American Water Works Association (AWWA):

1. C500: Metal-Seated Gate Valves for Water Supply Service.

D. NSF International (NSF):

1. 61: Drinking water system components Health effects.

1.03 SUBMITTALS:

A. Submit the following in accordance with Section 01300:

1. Data, regarding valve characteristics and performance including Cv.

2. Shop drawing data for accessory items.

3. Manufacturer's literature as needed to supplement certified data.

4. Operating and maintenance instructions and parts lists.

5. Listing of reference installations as specified with contact names and telephone numbers.

6. Valve shop test results.

7. Qualifications of field service technician.

8. Shop and Field inspections reports.

9. List of recommended spare parts other than those specified.

10. Recommendations for short and long term storage.

11. Special tools.

12. Shop and field testing procedures and equipment to be used.

13. Number of service technician days provided and per diem field service rate.

14. Manufacturer’s product data and specifications for shop painting.

15. Provide a layout drawing, plan and section showing orientation of valves and nearest obstructions for each valve.

16. Manufacturer's product data and specifications for shop coating and painting.

17. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.

18. The most recent ISO 9000 series certification or quality system plan.

19. Material Certification:

    a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Contracting Officer.

    b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

B. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations and clarifications from the specified requirements.

1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specification and justification are resubmitted with the entire package.

1.04 SPARE PARTS:

A. Comply with manufacturer's recommendations and requirements specified in Section 01610.

1.05 QUALITY ASSURANCE:

A. Comply with the requirements specified in Section 01400.

B. Provide enclosures for the area classifications specified and indicated.

C. Contractor responsible for verifying outside diameter of pipe to be tapped.

D. Services of Manufacturer's Representative as stated in Section 01400 and specified herein.

E. Manufacturer of valve shall have a minimum of five (5) operating installations with pumps of the size specified and in the same service as specified operating for not less than five (5) years.

1.06 DELIVERY, STORAGE AND HANDLING:

A. Comply with the requirements specified in Section 01610 and as specified.

PART 2 - MATERIALS

2.01 SELF-CONTAINED AUTOMATIC CONTROL VALVES:

A. Manufacturers:

1. Cla-Val

2. Ross

3. Golden Anderson

B. Type: Pilot operated piston or diaphragm design, automatic valve.

1. Body Type: Globe or angle body, provide body style as indicated.

2. Provide valve that utilize line pressure as its operating source.

3. Provide valves with all necessary accessories to provide a complete operating unit.

C. Provide size and configuration as specified and indicated.

D. End Connections:

1. Valves 3-inches and Smaller: NPT

2. Valves 1-1/2-inches and Larger: Flanged end connections ANSI standard B16.1 of a class to mate with pipe flanges.

E. Diameter of Seat Opening: Equal to diameter of pipe size.

F. Provide valves designed to remove and replace all internal parts without removing the valve body from the pipeline.

G. Diaphragm style valves: Provide NSF 61 approved replaceable seals designed to prevent metal to metal contact.

1. Material: Type 316 stainless.

H. Piston style valves: Provide treated leather replaceable seals designed to prevent metal to metal contact.

1. Material: Treated leather or polyurethane seats.

I. Minimum pressure rating: 150 psi

J. Hydrostatic test: 300 psi

K. Provide a visual position indicator.

L. Materials:

1. Valve Body and Covers: A536 (65-45-12) ductile iron or ASTM A126 cast iron.

a. Diaphragm style valve cover: Provide a separate stem cap giving access to the stem for alignment check, spring installation and ease of assembly.

(1) Provide main bonnet cover and locating pins to accurately locate the main valve body.

b. Internal and External Coating: NSF 61 fusion bonded epoxy.

c. Provide two NPT connections on each side of the valve body for external control piping and provide Type 316 stainless steel plugs for all unused ports

2. Piston: ASTM B62 Bronze, for piston style valves.

3. Diaphragm: EPDM or Buna N of the rolling type design.

4. Stem: Type 316 stainless steel, for diaphragm style valves.

5. Seat Disc:

a. Valves 12-inches and Smaller: ASTM B62 Bronze, Cast Iron, Ductile Iron or Type 316 stainless steel.

b. Valves 14-inches through 36-inches :

(1) ASTM A126 cast iron center with ASTM B62 bronze outer ring or cast iron.

(2) One piece design in Ductile Iron or Type 316 stainless steel.

c. Valves 42-inches through 48-inches: Cast steel, Cast Iron, Ductile Iron or Type 316 stainless steel.

6. Plates:

a. Valves 4-inches through 36-inches: ASTM B62 bronze or Ductile iron A536 (65-45-12).

b. Valves 42-inches through 48-inches: Cast steel or Ductile Iron A536 (65-45-12).

7. Bushings:

a. Valves 4-inches through 36-inches: ASTM B62 bronze.

b. Valves 42-inches through 48-inches: Type 316 stainless steel.

8. Seat Ring, Stem Nuts, Indicator, and Seat Packing Support: Type 316 stainless steel.

9. External Control Piping, Strainers, and Valves: Type 316 stainless steel.

a. Provide tubing or hose.

M. Valve Types:

1. Pressure Reducing Valves:

a. Provide reduced-port pressure reducing valves designed to maintain a pre-adjusted downstream pressure regardless of changes in flow rate.

b. Provide an external pilot control including an external strainer, needle valve, position indicator, gauges, and isolation ball valves.

c. Provide valves with ductile iron body and cover meeting ASTM A536, ANSI B16.42, 150 F pressure class. Disc guide, seat and cover bearing shall be stainless steel, with Buna-N disc and nylon reinforced Buna-N rubber diaphragm. Disc retainer and diaphragm washer to be cast iron.

d. Provide reduced internal port type with anti-cavitation valve where specified.

e. Provide settings as specified and indicated. Adjustment range is 15-75 psi.

2. Anti-cavitation Valves:

a. Provide hydraulically operated, single diaphragm actuated globe pattern valve with diaphragm assembly forming a sealed chamber to separate operating pressure from line pressure.

b. Provide valves with an anti-cavitation trim design to regulate internal pressure in high differential applications for relief valves having atmospheric discharge up to 150 psid.

c. Provide high service type with 316 SS disc guide and seat with drip-tight positive sealing. Valve shall be serviced without removal from piping.

d. Provide settings as specified and indicated.

3. Altitude Valves – 1 way:

a. Provide valves designed as a two position control valve, either fully open or fully closed.

(1) Provide valves to allow normal forward flow to fill the reservoir or tank to the maximum level and then closes drip-tight at the set-point.

(2) Provide valves to opens to refill the reservoir or tank once the level drops a fixed distance below the high water level.

(3) Valves do not operate as a check valve to prevent reverse flow.

b. Provide an external pilot control including an external strainer, needle valve, position indicator, gauges and isolation ball valves.

c. Provide positive action valve switch assembly actuated by opening or closing of the altitude valve to provide remote indication of valve position. The switch shall be a UL listed single pole, double throw with a normally closed contact when the valve is actuated in the close position. Switch shall be rated for 15A at 120VAC and shall be weather proof.

d. Provide settings as specified and indicated.

N. Provide all valves in compliance with NSF 61 for all services.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Prior to installation, protect stored valves and appurtenances from damage due to exposure to sunlight, heat, dirt, debris, freezing and thawing, vandalism, etc.

B. Clean all debris, dirt, gravel, etc, from inside of piping before placing valves in place.

C. Erect and support valves in respective positions free from distortion and strain on appurtenances during handling and installation. Inspect material for defects in workmanship and material. Clean out debris and foreign material from valve openings and seats, test operating mechanisms to check functioning, and check nuts and bolts for tightness. Repair valves and other equipment which does not operate easily or are otherwise defective at no additional cost to the Contracting Officer.

D. Set plumb and support valves in conformance with instructions of manufacturer. Shim valves mounted on face of concrete vertically and grout in place. Install valves in control piping for access.

3.02 FIELD TESTING:

A. Pressure test valves with pipeline pressure testing.

B. Test functions of each valve.

C. Make all adjustments necessary to place valves in specified working order at time of above tests.

D. Remove all replaced valves and appurtenances at no additional cost to the Contracting Officer with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Contracting Officer that valves will perform the service specified, indicated and as submitted and accepted.

3.03 FIELD TOUCH-UP PAINTING:

A. After installation and accepted testing by the Contracting Officer apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

3.04 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 15115

FLOWMETER

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide and test flowmeter and appurtenances as indicated and specified.

1. Provide sizes and capacities as indicated or specified.

1.02 REFERENCES:

A. American Society of Mechanical Engineers (ASME):

1. B16.1: Standard for Cast Iron Pipe Flanges and Flanged Fittings, 125 lb.

2. B16.4: Cast-Iron Threaded Fittings, Class 125 and 250.

B. American Society for Testing and Materials International (ASTM):

1. A48: Standard Specification for Gray Iron Castings.

2. A536: Standard Specification for Ductile Iron Castings.

C. NSF International (NSF):

1. 61: Drinking water system components Health effects.

1.03 SUBMITTALS:

A. Submit the following in accordance with Section 01300:

1. Data, regarding flowmeter characteristics and performance including Cv.

2. Shop drawing data for accessory items.

3. Manufacturer's literature as needed to supplement certified data.

4. Operating and maintenance instructions and parts lists.

5. Listing of reference installations as specified with contact names and telephone numbers.

6. Flowmeter shop test results.

7. Qualifications of field service technician.

8. Shop and Field inspections reports.

9. List of recommended spare parts other than those specified.

10. Recommendations for short and long term storage.

11. Special tools.

12. Shop and field testing procedures and equipment to be used.

13. Number of service technician days provided and per diem field service rate.

14. Manufacturer’s product data and specifications for shop painting.

15. Provide a layout drawing, plan and section showing orientation of flowmeter.

16. Manufacturer's product data and specifications for shop coating and painting.

17. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.

18. The most recent ISO 9000 series certification or quality system plan.

19. Material Certification:

    a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Contracting Officer.

    b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

B. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations and clarifications from the specified requirements.

1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specification and justification are resubmitted with the entire package.

1.04 SPARE PARTS:

A. Comply with manufacturer's recommendations and requirements specified in Section 01610.

1.05 QUALITY ASSURANCE:

A. Comply with the requirements specified in Section 01400.

B. Provide enclosures for the area classifications specified and indicated.

C. Contractor responsible for verifying outside diameter of pipe to be tapped.

D. Services of Manufacturer's Representative as stated in Section 01400 and specified herein.

E. Manufacturer of flowmeter shall have a minimum of five (5) operating installations with flows as specified and in the same service as specified operating for not less than five (5) years.

1.06 DELIVERY, STORAGE AND HANDLING:

A. Comply with the requirements specified in Section 01610 and as specified.

PART 2 - MATERIALS

2.01 FLOWMETER:

A. Manufacturers:

1. Neptune

2. Or equal

B. Type

1. Meters shall consist of a combination of an AWWA Class II in-line horizontal axis turbine for measuring high rates of flow and a positive displacement bypass meter conforming to AWWA C700 for measuring low rates of flow.

2. An automatic valve shall direct the flow from the bypass meter to the mainline meter as flow rates increase and back to the bypass meter as flow rates decrease.

3. All components of the meter assembly shall be both UL (Underwriter's Laboratory) Listed and FM (Factory Mutual) approved for fire service use.

4. Meters shall be certified to NSF/ANSI 61, Annex G and Annex F requirements.

5. Provide size and configuration as specified and indicated.

C. Capacity

1. The capacity of the meters in terms of normal operating range, maximum rate for continuous use, maximum loss of head, and extended low flow capability is as follows:

Size	**Normal Operating Range (gpm)**	**Maximum Rate for Continuous Use (gpm)**	**Maximum Loss of Head @ Max Rate (psi)**	**Extended Low Flow (gpm)**
4"	3/4 - 1200	1200	9	3/8
6"	1 1/2 - 2500	2500	10.5	3/4
8"	2 - 4000	4000	10.5	1
10"	2 - 6500	6500	9	1

D. Size

1. The size of meters shall be determined by the nominal size (in inches) of the opening in the inlet and outlet flanges. Overall lengths of the meters shall be as follows:

Meter Size	**Laying Length**
4"	33"
6"	45"
8"	53"
10"	68"

E. Case and Cover

1. The meter body, strainer body, and valve body shall be 300 series stainless steel.

2. The meter body shall be welded to the valve body effecting a uni-body construction with the valve.

3. The strainer outlet and meter inlet shall be connected by a Style 77 Victaulic or other UL Listed/FM Approved grooved coupling.

4. The meter assembly shall have a rated working pressure of 175 psi.

5. The meter cover shall be cast of a NSF/ANSI 61, Annex G and Annex F lead free alloy containing a minimum of 85% copper.

6. An arrow indicating direction of flow shall be cast in raised characters on the cover. The cover shall have a rated working pressure of 175 psi. The cover shall contain a calibration vane for the purpose of calibrating the turbine measuring element while in-line and under pressure. The calibration vane shall be mounted under the register that is attached in a tamper-resistant manner.

F. Strainer

1. Designed and approved for fire service use by UL and FM and shall have a rated working pressure of 175 psi. The size, model, and NSF certification shall be marked on the strainer cover.

2. The strainer shall be constructed of 300 series stainless.

3. The strainer basket shall be constructed of AISI Type 18-8 stainless steel.

4. The strainer shall contain a flushing port located near its bottom to facilitate easy cleaning.

G. External Bolts

1. Meter strainer and valve cover bolts shall be made of AISI Type 316 stainless steel. All other bolts shall be 300 series stainless steel.

H. Connections

1. Inlet and outlet flanges shall be 300 series stainless steel and round flanged per AWWA C207, Class D.

I. Registers, Boxes, Sealing

1. Registers shall be permanently roll-sealed in a copper can and glass lens, straight reading in gallons, cubic feet, or cubic meters. Registers shall include a center-sweep test hand and low flow indicator. Registers shall be removable for replacement without interruption of the service line.

2. Register boxes and covers shall be of bronze composition. The name of the manufacturer and the meter serial number shall be clearly identifiable and located on the register box covers.

3. The register box shall be affixed to the top cover by means of a plastic tamperproof seal pin that must be destroyed in order to remove the register.

J. Unitized Measuring Element

1. A UME is a complete assembly, factory calibrated to AWWA standards that includes the cover, registers, and a turbine measuring element. It shall be easily field removable from the meter body without the requirement of unbolting flanges.

K. Intermediate Gear Train

1. The intermediate gear train shall be directly coupled to the turbine rotor and magnetically coupled to the register through the meter cover. The gear train shall be housed within the turbine measuring chamber. All moving parts of the gear train shall be made of a self-lubricating polymer or AISI Type 316 stainless steel for operation in water.

L. Bypass Meter

1. The bypass meter shall be of a positive displacement, nutating disc type. The bypass meter may be piped on the left or right side of the assembly. The bypass meter shall conform to AWWA C700 standards in the following sizes:

Mainline Size	**Meter Size**
4” Mainline	1” Bypass Meter
6” Mainline	1 1/2” Bypass Meter
8” & 10” Mainline	2” Bypass Meter

M. Automatic Valve

1. The automatic valve shall be of the spring-loaded, knuckle-joint type. All internal linkage parts shall be stainless steel. A vulcanized rubber disc on a stainless steel clapper plate shall seal against a bronze seat. The springs shall be AISI Type 18-8 stainless steel.

2. The disc meter shall include a self-actuated valve that directs flow through the disc meter at low flow rates, and through the turbine meter at high flow rates. At high flow rates, the self-actuated throttle valve shall restrict the flow through the disc meter to minimize wear.

N. Registration Accuracy

1. Registration accuracy over the normal operating range shall be 98.5% to 101.5%.

O. Remote Capability Options

1. All meters shall be equipped with encoder remote registers per AWWA C707 and meet all AWWA C703 performance standards.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Prior to installation, protect stored flowmeter and appurtenances from damage due to exposure to sunlight, heat, dirt, debris, freezing and thawing, vandalism, etc.

B. Clean all debris, dirt, gravel, etc, from inside of piping before placing flowmeter in place.

C. Erect and support flowmeter in respective positions free from distortion and strain on appurtenances during handling and installation. Inspect material for defects in workmanship and material. Clean out debris and foreign material from flowmeter openings and seats, test operating mechanisms to check functioning, and check nuts and bolts for tightness. Repair flowmeter and other equipment which does not operate easily or are otherwise defective at no additional cost to the Contracting Officer.

D. Set plumb and support flowmeter in conformance with instructions of manufacturer.

3.02 FIELD TESTING:

A. Pressure test flowmeter with pipeline pressure testing.

B. Test functions of flowmeter.

C. Make all adjustments necessary to place flowmeter in specified working order at time of above tests.

D. Remove and replace flowmeter and appurtenances at no additional cost to the Contracting Officer with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Contracting Officer that flowmeter will perform the service specified, indicated and as submitted and accepted.

3.03 FIELD TOUCH-UP PAINTING:

A. After installation and accepted testing by the Contracting Officer apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

3.04 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 15400

PLUMBING SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide new and modify existing plumbing systems as indicated and in compliance with Contract Documents.

B. Remove and dispose of in-home treatment systems, as designated on the Details in Appendix B.

C. The Work of this Section shall include all labor, materials, tools, equipment and appurtenances, and performing all operations necessary to furnish and install complete and operable systems in accordance with this Section of these Specifications, the Drawings, and the codes and standards listed herein.

D. Coordinate with the Local Water Department as to any Local restrictions or requirements relative to backflow prevention devices and metering.

1.02 REFERENCES:

A. Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

B. In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

C. American Society of Mechanical Engineers (ASME):

1. B16.18: Cast Copper Alloy Solder Joint Pressure Fittings

2. B16.22: Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

3. B16.24: Cast Copper Alloy Pipe Flanges and Flanged Fittings Class 150, 300, 400, 600, 900, 1500, and 2500

4. B16.50: Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings

5. B40.1: Pressure Gauges and Gauge Attachments

D. American Society of Sanitary Engineering (ASSE):

1. 1013: Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers

E. American Society for Testing Materials (ASTM):

1. B32: Solder Metal

2. B42: Seamless Copper Pipe, Standard Sizes

3. B88: Seamless Copper Water Tube

4. B584: Copper Alloy Sand Castings for General Applications

F. American Welding Society (AWS):

1. A5.8: Filler Metals for Brazing and Braze Welding

2. BRH: Brazing Handbook

G. Foundation For Cross-Connection Control And Hydraulic Research (FCCCHR):

1. FCCCHR List: List of Approved Backflow Prevention Assemblies

H. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS):

1. SP-58: Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application and Installation

2. SP-80: Bronze Gate, Globe, Angle and Check Valves

3. SP-110: Ball Valves Threaded, Socket Welding, Solder Joints, Grooved and Flared Ends

I. National Sanitation Foundation (NSF):

1. 61: Drinking Water System Components

2. 372: Drinking Water System Components - Lead Content

1.03 SUBMITTALS:

A. Submit the following shop drawings in accordance with Section 01300:

1. Product Data - Annotate descriptive data to show the specific manufacturer, model, type, size, capacity, curves, wiring diagrams, options, etc. of each item. Where products are available with Energy Star labeling, they shall be provided.

a. Pipe and fittings

b. Valves

c. Strainers

d. Valve boxes

e. Backflow preventers: Submit a layout drawing indicating the location of all backflow preventers to the Connecticut Department of Public Health (CT DPH) for their approval prior to submitting to the Contracting Officer.

f. Pipe hangers and supports

2. Certification - Submit documentation certifying completion of the following items in compliance with this Section.

a. Tests

b. Flushing

c. Disinfection

3. Test Reports - prepare as specified in Part 3 of this Section

a. Pressure tests

b. Backflow preventer tests

4. Operation and Maintenance Manuals - Prepare manuals in accordance with Section 01300.

a. Valves

b. Backflow preventers

5. Closeout Submittals

a. Record Drawings - Prepare as specified in Part 1 of this Section.

1.04 QUALITY ASSURANCE:

A. Provide in accordance with Section 01400.

B. Provisions:

1. Drawings and specification direct attention to certain features of equipment, but do not purport to cover all details entering into design and construction of the equipment, controls, or appurtenances.

2. Consideration shall be given only to products of manufacturers who demonstrate successful experience in manufacture, operation, and servicing equipment of type, size, performance, and reliability equal to that specified. Equipment and components shall be the product of a single manufacturer insofar as possible.

3. Equipment furnished to fit within the space allocated with adequate clearance for proper operation and maintenance.

C. Workmanship and Design:

1. Provide equipment such that all parts are designed for continuous and uninterrupted service, and such that lubrication, adjustment, or replacement of parts is possible without manufacturer's assistance. Corresponding parts of multiple units shall be interchangeable.

2. Install equipment that complies with state, local and federal codes and regulations.

D. Alternate Equipment and Arrangement:

1. If any equipment submitted for acceptance requires arrangement differing from that indicated or specified, prepare and submit for review, detailed structural, mechanical and electrical drawings, and equipment lists showing all necessary changes and all special features of equipment proposed. Changes are at no additional cost.

1.05 DELIVERY, STORAGE AND HANDLING:

A. Provide in accordance with Section and as specified.

B. Shipping:

1. Equipment, material and spare parts are to be shipped completely assembled except where partial disassembly is required by transportation regulations or for protection of components.

C. Receiving:

1. Inspect and inventory items upon delivery to site.

2. Store and safeguard equipment, material and spare parts in accordance with manufacturer's recommendations.

1.06 COOPERATION AND COORDINATION WITH OTHER TRADES:

A. Work shall be performed in cooperation with other trades on the project and so scheduled as to allow efficient completion of the project. Materials and equipment shall be installed as fast as conditions will permit, and installed properly.

B. Furnish to all other trades advance information on location and size of all concrete pads, chases, frames, boxes, pits, sleeves, and openings needed for the Work, and also furnish layout information and shop drawings necessary to permit other trades affected by the Work to install their work properly coordinated and without delay.

C. Where there is evidence that Work installed interferes with the work of other Sections, assist in working out space conditions to make satisfactory adjustments.

D. With the acceptance of and without extra cost to the Contracting Officer, make reasonable modifications in Work specified under this Section required to coordinate with normal structural interference's, or for proper execution of specified work.

E. If work is installed before coordinating with other trades so as to cause interference with the work of such trades, make all necessary changes in Work under this Section of the at no additional cost to the Contracting Officer.

F. Protect all materials and work of other trades from damage that may be caused by the Work required under this Section and be responsible for repairing any damages caused by such work without any additional cost to the Contracting Officer.

G. Follow Drawings in layout work. Check drawings of, and coordinate with, other trades to verify special provisions, installation requirements and spaces in which Work provided under this Section will be installed. Maintain maximum headroom or space conditions at all points. Where headroom or space conditions appear inadequate, notify the Contracting Officer before proceeding.

H. Attend regular coordination and job progress meetings required.

1.07 REMOVAL WORK:

A. Particular care shall be taken to avoid creating hazards on the site or causing disruption of service of unaffected spaces and/or systems.

B. All existing equipment indicated to be removed shall be done in a neat and workmanlike manner. All equipment shall be removed from the premises and legally disposed of.

C. Remove all abandoned material and equipment not built into building construction. All live services left by removal work shall have ends capped and marked live.

D. Should any asbestos and/or asbestos related products or materials be encountered during the performance of the Work, stop work immediately and inform the Contracting Officer of the presence of asbestos.

1.08 CODES, PERMITS AND FEES:

A. Except for additional requirements as specified or indicated under the Work of this Section, materials, workmanship and equipment shall conform with the governing edition of the following regulations, and agency requirements.

1. State and Local Building Codes, including but not limited to, the Connecticut Plumbing Code, and Connecticut Building Code.

2. Connecticut Department of Energy and Environmental Protection (CT DEEP)

3. Local Fire Department

4. Local Water Department

5. Occupational Safety and Health Administration (OSHA)

6. Any other local codes or requirements of Authorities Having Jurisdiction.

B. Pay for all fees and give all notices, file all plans, obtain all permits and licenses, and obtain all necessary approvals from Authorities Having Jurisdiction. Deliver all certificates of inspection to the Authorities Having Jurisdiction. No work shall be covered before examination and approval by Authorities Having Jurisdiction. Replace imperfect or condemned work to conform to inspectional requirements, satisfactory to the Contracting Officer and Authorities Having Jurisdiction without extra cost to the Contracting Officer. If Work is covered before inspection and acceptance, pay costs of uncovering and reinstalling the covering, whether it meets contract requirements or not.

PART 2 - PRODUCTS

2.01 GENERAL:

A. Where applicable, all products requiring approval by the Connecticut Division of Construction Services shall be so approved. Where product types are available with Energy Star labeling, they shall be provided.

B. All potable water piping components shall comply with NSF 61 test standards via third-party testing and certification. Potable water piping components under the jurisdiction of the Federal Reduction of Lead in Drinking Water Act shall comply with NSF 372 test standards via third-party testing and certification.

2.02 DOMESTIC WATER PIPING:

A. Buried Piping:

1. Copper Tubing for Piping 2 inch and Smaller:

a. ASTM B88, Type K, soft annealed copper tubing with ASME B16.50 brazed joint fittings. Provide minimum number of joints in buried copper tubing.

(1) Joints shall be brazed. Brazing filler metal shall conform to AWS A5.8, Type BAg-5 with AWS Type 3 flux, except Type BCuP-5 or BCuP-6 may be used for brazing copper-to-copper joints.

B. Aboveground Piping:

1. Copper Tubing:

a. ASTM B88, Type L, hard drawn copper tubing with ANSI B16.18 or ASME16.22 solder joint fittings. Provide ASTM B42 copper pipe nipples with threaded end connections. Provide copper unions. Provide ASTM B32, 95-5 tin-antimony solder, or provide Plumbing Code approved lead-free solder.

C. Flanges:

1. ASME B16.22 or ANSI B16.24 for use in copper tubing.

2. Flange Accessories:

a. Gaskets: Provide one piece, factory cut, 1/16 inch thick, synthetic rubber gaskets suitable for use with potable water. Gaskets shall be rated for 32 to 180 degrees F service temperature. Provide full-face gaskets for flat-face flanged joints, and ring gaskets for raised-face flanged joints. Dimensions for gaskets shall be in accordance with ASME B16.21.

b. Bolting: Material for bolts and studs ASTM A307, Grade-B and for nuts ASTM A194/A194M, Grade-2. Dimensions of bolts, studs and nuts ANSI B18.2.1 and ASME B18.2.2 with threads conforming to ASME B1.1 coarse type, with Class 2A fit for bolts and studs, and Class 2B for nuts.

D. Valves:

1. Provide valves suitable for minimum of 125 psig and minimum of 180 degrees F hot water. Valves shall have threaded end connections with a union on all but one side of the valve, or solder end connections for connections between bronze valves and copper tubing. For gate, globe and angle valves, provide blue finish, and red finish on handwheels for valves in domestic cold water piping, and domestic hot water piping respectively. Ball valves may be provided in lieu of gate valves**.**

2. Gate Valves (3 inch and Smaller):

a. MSS SP-80, Class 125 bronze valves.

3. Globe and Angle Valves:

a. MSS SP-80, Class 125.

4. Check Valves:

a. MSS SP-80, Class 125, swing check.

5. Ball Valves:

a. MSS SP-110, full port design, copper alloy. Valves shall have lever handles, stainless steel ball and PTFE seats and seals.

6. Hose bibbs:

a. Provide angle type copper alloy hose bibb with lockshield and removable handwheel. Inlet shall have internal threads. Outlet shall have vacuum breaker with 3/4 inch external hose threads

E. Strainers:

1. Wye type, Class 125, copper alloy body, threaded ends. Provide 20 mesh stainless steel strainer element. Strainers shall have blow off outlet with pipe nipple and gate valve or ball valve with discharge pipe nipple.

F. Valve Boxes:

1. For each buried valve provide cast-iron box of a suitable size. Provide cast-iron cover for the box with the word "WATER" cast on the cover. Coat cast-iron boxes with bituminous paint. Provide stainless steel valve operating rod.

G. Backflow Preventers:

1. Provide reduced pressure principle backflow preventer with gate or ball valve on both ends and inlet strainer. Backflow preventers shall have replaceable seats and discs, bronze body, rated for minimum 35 to 150 degrees F and 175 psig. Backflow prevention assemblies shall have current "Certificate of Approval from the Foundation for Cross-Connection Control and Hydraulic Research, FCCCHR List." Listing of the specific make, model, design, and size in the FCCCHR List shall be acceptable as the required documentation. Reduced pressure principle backflow preventers shall be tested and certified under ASSE 1013 and be provided with test cocks and drainage air gap fitting.

H. Dielectric Unions:

1. Provide dielectric unions in all copper to ferrous transitions. Couplings shall be factory certified to withstand a minimum of 600 volts on a dry line with no flashover. Couplings shall be rated for minimum 300 degrees F at 250 psig .

2.03 PIPE HANGERS AND SUPPORTS:

A. Provide MSS SP-58, Type 3, 4 and 7 hangers with adjustable type steel support rods, except as specified or indicated otherwise.

B. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel with drilled hole on centerline and double nut and flat washer. Attach to wood framed structures using wood screws designed for use with

threaded rod adapters, or through-bolted with double nut and flat washer. Attach to concrete with drilled expansion anchor.

C. Hangers, supports, rods and fasteners shall be hot dipped galvanized steel, except hangers and supports in contact with bare copper tubing shall be copper, copper-plated or PVC coated.

2.04 SUPPLEMENTARY STEEL AND CHANNELS:

A. Provide all supplementary steel and factory fabricated channels required for proper installation, mounting and support of all equipment and systems provided under this Section.

B. Channels and supplementary steel shall be of sufficient strength and size to allow only a minimum deflection in conformance with the manufacturer's requirements for the specific loading on the system installed herein.

C. All supplementary steel shall be ASTM A36 factory-formed standard mill finished structural shapes. Supplementary steel assemblies shall be hot dipped galvanized after fabrication. Channels shall be hot dipped galvanized steel.

2.05 PIPE SLEEVES:

A. Sleeves in Masonry and Concrete Walls and Floors: **S**tandard weight ductile-iron or cast-iron pipe sleeves.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Installation, workmanship, inspection, and testing shall be in accordance with the specified Plumbing Code and Building Code with the additions specified herein. Install piping straight and true to bear evenly on hangers and supports. Keep the interior and ends of new piping and existing piping affected by the Work thoroughly cleaned of water and foreign matter. Keep piping systems clean during installation by means of plugs or other acceptable methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter. Inspect piping before placing into position. When fixtures require both hot water and cold water supplies, provide the hot water supply to the left of the cold water supply. Copper tube extracted joints shall not be permitted.

B. Piping shall not be permitted within 6 feet of electrical panelboards and other electrical equipment unless otherwise permitted by the Connecticut Electrical Code .

C. Piping and other apparatus shall not be installed in such a manner so as to interfere with the full swing of doors, movement of personnel and equipment, and access to other equipment.

D. Install aboveground pressurized piping to permit draining of all sections of each piping systems without traps. Pitch piping back to system low points. Provide drain valves at all piping low points.

E. Make provisions for pipe expansion and contraction with suitable anchors and offsets, expansion joints, or expansion loops. Install piping to allow freedom of movement in all planes without imposing undue stress on any section of the main piping, branch piping, equipment and structure.

F. Buried Piping:

1. Pipe bedding and compacted backfill to a point 12 inches above crown of buried pipe shall be provided under Section 02210. Coordinate requirements herein with the general contractor.

2. Pipe bedding shall be minimum 6 inches deep. Bedding and compacted backfill shall be non-corrosive material such as cleaned washed sand, and contain no stones, metal, rubbish of any kind, frozen material, organic matter, or any other material capable of damaging piping or coating, and/or of settling.

3. Where feasible, install buried lines in a single trench. Trenches shall be wide enough to permit at least 6 inches spacing between lines and the sides and floor of the trench.

4. Terminate buried piping not more than 6 inches above finished ground surface or floor slab-on-grade, or from foundation wall inside surface.

5. Make provisions in buried piping for differential settlement.

6. Completely encase buried copper tubing, ductile-iron piping, and cast iron piping with polyethylene tube or sheet in accordance with AWWA C105.

G. Threaded Connections:

1. Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread paste, pipe cement and oil, or PTFE powder and oil; apply only on male threads. Provide exposed ferrous pipe threads with one coat of primer applied to a minimum dry film thickness of 1.0 mil.

H. Soldered Connections:

1. Soldering shall be performed in accordance with best soldering practice. Before soldering copper tubing joints, both the outside of the tube and the inside of the fitting shall be cleaned with a wire fitting brush until the entire joint surface is bright and clean. Provide suitable flux for use with solder. Surplus soldering material shall be removed at all joints. Piping shall be supported prior to soldering and not be sprung or forced.

2. For solder end valves, remove stems and washers and other items subject to damage by heat during installation. Reassemble valve after soldering is complete. Valves without heat sensitive parts do not require disassembly but shall be fully opened during soldering.

I. Brazed Connections:

1. Brazing of copper tubing joints shall be performed in accordance with AWS BRH, except as modified herein. During brazing, the pipe and fittings shall be continuously purged with a pressure regulated inert gas, such as nitrogen, to prevent the formation of scale. Before brazing, both the outside of the tube and the inside of the fitting shall be cleaned with a wire fitting brush until the entire joint surface is bright and clean. Brazing flux shall not be used. Surplus brazing material shall be removed at all joints. Piping shall be supported prior to brazing and not be sprung or forced.

J. Flanged Connections:

1. Flanges shall be faced true, and made square and tight.

K. Pipe Hangers and Supports:

1. Selection, application and installation of piping hangers and supports shall conform with MSS SP-58, unless otherwise indicated.

2. Furnish and install safe and substantial means of support for all parts of the piping system. Attach all pipes securely to the structure in correct alignment and pitch, to prevent vibration and to effectively care for expansion and construction.

3. All piping shall be hung to true alignment, using appropriate hanger arrangements. Wire and strap hangers shall not be permitted. Hangers shall be located so that piping and hangers will be 6 inches clear from other piping, hangers, conduits, lighting fixtures, equipment, ceiling suspension systems, ductwork and other obstructions. Where insulation or other covering is provided, minimum clearance shall take into account such covering.

4. Supplementary steel and channels shall be firmly connected to the building construction in a manner accepted by the Contracting Officer or as otherwise shown on the Drawings. Equipment and piping shall not be supported from metal decking or plaster ceilings.

5. Rod Sizes, MSS SP-58.

6. Maximum Spacing Between Supports

a. Vertical Piping: Support piping at each floor, but at not more than 10 foot intervals, with pipe riser clamps or offset pipe clamps. Pipe shall be supported not more than 2 feet from end of risers.

b. Horizontal Piping: Support piping within one foot of each change of direction. Support copper tubing as follows:

Maximum Spacing (Feet)										
Nominal Pipe Size (inches)	1" and under	1-1/4	1-1/2	2	2-1/2	3	4	5	6	8
Copper Tube	5	7	8	8	9	10	12	13	14	-

7. Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while supporting the load.

8. Pipe hangers, inserts and supports shall conform to MSS SP-58, except as specified as follows:

   a. Types 5, 12, and 26 shall not be used.

   b. Type 3 and Type 4 may be used on insulated pipe if clamped directly to the pipe and if the clamp bottom does not extend through the insulation and the top clamp attachment does not contact the insulation during pipe movement.

   c. Type 19 and 23 C-clamps shall be torqued per MSS SP-58 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

   d. Type 20 attachments used on angles and channels shall be furnished with an added malleable iron heel plate or adapter.

   e. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

L. Seismic Bracing Requirements:

1. Piping and equipment shall be supported and braced to resist seismic loads where required by the specified Building Code. Provide seismic restraints in accordance with the SMACNA Seismic Restraint Unit.

M. Pipe Through-Penetrations:

1. Furnish and install pipe sleeves where piping passes through walls and floors. Core drilling of masonry and concrete may be provided by this Section in lieu of pipe sleeves when cavities in the core-drilled holes are completely grouted smooth. Furnish sleeves of sufficient length to pass through entire thickness of walls and floors.

2. Pipe Penetrations Through Interior Building Construction: Provide not less than 1-inch space between exterior of piping or pipe insulation and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. For non-fire rated assemblies, seal at both ends of the sleeve or core-drilled hole with silicone. Seal both ends of penetrations through fire rated assemblies to maintain fire resistive integrity with UL listed fill, void, or cavity material.

3. Pipe Penetrations Through Exterior Building Construction: Provide not less than 1/2-inch space between exterior of piping and interior of sleeve or core-drilled hole. Firmly pack space with non shrink grout.

4. Extend sleeves in floor slabs 2 inches above the finished floor. Sleeves through walls shall terminate flush with the finished surface on either side of the wall.

N. Cross Connection and Interconnections:

1. No equipment, devices or piping shall be installed which will provide a cross or interconnection between a domestic water supply and a drainage, soil or waste pipe which will permit or make possible the backflow of sewage, polluted water or waste into the domestic water supply system.

3.02 TREATMENT SYSTEM REMOVAL

A. General: Point-of-use treatment systems shall be removed from existing plumbing prior to connecting to the new service line. Any materials and equipment removed that are not wanted by the property owner shall be recycled, to the maximum extent possible, or disposed. Spent carbon or other treatment residuals shall be sent to an appropriate facility for regeneration or disposal. POU devices, including residuals, are considered household waste and are exempt from being regulated as hazardous waste under RCRA. However, applicable state regulations shall apply.

3.03 FIELD QUALITY CONTROL:

A. General: After system installation has been completed and prior to initial operation, inspect piping for compliance with Drawings, Specifications, and accepted submittals. Perform flushing and tests in compliance with the specified Plumbing Code with the additions specified herein. Have piping accepted by the Contracting Officer before insulating or otherwise concealing.

B. Test Procedures and Reports:

1. Prepare and submit procedures for all specified tests to the Contracting Officer for acceptance prior to the planned preliminary tests. Test reports shall include accepted test procedures, test results, deficiencies identified, and recommended corrective actions. Provide a complete explanation including supporting documentation detailing the design deficiencies. State that no deficiencies are evident if that is the case.

2. Material and equipment used in testing shall be subject to inspection by the Contracting Officer. Provide instruments, appliances, equipment, connecting devices, and personnel for the tests. The Contracting Officer will furnish water and electricity for the tests.

3. When tests have been completed and corrections made, submit signed and dated test reports.

4. Test all new equipment and piping to demonstrate compliance with the contract requirements. Correct defects in the Work and repeat tests until Work is in compliance with contract requirements.

5. Gages used in pressure tests shall have been calibrated within the 6-month period preceding the tests. Leaks found during tests shall be repaired by replacing pipe and/or fittings and the system retested. Caulking of joints shall not be permitted.

C. Tests:

1. Domestic Water Piping Pressure Tests: Before applying insulation, and before the installation of fixtures, cap ends of each system and hydrostatically test each piping system at not less than 100 psig for a period of time sufficient for inspection of every joint in the system but in no case less than 1 hour. During the pressure test, there shall be no leakage or reduction in pressure.

2. Backflow Preventer Tests: Backflow preventers shall be tested by a locally approved and certified backflow assembly tester. A copy of the test report shall be provided to the Contracting Officer prior to placing the domestic water system into operation, or no later than 5 days after the test.

D. Flushing:

1. After completion of testing and before placing in operation, flush all new and existing piping of all foreign matter. Use the permanent water service at its maximum available pressure as the source of flushing water. Remove integral strainer screens, aerators, shower heads, hose end vacuum breakers, and other devices susceptible to clogging prior to flushing and re-install upon completion. Flush piping through each fixture outlet, strainer blowdown and equipment drain valve. Discharge used water to sanitary sewer. Remove and provide new screens in strainers after flushing is completed. System shall be drained prior to final filling.

3.04 MANUFACTURERS INSTRUCTIONS:

A. Obtain instructions from the manufacturer for the proper method of installation and connection of the equipment that is to be installed. Obtain all information that is necessary to facilitate the Work and to complete the project.

3.05 DISINFECTION:

A. Disinfect the new water piping and existing water piping affected by the Work in accordance with the specified Plumbing Code with the additions specified herein. Fill piping systems with chlorine solution and allow solution to stand. Following the required standing time, flush solution from the systems with domestic water until maximum residual chlorine content is within the range of 0.2 to 0.5 ppm, or the residual chlorine content of domestic water supply. Obtain at least two consecutive satisfactory bacteriological samples from new and existing water piping, analyzed by a certified laboratory, and submit results prior to the new and existing water piping being placed into service.

B. Where it is not possible to disinfect a potable water storage tank as specified above, the entire interior of the tank shall be swabbed with a solution which contains 200 parts per million of available chlorine; and the solution shall than be allowed to stand 3 hours before the tank is flushed and returned to service.

C. For a potable water filter or similar device, the dosage shall be determined by the Connecticut Department of Environmental Protection.

3.06 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700 .

END OF SECTION

SECTION 15806

HEATING, VENTILATING AND AIR CONDITIONING

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide heating, ventilating and dehumidification equipment, controls, accessories and appurtenances as indicated and specified.

B. Furnish all local, state and federal permits as necessary.

1.02 RELATED WORK:

A. Division 1: General Requirements

B. Section 16220: Electric Motors

C. Section 09941: Field Painting

D. Section 10200: Louvers

E. Section 13300: Utility Control Instrumentation System

F. Section 15105: Pipe Supports

G. Section 15400: Plumbing

H. Section 16050: Electrical Work - General

I. Section 16900: Electrical Controls and Miscellaneous Electrical Equipment

1.03 REFERENCES:

A. Underwriters' Laboratories (UL)

B. National Electric Code (NEC)

C. Air Moving and Conditioning Association (AMCA)

D. American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

E. American Society of Mechanical Engineers (ASME)

F. Building Officials and Code Administrators (BOCA)

G. Low and High Pressure Duct Construction Standards by Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)

H. National Fire Protection Association (NFPA)

I. American National Standards Institute (ANSI)

J. Associated Air Balance Council (AABC)

K. American Society for Testing and Materials (ASTM) Publications:

1. D1785: Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

2. D2464: Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

3. D2467: Specification for Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

4. D2564: Specification for Solvent Cements for Poly (Vinyl-Chloride) (PVC) Plastic Pipe and Fittings.

L. Factory Mutual (FM).

1.04 SYSTEM DESCRIPTION:

A. Heating is provided by electric unit heaters as specified herein and indicated on the equipment schedule and contract drawings.

B. The ventilating systems have fans, dampers, and associated ductwork as specified herein and indicated on the equipment schedule and contact drawings.

C. Dehumidifiers are specified herein and indicated on the equipment schedule and contract drawings.

1.05 SUBMITTALS:

A. Submit the following in accordance with Section 01300:

1. Shop drawings including manufacturer's specifications and catalog data, brochures, descriptive matter, illustrations, diagrams, including complete motor data, and finishes with color charts of equipment to be selected, and complete performance

data. Where product types are available with Energy Star labeling, they shall be provided.

a. Equipment performance curves.

b. Schematic wiring diagrams with control system submittals.

2. For informational purposes only, submit manufacturer's printed installation instructions for all items specified.

3. Record drawings of heating, ventilation and air conditioning installation.

4. Operation and maintenance manuals in accordance with Section 01730.

5. List of manufacturer's recommended spare parts.

6. Provide nomenclature labels on submittals.

1.06 QUALITY ASSURANCE:

A. Provide in accordance with Section 01400 and as specified.

B. Provisions:

1. Drawings and specification direct attention to certain features of equipment, but do not purport to cover all details entering into design and construction of the equipment, controls, or appurtenances.

2. Considerations given only to products of manufacturers who demonstrate successful experience in manufacture, operation, and servicing equipment of type, size, performance, and reliability equal to that specified. Equipment and components shall be the product of a single manufacturer insofar as possible.

3. Equipment furnished to fit with in the space allocated with adequate clearance for proper operation and maintenance.

C. Workmanship and Design:

1. Provide equipment such that all parts are proportioned for continuous and uninterrupted service, and such that lubrication, adjustment, or replacement of parts is possible without manufacturer's assistance. Corresponding parts of multiple units and shall be interchangeable.

2. Equipment is subject to corrosion. Provide coatings to all metallic elements as specified in subpart – PAINTING.

3. Install equipment that complies with state, local and federal codes and regulations.

D. Alternate Equipment and Arrangement:

1. If any equipment submitted for acceptance requires arrangement differing from that indicated or specified, Contractor to prepare and submit for review, drawings, and equipment lists showing all necessary changes and all special features of equipment proposed. Changes are at no additional compensation to the Contractor.

1.07 DELIVERY, STORAGE AND HANDLING:

A. Provide in accordance with Section 01610 and as specified.

B. Shipping:

1. Equipment, material and spare parts are to be shipped completely assembled except where partial disassembly is required by transportation regulations or for protection of components.

C. Receiving:

1. Inspect and inventory items upon delivery to site.

2. Store and safeguard equipment, material and spare parts in accordance with manufacturer's recommendations.

1.08 INTERFACE WITH OTHER TRADES:

A. Power wiring, circuit breakers, starters, conduit, wire and connections for equipment and appurtenances are as indicated and specified under Division 16, unless otherwise indicated or specified. All control conduit and wire required between HVAC equipment and control points are provided under this Section.

B. Wiring and conduit for power and building alarm signaling are provided in Sections 16050 and 16900.

C. Louvers are provided under Section 10200.

PART 2 - PRODUCTS

2.01 GENERAL:

A. Where product types are available with Energy Star labeling, they shall be provided.

2.02 DEHUMIDIFIER:

A. General: The dehumidifier shall be a heavy-duty industrial self-contained indoor unit, completely assembled, piped, wired and factory tested. The unit includes the following minimum parts and components: Compressor, evaporator coil (dehumidifier), condenser coil (reheat), blower, blower motor, refrigeration valves and electrical controls. The unit shall be fixed mounted with a broad operating temperature range that includes low temperature operation.

B. Quality Assurance: All parts and components shall be shall be UL listed. The manufacturer of the dehumidification system shall have a minimum of five (5) years of experience in the production of these systems.

C. Enclosure: The frame, panels, and removable access panels shall be constructed of 16- or 18-gauge Galvanneal steel. The base panel shall be 11-gauge Galvanneal steel. Panels shall be removable to allow easy access to internal parts.

D. Paint and Finish: All metal parts shall be painted with 1-1/2 to 3 mils powder coat paint. Powder coat shall be oven cured per paint manufacturer's specifications.

E. Evaporator (Dehumidifier coil):

1. Fins: Fins shall be die formed, plate type tempered aluminum for easy cleaning and shall be damage resistant. Fins shall have extruded fin collars.

2. Tubes: Coil tubes shall be fabricated from seamless drawn copper. The tubes shall be mechanically expanded into the tubes to form a permanent metal to metal bond.

3. Headers: All manifolds, headers, and connecting tubing shall be made with heavy wall seamless copper tubing.

4. Testing: Coils shall be leak tested with 625-psig nitrogen and sealed to prevent contamination.

F. Condenser (Reheat Coil):

1. Fins: Fins shall be die formed, plate type tempered aluminum for easy cleaning and shall be damage resistant. Fins shall have extruded fin collars.

2. Tubes: Coil tubes shall be fabricated from seamless drawn copper. The tubes shall be mechanically expanded into the tubes to form a permanent metal to metal bond.

3. Testing: Coils shall be leak tested with 625-psig nitrogen and sealed to prevent contamination.

G. Refrigerant Feature: Low Temperature Feature: Unit will be equipped with a demand defrost system. Evaporating temperatures must be capable of dropping below 32F to maximize moisture removal during low load. The demand defrost system will monitor conditions at the evaporator, activating and de-activating the evaporator defrost cycle on an as-needed basis.

H. Compressor: The compressor shall be a heavy-duty, hermetic, rotary type. The compressor is equipped with a high-pressure safety switch, and internally protected from overheating. The compressor shall be vibration isolated internally and externally. The compressor shall be covered by a two-year warranty.

I. Electrical Control Panel: The electrical control panel shall be easily accessible so that all service can be performed from one side of the unit. It shall be of adequate size to house all electrical controls and devices. The electrical controls shall include a Class 2 low-voltage control transformer, clearly labeled high- and low-voltage terminal strips, potential starting relay, start and run capacitors, and high-pressure protection with manual reset.

J. Controls: Unit shall have an on / off switch, a factory wired and installed humidistat and a factory installed run timer.

K. Condensate Drain Pan: Drain pan shall be made of ABS plastic or stainless steel and be mounted directly under the coil assembly. Pan must have round edges and be sloped toward the drain to assure no standing water in the pan.

L. Blower: The blower shall be a single inlet, direct drive, centrifugal fan type.

M. Filter Rack: Unit must be equipped with filter rack utilizing 18 ” x 18” x 1” extended surface filter. Filter shall be disposable and must meet or exceed average (ASHRAE 52.1-1992) atmospheric efficiency of 20 to 35% and arrestance of 92%.

N. Warranty: All components shall be warranted for a period of two (2) years from date of shipment.

O. Approvals/Listings: The complete unit shall be ETL listed.

P. Unit Manufacturer: The unit shall be manufactured by Desert Aire Corp., Milwaukee, Wisconsin, or equal.

2.03 METAL DUCTWORK:

A. Ducts shall be fabricated of sheet aluminum, designation 1100 or 3003, H-14 alloy and temper.

B. Design for 2 in. w.g. positive or negative, with weight of duct and stiffener materials, fabrication methods and crossbreaking conforming to latest low pressure construction standard published by SMACNA; do not use beaded duct construction.

C. Provide joints recommended by SMACNA for duct pressure rating, except that button punch snaplock joints shall not be used.

D. Provide access doors for maintenance of dampers and equipment and access panels at fire dampers.

E. Provide neoprene-coated, flexible, airtight, fabric sleeves weighing approximately 30-oz. per square yard for ductwork connections to equipment.

F. Ductwork Insulation: Provide 1-1/2-inches of 1-1/2-lb. minimum density flexible blanket fibrous glass with factory applied vapor barrier jacket. Provide insulation as manufactured by Owens-Corning Fiberglass Corp., Toledo, OH; PPG Industries, Inc., Pittsburgh, PA; Certain-Teed Products Corp., Valley Forge, PA; or acceptable equivalent product.

2.04 DAMPERS GENERAL:

A. Motor-operated dampers are specified and furnished under CONTROLS unless otherwise indicated or specified. Motor operators furnished and installed under CONTROLS.

B. For dampers in outdoor intakes, provide an 18 by 14 aluminum mesh, 0.0123-in. diameter wire insect screen, secured in a removable aluminum frame with provisions for screen replacement.

2.05 ELECTRIC UNIT HEATERS:

A. Corrosion Resistant Electric Unit Heaters:

1. Provide corrosion resistant forced-convection type, electric unit heater, rated as indicted on the equipment schedules.

2. Provide each heater unit complete with heating element, fan, contactor, and integral thermostat.

3. Provide fan motors totally enclosed, oil sealed, and quiet in operation.

4. Provide each unit housed in a sheet-metal enclosure equipped with swivel hanger suitable for ceiling or wall mounting as indicated.

5. Provide adjustable louver and thermal cutout. Cutout to protect heater from overheating by opening the electric circuit and automatically reenergizing the heater when a safe temperature is reached.

6. Provide integral corrosion resistant thermostat.

2.06 VENTILATING FANS:

A. General:

1. AMCA rated and constructed for capacity and sound level. UL labeled.

2. Impeller wheels statically and dynamically balanced, free from vibration and noise.

3. Provide electric motor, drive equipment, controls, vibration isolators, supports and appurtenances including safety disconnect switches at each unit.

4. Provide fan with non-overloading characteristics for maximum CFM and static pressure achievable with drive provided.

5. Provide direct drive, motor sized to deliver maximum CFM.

6. For electric motors, provide adjustable heavy steel plate mounts; provide single phase motors with built-in thermal overload protection.

7. Provide motor-operated damper for fan openings as indicated. Motor-operated dampers and motor operators are specified under subpart – CONTROLS.

8. Provide vibration isolation fan mountings.

B. Inline- Fans- Square:

1. Manufacturers:

a. Greenheck Fan Corp.

b. Loren Cook Co.

c. Penn Ventilator

2. Fan shall be duct mounted, direct driven centrifugal square inline.

3. The fan shall be of bolted construction utilizing corrosion resistant fasteners. Housing shall be minimum 18 gauge galvanized steel with integral duct collars. Bolted access doors shall be provided on three sides, sealed with closed cell neoprene gasketing.

4. Wheel shall be centrifugal backward inclined, constructed of 100% aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone.

5. Motor shall be heavy duty type with permanently lubricated sealed ball bearings.

2.07 CONTROLS - GENERAL:

A. Provide all control operators for control items furnished by equipment suppliers herein specified.

B. Provide control item enclosures of the appropriate NEMA classification as indicated on the Electrical Drawings for the area the enclosure is to be located.

C. Provide factory-fabricated multiblade control insulated dampers with factory-mounted linkages, minimum 0.080-inch (No. 12 AWG gage) thick extruded aluminum blades and frames. Reinforced channel-type frames; maximum 6-inch wide blades with interlocking or overlapping edges; minimum 1/2-inch diameter rods with self-lubricating bearings; all hardware of noncorrosive material or cadmium plated.

1. Provide low-leakage dampers. Damper construction to have compressible seals at all points of contact to minimize leakage when damper is closed; manufacturer to submit guarantee that damper leakage will not exceed 20 cfm per square foot when closed against a static pressure of 4-inches w.c.

2. Provide parallel blade dampers for two-position operation, which shall open wide to give minimum air stream resistance.

D. Provide damper motor-operators of rugged commercial/industrial construction and quiet in operation. When operated at rated voltage, each motor capable of delivering not less than twice the torque required by the damper, and to withstand, without damage, continuous stalling. Motors designed to function properly with a 10 percent plus or minus change in line voltage feeding the equipment, maximum 120/1/60 HZ control system voltage. Manufacturers: Belimo, Andover, Allerton or acceptable equivalent product.

1. Damper actuators shall be electronic direct coupled, unless the control shaft is not accessible. Actuator-drive pinions and high-speed gears may be made of a suitable nonmetallic composition to ensure quiet operation. All other gears of steel or bronze. All gears accurately machine cut, with face widths of not less than 1/8-in. Shafts of hardened steel, running in bronze, hardened steel, nylon or other suitable sleeves or ball bearings. Lever arms attached to motor shafts with set screws or other secure and adjustable means. Actuators shall contain a “V” bolt mounting mechanism for mounting to the control shaft. Set screws will not be acceptable.

2. Motors and gear trains totally enclosed in dustproof housing of pressed steel or acceptable cast metal with rigid conduit connections. Motors shall be protected by

electronic current overload circuitry. End switches for motor protection will not be accepted.

3. Proportioning motors of the reversing, shaded pole or capacitor induction type, capable of stopping at any point in the cycle and starting either direction from any point. Reversing and proportioning motors with limit switches to limit the lever travel in either direction, unless operator is "stall" type.

4. Motors provided with spring return so they will "fail safe" in closed position, as indicated or required to suit job conditions, in the event of power failure. Battery backup and capacitor discharge types of fail safe actuators will not be accepted.

5. Damper motor-operating speeds to be selected or adjusted so that the motors will remain in step with the controller without hunting, regardless of load variations. Provide motors which operate in sequence with other motors with adjustable operating ranges and starting points to permit adjustment of the control sequence as required by the operating characteristics of the system.

6. When direct coupling is not feasible, dampers to be provided with adjustable linkages and crank arms as required, suitable for the motors hereinbefore specified. Linkages and crank arms to be zinc or cadmium plated.

7. Damper linkages and operators to be arranged for mounting out of the air stream and to be rated for at least twice the maximum operating force of the damper motor. Do not locate operator outside of building, unless allowed by Contracting Officer.

2.08 HVAC SEQUENCE OF OPERATION:

A. HVAC Sequences of Operation

1. Ventilation Fan VF-2 & VF-4:

a. The ventilation fans shall be controlled by a manual switch. When the building is occupied, the fan shall be turned on and the interlocked motor operated dampers MD-1 and MD-2 shall open.

b. When the switch is closed the fan shall stop and the dampers close.

2. Motor Operated Dampers

a. The inlet and exhaust dampers shall be closed when the Ventilation Fan is off. The dampers shall open when the ventilation fan is turned on.

b. The dampers shall fail closed on loss of power.

3. Dehumidifier

   a. Dehumidifiers shall be controlled by manufacturer provided controls.

4. Electric Unit Heaters

   a. The unit heater shall be controlled by an integral thermostat. On a drop in room temperature below the thermostat set point of 55 degrees F (adjustable), the unit heater shall start. When the space temperature is above the set point, the unit shall stop.

2.09 CONTROLS - IDENTIFICATION PLATES:

A. Provide identification plates for the identification of room thermostats, adjustable controls, manual switches and remote operators, control panels and boxes, indicating lights, and alarm devices. Plates to identify the system or unit controlled and its function or position. Also provide, where appropriate, indicators and labels for switch positions.

B. Plates to have 1/4-in. high white letters on a black background.

C. Provide identification plate above ventilation fan switch that states: "SHUT OFF VENTILATION FAN WHEN BUILDING UNOCCUPIED".

2.10 PAINTING:

A. Field painting is specified under Section 09941.

B. Give ferrous surfaces obviously not to be painted a shop coat of grease or other suitable rust-resistant coatings.

C. Protect aluminum work, unless otherwise specified, against contact with other metals by coating nonaluminum surfaces with an aluminum pigmented asphalt paint. Coat aluminum in contact with concrete with asphalt or bituminous mastic.

D. Other shop painting to be as specified under SHOP PAINTING.

E. Motors, fan casings, and similar equipment customarily finished at the shop given coats of paint filler and enamel or other treatment customary with the manufacturer.

F. Provide other ferrous surfaces not previously specified with one shop coat of Kop-Coat 622-LCF Primer made by Koppers Co., Inc., Pittsburgh, PA.; 37-77 Chem-Prime made by Tnemec Co., North Kansas City, MO; U-Prime 280 made by Porter International, Louisville, KY; or an acceptable equivalent product applied in accordance with the instructions of the manufacturer.

2.11 SPARE PARTS:

A. Provide in accordance with Section 01730.

B. Furnish the following spare parts for the equipment:

1. One set of replacement filters for each dehumidifier.

C. Delivered from supplier at the same time as the equipment to which they pertain.

D. Properly store and safeguard until completion of the work, then deliver to Contracting Officer.

PART 3 - EXECUTION

3.01 INSTALLATION - GENERAL

A. General:

1. Obtain and pay for all permits.

2. Comply with Sections 15105, 16050 and 16900.

3. Field painting per Section 09941.

4. Install equipment and appurtenances in accordance with manufacturers' recommendations.

3.02 INSTALLATION OF PIPING:

A. Install to grades and elevations indicated.

B. Install hangers and supports per Section 15105.

3.03 DUCTWORK:

A. Aluminum ductwork shall be used.

B. Assemble per SMACNA.

C. Do not exceed 6-ft. spacing of hangers on horizontal ducts; 4-ft. on vertical ducts.

D. Support ductwork from structure per SMACNA; use steel rods and angles for ducts with largest dimension more than 42-in. Use hanger material similar to ducts; use angle brackets to support vertical ducts. Friction clamps are not allowed.

E. Use anchors, inserts or forged beam clamps with restraints to secure hangers to structures; use stainless steel anchors if drilled-in type are installed.

F. Install duct connections to masonry openings airtight.

G. Wherever aluminum is in contact with concrete, thoroughly clean aluminum to remove all dirt, heavy deposits of grease or oil, and other foreign substances, and immerse in or swab with a suitable solvent; rinse the surface with clear water and thoroughly dry; coat cleaned surfaces with Bitumastic Super Service Black manufactured by Koppers Co., Inc.; Tarmastic 103 manufactured by Porter Coatings Div.; or an acceptable equivalent product.

H. Insulate aluminum from dissimilar metals by strips or roofing felt or other approved means.

I. Apply dull black paint to ductwork at visible locations behind registers.

J. Pack the space between the sleeve and framed prepared opening and the duct and the duct installation with mineral wool or other approved fire resistant material.

3.04 DUCTWORK INSULATION:

A. Apply with adhesive or fasten with pins or clips.

B. Install flexible blanket type externally.

C. Seal seams and joint strips for butt joints with vapor-barrier adhesive.

3.05 IDENTIFICATION PLATES:

A. Affix identification plates to switch boxes, controls and appurtenances as specified.

3.06 CONTROLS:

A. Provide competent mechanics, experienced in control system installations, for the work.

B. After all installations are complete, operate equipment in presence of the Contracting Officer to demonstrate satisfactory performance.

C. Leave all systems complete and in first-class condition ready to operate.

3.07 TEST AND ADJUSTMENTS:

A. Provide all materials and equipment required.

3.08 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 15809

WATER BOOSTER PUMPS AND APPURTENANCES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide and test water pumps, motors, and bladder tank, as specified and indicated.

B. Service Description: The pump station purpose is to increase water distribution system pressure in the 12-inch and 8-inch water mains serving Talcott Ridge Drive and Watch Hill Drive.

C. Two service pumps will be provided. The service pumps shall be controlled with a pressure transmitter on the discharge header and will be operated on alternate cycles. Each shall be capable of 45 gpm at 101-feet TDH and will be automatically activated as needed, when boosted distribution system pressure falls at or below 80 psi.

D. Pumps shall be stainless steel inline vertical multi-stage centrifugal pumps.

1.02 RELATED WORK:

A. Division 1: General Requirements

B. Section 09941: Field Painting

C. Section 13300: Utility Control Instrumentation System

D. Section 15101: Process Piping, Valves and Appurtenances

E. Section 16220: Electric Motors

F. Section 16260: Low Voltage Variable Frequency Drive Unit

1.03 REFERENCES:

A. American Society of Mechanical Engineers (ASME):

1. ASME Boiler and Pressure Code, Section VIII, Division 1

B. ASTM International (ASTM):

1. A351: Standard Specification for Castings, Austenitic, for Pressure-Containing Parts
2. D2240: Standard Test Method for Rubber Property – Durometer Hardness.

C. American National Standards Institute (ANSI).

D. Hydraulic Institute (HI):

1. Current Standards.
2. 14.6: Rotodynamic Pumps for Hydraulic Performance Acceptance Tests

E. American Iron and Steel Institute (AISI).

F. National Electrical Manufacturers Association (NEMA):

1. MG1: Motors and Generators.

G. NSF International:

1. NSF/ANSI Standard 61: Drinking Water System Components.

1.04 SUBMITTALS:

A. Submit the following shop drawings in accordance with Section 01300 – Submittal Procedures:

1. Pumps:

a. Data regarding pump and motor characteristics and performance:

(1) Prior to fabrication and testing, provide guaranteed performance curves based on actual shop tests of mechanically duplicate pumps, showing they meet indicated and specified requirements for head, capacity, horsepower, efficiency and $NPSH_3$.

(a) For units of same size and type, provide curves for a single unit only.

(2) Provide catalog performance curves at maximum pump speed indicated and specified for each service showing maximum and minimum impeller diameters available, acceptable operating range (AOR) and preferred operating range (POR).

(3) Results of shop performance tests as specified.

(4) Submit curves for guaranteed performance, and shop performance tests on 8-1/2-inch by 11-inch sheets, one curve per sheet.

b. Characteristic curves for variable speed pumps for maximum pump speed and for speeds required to obtain minimum pump flow and head conditions specified and indicated. Identify curves by speed and provide all curves on one sheet. Provide $NPSH_3$ curve for each speed.

c. 11x17, to-scale, dimensioned drawings in US customary units with the supplier's title block showing plans and sections. Identify location, type,

and size of all external connections. Identify all instruments. Show all clearances required for maintenance and replacement. Show empty and flooded weights.

d. Motor data sheets.

e. Product sheets for valves and instruments, annotated so it is clear which models, options, materials, and accessories are being provided.

f. Operating and maintenance instructions and parts lists.

g. List of reference installations as specified with contact names and telephone numbers.

h. Certified results of hydrostatic testing.

i. Certified results of dynamic balancing.

j. Bearing Life: Certified by the pump manufacturer. Include design data.

k. Bearing temperature operating range for the service conditions specified.

l. List of recommended spare parts other than those specified.

m. Shop and field inspection reports.

n. Pump shop test results.

o. Motor shop test results.

p. Qualifications of field service engineer.

q. Recommendations for short and long-term storage.

r. Shop and field testing procedures, pump and piping set up, equipment to be used and ANSI/HI testing tolerances to be followed.

s. Special tools.

t. Number of service person-days provided and per diem field service rate.

u. Results of field vibration test data including a vibration signature for each pump and drive assembly. Provide vibration testing procedure for review.

v. Manufacturer's product data, specifications and color charts for shop painting.

w. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.

x. The latest ISO 9001 series certification or quality control plan.

B. Bladder Tank:

1. Manufacturer's product sheets annotated to indicate which model, options, materials, and accessories are being provided.
2. Dimensioned shop drawings.

C. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.

1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

D. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

1.05 SPARE PARTS:

A. Comply with the requirements specified in Section 01610 – Delivery, Storage and Handling.

B. Provide spare parts that are identical to and interchangeable with similar parts installed.

1. For each pump:

a. (1) complete set of gaskets and O-rings

b. (1) mechanical seal

c. (1) set of all special tools required.

1.06 QUALITY ASSURANCE:

A. Comply with the requirements in Section 01400 – Quality Assurance.

B. Pumps to be the product of one manufacturer.

C. Pumps to be manufacturer’s standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

D. Welding: In accordance with latest applicable American Welding Society Code or equivalent.

E. Shop tests as specified.

F. The Contractor to obtain the pumps and motors from the pump manufacturer, as a complete and integrated package.

G. Services of Manufacturer's Representative as stated in Section 01400 – Quality Assurance and as specified herein.

H. Provide services of pump manufacturer’s service technician, specifically trained on the specified equipment:

1. Service technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

2. Installation, Functional Testing, Field Performance Testing: Inspect grouting, location of anchor bolts, setting, leveling, alignment, and electrical. Calibrate, check alignment and perform a functional test with water. Tests to include all items specified. Field performance test equipment specified.

a. (1) person-day.

3. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions.

a. (1) person-day.

4. Credit to the Contracting Officer, all unused service person-days specified above, at the manufacturer’s published field service rate.

5. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in

installation, equipment or material shall be provided at no additional cost to the Contracting Officer.

I. Manufacturer of pumps to have a minimum of (20) operating installations with pumps of the size specified and in the same service as specified operating for not less than (5) years.

J. If equipment proposed is heavier or taller, different rotation, or discharge arrangement than specified and indicated; provide all structural, architectural, mechanical, electrical and plumbing revisions at no additional cost to the Contracting Officer.

1.07 DELIVERY, STORAGE AND HANDLING:

A. Comply with the requirements specified in Section 01610 – Delivery, Storage and Handling.

PART 2 - PRODUCTS

2.01 PUMP:

A. Manufacturers:

1. Xylem, Goulds Water Technology

2. Grundfos

3. Or an acceptable equivalent product

B. Design Conditions:

1. Refer to the Process Pump Schedule on the mechanical process drawings for general layout and specific design criteria.

2. Installed in a temperature controlled building.

3. Flooded suction, 57-67 psig available.

4. Service: Potable water.

C. Pumps:

1. Type: Stainless steel inline vertical multi-stage centrifugal.

2. Materials:

a. Pump body and casing: CF8M, ASTM A351

b. Pump base: Aluminum

c. Motor Stool: Cast Iron ASTM Class 35/40B

d. Flanges: CF8M, ASTM A351

e. Shaft: 316 stainless steel

f. Impellers, diffuser, seal chamber, outer sleeve: 316 stainless steel

g. Impeller wear rings: PPS

h. Shaft sleeve and bushing: Tungsten carbide

i. Pump bearing: Tungsten Carbide

j. O-Rings and/or gaskets: Viton

k. Coupling: Aluminum

3. Shaft Seal:

a. Single flush-less mechanical cartridge type with the following materials:

(1) Collar, drivers, spring: Type 316 stainless steel

(2) Shaft sleeve, gland plate: Type 316 stainless steel

(3) Stationary ring: Silicon carbide imbedded with graphite

(4) Rotating ring: Carbon

(5) O-rings: Viton

b. Replaceable without removing pump from piping, other than coupling guard, shaft coupling, and motor.

4. Provide a vent valve or screw at top of pump.

D. Instruments:

1. Mount a pressure gauge on the suction and discharge header:

a. Discharge range: 0-150 psig

b. Suction range: Vacuum to 150 psig

2. Pressure Gauges:

a. Manufacturers: 3D, Perma-Cal, Wika

b. 4.5-in process gauge, gearless direct drive, non-liquid filled

c. Case: ABS

d. Lens: Acrylic

e. Helical wound bourdon tube: Inconel X-750

f. Shaft bearing: synthetic sapphire both ends

g. Fittings and socket: 316 stainless

h. Connection: 1/2-in

i. Diaphragm Seal: 316 stainless

j. External zero adjustment

k. Accuracy: +/- 0.5% at mid scale

l. Repeatability: +/- 0.025% at full scale

3. All instruments to be factory calibrated.

E. Motors:

1. Horsepower rating of motors: Not less than maximum brake horsepower requirements to start pumps under any condition of operation specified and indicated without operating in the motor service factor.

2. Motor HP, speed, and enclosure: In accordance with the Process Pump Schedule on the mechanical process contract drawings.

3. Provide ball or roller bearings with at least one bearing designed for thrust. Bearings to have a minimum B-10 life of 100,000 hours.

4. Overall sound-pressure level of each motor shall not exceed 88 decibels when measured on flat network using an octave-band frequency analyzer conforming to ANSI S1.11. Determine overall sound-pressure level as average of four or more readings at evenly spaced points, 3 feet from motor.

5. Operate without overheating at the speeds specified and indicated.

6. Power: 460V, 3-phase, 60 Hertz.

7. Inverter duty rated with 1.0 service factor when operating with VFD.

8. Premium efficient with nominal and minimum efficiencies per NEMA MG1.

9. Insulation: Class F with Class B temperature rise, 40 degrees C ambient.

10. Site altitude: Less than 3,300 feet above sea level.

11. Provide thermal overload and anti-condensation heater.

12. Provide nameplates per NEMA MG1.

13. For motors heavier than 50 lbs, provide lifting lugs.

F. Booster Pump Station Description of Control:

1. The booster pump station has two pumps with space available for a future third pump. One pump shall be the service pump and the other is a standby unit.

2. In automatic operation, the control system shall activate the service pump when the pressure sensor on the discharge header measures 80 psi or lower.

3. In automatic mode, the system will maintain system pressure at the setpoint, 100 psi.

4. The service pump shall shutdown when the pressure sensor on the discharge header exceeds 100 psi for a set amount of time or the flow rate is less than 25 gpm.

5. The pumps will switch starting positions after each activation.

G. Shop Testing:

1. Provide motor shop testing in accordance with Section 16220 – Electric Motors.

2. Pump Tests:

a. Perform hydrostatic static test of all pressure components at 1.3 times the nominal pressure of each part.

b. Provide certified performance tests as specified herein for all pumps.

c. Certified performance testing.

(1) Run pump at full speed rating point for (60) minutes prior to start of any testing.

(2) Full speed tests:

(a) Test pumps at the conditions specified and indicated and take not less than (7) operating points between shut-off and run out. Test points must be at the conditions specified and indicated.

(b) Take readings to determine flow, differential pressure, rpm, horsepower, and efficiency.

(c) Operate each pump for not less than one hour and take readings to determine the pump will operate as specified and indicated without cavitation at the specified minimum head condition with not more than the specified NPSH available.

(d) Use tested job motors that are shipped to the pump testing facility for use in the pump tests.

(e) Use factory calibrated test drives.

d. Run all tests in accordance with the latest standards of the Hydraulic Institute and as specified.

e. Testing Acceptance Grade and Tolerances:

(1) ANSI/HI 14.6 Acceptance Grade: 1U.

(2) Efficiency Tolerance: -0 percent.

(3) If pumps do not meet the tolerances specified, trim the impeller and retest until the specified results are obtained.

f. In the event specified tests reveal that pump or motor, will not meet the specifications, Contracting Officer has the right to require additional complete tests for all pumps and motors, at no additional cost to the Contracting Officer.

g. Repeat tests until specified results are obtained.

h. Correct or replace promptly all defects or defective equipment revealed by or noted during tests at no additional cost to the Contracting Officer.

2.02 BLADDER TANK:

A. Manufacturers:

1. Amtrol, Well-X-Trol Series, WX

2. Or an acceptable equivalent product

B. Service: Potable Water Service.

C. Shape: 48-in diameter vertical steel tank with integrated stand.

D. Steel shell designed, fabricated, tested, and stamped per ASME section VIII, Division 1.

1. Working Pressure: 150 psig

2. Maximum Operating Temperature: 240 Deg F

E. Minimum tank volume: 422 gallons

F. Full acceptance butyl bladder, replaceable through a bolted flange on top of the tank.

1. Minimum thickness: 0.100-in

G. Connections:

1. Water: 3-in NPTF

2. Air valve: Schrader valve with EPDM seats and threaded cap.

3. Provide a 3/4-in NPT drain plug on the tank bottom.

H. Provide seismic restraints.

I. Pipe and Valves:

1. Connect tank to the water system as indicated on the mechanical process drawings.

2. Provide Class 53 ductile iron pipe in accordance with Section 15101 – Process Piping, Valves, and Appurtenances.

3. Provide resilient seat gate valves in accordance with Section 15101 – Process Piping, Valves and Appurtenances.

J. Painting:

1. Shop painting: Tank manufacturer to provide red oxide primer.

2. Field painting: Contractor to provide (2) coats of two-part high solids polyamide epoxy in accordance with Section 09941 – Field Painting.

K. Installation:

1. Mount tank on concrete pad as indicated.

2. Follow manufacturer’s procedures for charging the tank with air.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Install all items in accordance with accepted shop drawings, manufacturer's printed instructions and as indicated.

B. Mount bladder tank on concrete pad as indicated.

1. Prior to filling the tank with water, use an air compressor to charge the tank to the specified pressure.

C. After alignment is correct, grout using high grade non-shrink grout.

1. Do not imbed leveling nuts in grout.

3.02 FIELD TESTING:

A. Test piping connections to prove the pump nozzles are installed with the pipe in a free supported state and without need to apply vertical or horizontal pressure to align piping with pump nozzles. This must be performed and the piping acceptable prior to any field performance testing.

B. Field testing will not be conducted without an accepted procedure, calibration certificates for all testing equipment, gauges and flow meters and a completed and signed pretesting check list.

C. After installation of pumping equipment, and after inspection, operation, testing and adjustment have been completed by the manufacturer's field service technician, conduct running test for each pump in presence of the Contracting Officer to determine its ability to operate within the vibration and temperature limits specified, and to deliver its rated capacity under specified conditions.

1. During tests, observe and record head, capacity, pump bearing housings and motor bearing temperature, noise and vibration and motor inputs.

a. Provide vibration signature test data for each pump and drive assembly.

(1) Limit: ANSI/HI allowable limits.

b. Bearing Temperature: Bearing temperature not to exceed 180 degrees F.

c. Test Duration: Determined by the Contracting Officer, but not less than (3) hours of continuous operation.

2. Run each pump for minimum (2) hours prior to taking temperature readings.

3. Immediately correct or replace all defects or defective equipment revealed by or noted during tests at no additional cost to the Contracting Officer.

4. Repeat tests until specified results are obtained.

5. Contractor to provide all water, labor, piping, testing equipment, equipment, flow meters and test gauges for conducting tests.

a. Contractor to provide calibrated test gauges for all permanently installed gauges and portable calibrated flow meters for all pumping systems even in those cases where permanent flow meters are installed.

b. All calibrations must be within 30 days of the field testing.

c. The testing will not be started and will not be accepted until the calibrated testing equipment stated above is operational and all certifications have been submitted.

D. Make all adjustments necessary to place equipment in specified working order at time of above tests.

E. Remove and replace equipment at no additional cost to the Contracting Officer with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Contracting Officer that equipment will perform the service specified, indicated and as submitted and accepted.

3.03 FIELD TOUCH-UP PAINTING:

A. After installation and accepted testing by the Contracting Officer, apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

3.04 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700 – Contract Closeout.

END OF SECTION

DIVISION 16

ELECTRICAL

SECTION 16050

ELECTRICAL WORK – GENERAL

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide complete and operational systems for normal electric power systems, lighting systems, controls system, grounding systems and other specificed systems, inlcluding the installation and wiring of miscellaneous equipment and devices. Perform all work and testing as indicated and specified.

1. Provide conduit, wiring and connections for power, control, lighting, instrumentation and alarms for equipment furnished under this contract.

2. Provide temporary circuits, overcurrent devices, conduit and wiring, and other equipment required during construction and change-over from existing to proposed electric system. Perform work at the convenience of the Contracting Officer.

3. Raceways supports and equipment anchoring shall be provided as specified in the Division 16 sections which form a part of the Contract Documents.

4. Provide electrical relocation work associated with the relocation of equipment for the existing and new facilities, including disconnecting all existing wiring and conduits and providing new wiring and conduit to the relocated equipment. Make equipment scheduled for relocation free of electrical shock hazard.

5. The equipment enclosure classification of the project areas are indicated on the Area Classification Schedule. Provide all equipment, devices and material meeting the requirements for these area classifications unless otherwise noted or specified.

1.02 REFERENCES:

A. National Fire Protection Association (NFPA):

1. 70: National Electrical Code (NEC).

2. Connecticut Electrical Code (CEC).

B. Applicable local codes and standards.

1.03 SEQUENCING AND SCHEDULING:

A. Coordinate electrical equipment installation with other building components.

B. Arrange for chases, slots and openings in the building structures during the progress of construction to allow for the electrical installation.

C. Coordinate installing required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

D. Review the electrical underground system and the civil yard piping. Install the electrical underground system in a manner that avoids conflicts with manholes, catch basins, piping etc. provided under other Divisions of the specifications.

E. Sequence, coordinate and integrate the installation of electrical materials and equipment for efficient flow of the work.

F. Sequencing and scheduling work at existing facilities:

1. Remove and demolish equipment and materials in such a sequence that the existing and proposed plant will function properly with no disruption of power. Continuous service is required on all circuits and outlets affected by the work detailed in the contract, except where the Contracting Officer will permit an outage for a specific time. Obtain Contracting Officer's consent before removing any circuit from continuous service.

2. Coordinate electrical power outages to the electrical systems and equipment with the Contracting Officer. Where duration of proposed outage cannot be allowed by the Contracting Officer, phase the work to allow the system or equipment to be re-connected to the electrical power system within the time frame allowed by the Contracting Officer or provide temporary power connections as required to maintain service to the systems or equipment. The temporary power can be from a generator or another part of the facility not affected by the outage provided there is sufficient spare capacity.

1.04 QUALITY ASSURANCE:

A. Install electrical work in conformance with latest rules and requirements of National Fire Protection Association Standard No. 70 (National Electrical Code) and in accordance with requirements of State and Local Codes.

1.05 SUBMITTALS:

A. Submit the following:

1. The following defines a minimum for all Division 16 shop drawing and data submittals:

a. Submit shop drawings delineated by specification number with all information for one piece of equipment provided as one package.

b. Partial submittals will be returned without action.

c. Submit bills of material: Include a numbered list of all components, with manufacturer's name, catalog number, rating, and other identification. Place item number or similar identification on all other drawings where item appears.

d. Submittal shall include:

(1) Manufacturer’s drawings

(2) Panel layout

(3) Equipment layout

(4) Schematic diagram

(5) One line diagram

(6) Control sequence diagrams

(7) Interconnection diagrams

(8) Wiring diagrams

(9) Catalog data

e. Submit only completed drawings showing all local and remote devices associated with each item.

f. Mark shop drawings and data submitted showing only items applicable to specific contract.

g. Where additions and modifications are made to existing equipment, provide drawings which include both retained existing equipment and new work.

h. Submit time-current characteristic curves for all submitted protection devices such as circuit breakers and fuses.

i. Submit other documentary or descriptive information as required for each assembly to demonstrate compliance with the applicable contract documents.

1.06 INTERFERENCE AND ERRONEOUS LOCATIONS:

A. Locations of electrical equipment, devices, outlets, and similar items, as indicated, are approximate only. Exact locations shall be determined during construction.

B. Verify in field, all data and final locations of work installed under other sections of specifications, required for placing of electrical work.

C. In case of interference with other work or erroneous locations with respect to equipment or structures, furnish all labor and materials to complete the work.

1.07 SEISMIC DESIGN REQUIREMENTS:

A. All raceways and equipment installed under Division 16 shall use earthquake resistant supporting systems as specifically required in each applicable section.

1.08 APPROVAL AND MARKING EQUIPMENT:

A. Insure that devices and materials are listed and/or labeled by UL, wherever standards have been established by that organization. Where a UL listing is not available for equipment, submit certified test reports of a Nationally Recognized Testing Laboratory (NRTL), approved by the local inspecting authority, indicating that equipment is in conformance with local code requirements or any other applicable requirements. Tests and inspections for approval of equipment shall be performed at no additional cost to Contracting Officer.

B. Clearly mark equipment, devices and material with name or trademark of manufacturer and rating in volts and amperes and other pertinent information on a nameplate.

1.09 ELECTRIC SERVICE:

A. Electrical power system for the following facilities operates at 120/240 volt, 1-phase, 3 wire, 60 Hertz:

1. Cherry Hill Storage Tank/Altitude Valve Vault (Dwg. E-2, E-3, E-4)

2. Water Meter Vault (Dwg. E-5)

3. Pressure Reducing Valve Vault (Dwg. E-6)

B. Electrical power system for the following facilities operate at 480 volt, 3-phase, 3 wire, 60 Hertz:

1. Long Hill Pump Station (Dwg. E-8 through E-12)

C. Electrical power system for the following facilities operate at 480/277 volt, 3-phase, 4-wire, 60 Hertz:

1. Talcott Ridge Booster Station (Dwg. E-13 through E-14)

1.10 EQUIPMENT SPECIFIED ELSEWHERE:

A. Certain items of control equipment and other equipment are indicated on electrical drawings for connection, but are specified in other sections pertaining to plumbing, heating, ventilating and air conditioning, mechanical process, instrumentation, etc. Such items are not furnished as part of electrical work.

1.11 INCOMING SERVICE:

A. Contact the following organization for coordinating the incoming power requirements for the project:

Eversource
Calvin Hart
Field Engineering Design Specialist
(860) 267-3877
22 East High Street
East Hampton, CT 06424

B. The Electrical Utility to provide and install the following:

1. Pole and pole-mounted transformer.

2. Meter.

3. Primary service cable and final terminations

C. The Electrical Contractor shall provide and install the following in accordance with the contract documents:

a. Primary and Secondary Service duct banks.

b. Secondary cables of sufficient length for termination at the transformer.

c. Grounding at pad and service pole.

d. Conduit at service pole.

e. Meter socket.

2. Provide all conduit and wire to service pole, extend conduit up pole for distance of 10 feet, and leave sufficient length of conductors to reach the electrical distribution system overhead conductors. Connections at pole shall be made by the power company. Perform work at service pole in accordance with the power company's requirements.

D. Include an allowance of $5,000 per location to cover cost of power company's charges and fees for providing service. If the total cost of such charges is greater or less than the allowance, a debit or credit of difference in cost will be made to Contracting Officer.

E. Perform all work in accordance with power company's requirements and in manner approved by power company.

F. Notify power company, in writing, within two weeks after the contract award date concerning incoming service requirements.

G. The final, complete installation shall comply with all state and local statutory requirements having jurisdiction. The Contractor shall arrange for all necessary permits, pay all fees and arrange for all required inspections by local authorities. In general, all work shall comply with the requirements of the National Electrical Code, all state codes and the codes and ordinances of the city or town in which the work is to be done.

1.12 TELEPHONE SERVICE

A. For telephone service, coordinate new telephone service requirements with the following contact:

Eldon Bailey
Technology Services Department
(860) 638-4991
City of Middletown
245 deKoven Drive
Middletown, CT 06457

B. Include an allowance of $5,000 per location to cover the cost of the telephone company's charges and fee's for providing service. If the total cost of such chargers is greater or less than allowance, a debit or credit of difference in cost will be made to the owner.

1.13 CALCULATE THE ARC FLASH HAZARD LEVEL:

A. Perform a calculation to determine the short circuit and the arc flash hazard levels.

B. Aquire the utility fault current availability from the utility.

C. Perform work and provide warning labels in accordance with Connecticut Electrical Code, IEEE-1584 and NFPA-70E.

1.14 FAULT CURRENT AND ARC FLASH HAZARD LEVEL LABELING:

A. Provide electrical warning labels describing fault current availability at the metersocket, the main service disconnect, the electrical system enclosure and panels. Affix label to equipment.

B. For existing facilities obtain and field verify existing equipment information to support required study for new equipment to be provided under this contract.

C. Provide label describing the arc flash hazard at the required equipment. Label shall deisplay the following information:

1. Available incident energy and the corresponding working distance.

2. Required level of personal protective equipment (PPE).

3. Highest hazard/risk category for the equipment.

4. Nominal system voltage.

5. Arc flash boundary.

6. Shock hazard.

PART 3 - EXECUTION

3.01 METERING EQUIPMENT:

A. Install metering equipment as follows:

1. Obtain from power company drilling templates, dimensions, and mounting arrangements for metering transformers. Transmit this information to electrical equipment manufacturer for cutting and drilling.

2. Ensure that metering equipment installation shall be in accordance with requirements of power company by submitting drawings, sketches, catalog information and other appropriate material for power company approval.

3.02 REMOVAL AND RELOCATION OF MATERIAL AND EQUIPMENT:

A. Carefully dismantle and salvage electrical equipment, switches, fixtures, conduits, cables, wiring, boxes, as necessary to carry out proposed changes. Rehabilitate and relocate items of equipment as required and as indicated or specified.

1. Deliver material and equipment not indicated for reuse to Contracting Officer for his disposal.

B. Remove from site and dispose of material and equipment not indicated for reuse.

3.03 WORK IN EXISTING STRUCTURES:

A. In general, any or all existing electrical equipment and services are to remain in operation and shall not be disturbed unless otherwise noted in these Specifications and/or on the drawings or as required for the proper execution of the work.

B. In each area of the work, disconnect and carefully remove the existing electrical equipment and devices so noted. With the exception of items indicated as having to be re-used, all such existing equipment and devices shall be disposed of as specified herein. If not required by the Contracting Officer, remove them from the premises and site. All existing electrical equipment and devices indicated as not removed or abandoned are to be maintained in operation and any circuits disturbed by the construction shall be restored.

C. Maintain existing electrical services and systems to and in the buildings throughout the project and all “down-time” shall be scheduled at least two weeks in advance with the permission of the Contracting Officer and such scheduling shall be rigidly adhered to.

3.04 DEMOLITION:

A. Survey the existing electrical systems and equipment identified for removal with representatives from the other trades prior to performing any demolition work. Identify all conduit and equipment to be removed with tags or paint.

B. Where a piece of equipment is to be removed all associated ancillary components (e.g. solenoid valves, pressure switches, etc) and associated wiring and conduit shall also be removed.

C. Equipment, building or structures scheduled for complete demolition shall be made safe from electrical shock hazard prior to demolition. Disconnect all electrical power, communications, alarm and signal system.

D. Equipment scheduled to be turned over to the Contracting Officer shall be carefully disconnected, removed and delivered to the Contracting Officer where indicated. Provide labor, hoisting and transportation of the equipment. All other miscellaneous electrical materials, devices, etc., associated with the equipment being turned over shall be demolished and removed from the site.

E. Remove electrical work associated with equipment scheduled for demolition except those portions to remain or be reused.

F. Unless otherwise specifically noted, remove unused exposed conduit and support systems back to point of concealment including abandoned circuit above accessible ceiling finishes. Removed unused wiring back to source (or nearest point of usage).

G. Disconnect abandoned outlets and removed devices. Removed abandoned outlets if conduit services them is abandoned or being removed. Provide blank covers for abandoned outlets which are not removed.

H. Disconnect and remove abandoned electrical equipment unless otherwise indicated or specified.

I. Disconnect and remove abandoned luminaries. Remove brackets, stems, hangers and other accessories.

J. Repair adjacent construction and finishes damaged during demolition and extension work.

K. Where electrical systems pass through the demolition areas to serve other portions of the premises, they shall remain or be suitably relocated and the system restored to normal operation.

L. The electrical and process equipment to be removed or relocated under this contract has been identified on the Drawings.

M. Trace out existing wiring that is to be relocated, or removed and perform the relocation or removed work as required for a complete operating and safe system.

N. Remove exposed conduits, wireways, outlet boxes, pull boxes and hangers made obsolete by the alterations, unless specifically designated to remain. Patch surfaces and provide blank covers for abandoned outlets which are removed.

O. All equipment, materials, controls, motor starters, branch and feeder breakers, panelboards, transformers, wiring, raceways, etc. furnished and installed to the temporarily keep circuits energized shall be removed when the permanent installation is fully operational.

3.05 PROTECTION OF ELECTRICAL EQUIPMENT:

A. Store equipment in compliance with manufacturer's recommendations and as specified herein.

B. Protect electrical equipment from the weather, especially from water dripping or splashing upon it, at all times during shipment, storage, and construction.

C. Do not store equipment outdoors.

D. Where equipment is installed or stored in moist areas, or unheated buildings, provide acceptable means to prevent moisture damage. Provide uniformly distributed source of heat in electrical equipment to prevent condensation and damage to electrical insulation systems.

3.06 DEFECTIVE OR DAMAGED EQUIPMENT:

A. Damaged equipment shall not be used. Equipment damaged in shipment, storage, installation or through other means shall be replaced without additional cost to the Contracting Officer.

B. All equipment showing signs of water damage shall be rejected regardless of dielectric test results.

C. All electrical equipment is considered "in storage" regardless of location until first energized. Manufacturer's recommendations for storage precautions, conditions and care shall be followed.

3.07 DRAWINGS AND SPECIFICATIONS:

A. Drawings and specifications are typical of work to be done and of the arrangement desired. Provide accessories and appurtenances which the Contracting Officer deems

functionally necessary for a complete installation, whether or not explicitly indicated or described.

3.08 AS-BUILT DRAWINGS:

A. The Contractor shall maintain a master set of as-built drawings showing the changes and deviations from the contract drawings.

B. A minimum of 30 days prior to application for Final Payment, submit two sets of drawings for approval that are marked to show the as-installed equipment, devices, raceway locations and wiring. The markings on the drawings are to be neat, clean and legible.

3.09 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 16110

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide complete raceway systems, with matching accessories, fittings, boxes, and other hardware, as indicated and specified. When non-metallic raceway systems are specified, provide green insulated grounding conductor sized per National Electrical Code (NEC) requirements.

B. All raceway runs are indicated diagrammatically to outline general routing of raceway. Unless specifically identified for installation in concrete walls or slabs, raceways shall be run exposed with raceway supporting systems. Avoid interfering with pipes, ducts, structural members, or other equipment. Any installation deviations from the contract requirements shall be corrected at no cost to Contracting Officer.

C. Provide raceway systems in accordance with the following:

1. In NEMA 1, NEMA 12, NEMA 3R, NEMA 4, and NEMA 4X areas, use Galvanized Rigid Steel (GRS) raceway systems.

2. Inside concrete slabs or walls, use PVC Schedule 40 raceway systems except where GRS has been indicated on the duct bank schedule.

D. All raceway systems shall be installed in accordance with the criteria described in this section. Any proposed deviations from these requirements shall be submitted to the Contracting Officer in writing for review and disposition.

1. Use Type 316 stainless steel support systems for exterior applications and in NEMA 4 and NEMA 4X areas.

2. All NEMA 1 areas shall use hot dipped galvanized steel support systems.

E. Aluminum conduit and boxes are not acceptable products.

F. All raceways shall be supported to NEC requirements and to meet all applicable seismic criteria. Raceways 2 inch (50 mm) outside diameter or greater shall be independently supported in a manner to meet the criteria to resist failure during earthquake events.

1.02 REFERENCES:

A. National Electrical Manufacturers Association (NEMA):

1. RN-1: Polyvinylchloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

2. TC-3: Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing

B. National Fire Protection Association (NFPA):

1. 70: National Electrical Code (NEC).

C. Occupational Safety & Health Act (OSHA).

1. Regulation 1910.7

D. Underwriter's Laboratories, Inc. (UL):

1. 1: Electrical Flexible Metal Conduit

2. 6: Rigid Metal Electrical Conduit

3. 94: UL Standard for Safety Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

4. 360: Electrical Liquid-Tight Flexible Steel

5. 651: Schedule 40 and 80 PVC Conduit

6. 1684: UL Standard for Safety Reinforced Thermosetting Resin Conduit (RTRC) and Fittings

1.03 SUBMITTALS:

A. Submit the following shop drawings in accordance with Section 01300:

1. Submit shop drawings and manufacturers' product data in accordance with the requirements of Section 16050.

1.04 QUALITY ASSURANCE:

A. Provide in accordance with Section 01400 and as specified.

B. Items provided under this section shall be listed and labeledby UL or other Nationally Recognized Testing laboratory (NRTL).

1. Term “NRTL” shall be as defined in OSHA Regulation 1910.7.

2. Terms “listed” and “labeled” shall be as defined in NFPA 70, National Electrical Code, Article 100.

C. Regulatory requirements:

1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.

1.05 SEISMIC DESIGN REQUIREMENTS:

A. It shall be the responsibility of manufacturer and supplier along with the Electrical Contractor to conform to the seismic design requirements for this project and for the work of this specification section.

B. Install supports for raceway systems greater than 2 inches (50 mm) in diameter to meet the seismic requirements indicated and specified.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Galvanized Rigid Steel Conduit:

1. Triangle/PWC, Inc.

2. Perma-Cote Industries.

3. Republic Steel Corporation.

4. Robroy Industries.

5. Allied Tube and Conduit.

B. Polyvinylchloride (PVC) Conduit:

1. Triangle/PWC, Inc.

2. Robroy Industries.

3. Carlon Electrical Sciences, Inc.

C. Flexible Conduit:

1. American Flexible Conduit Company.

2. Anamet, Inc.

3. Electri-Flex Company.

4. International Metal Hose Company.

5.

D. Boxes and Fittings:

1. O.Z./Gedney Company.

2. Crouse-Hinds Electrical Construction Materials.

3. Appleton Electric Company.

E. Fiberglass-Reinforced Polyester Boxes:

1. Crouse-Hinds Electrical Construction Materials.

2. Fibox.

3. Hoffman Engineering Company.

4. Vynckier Enclosure Systems.

F. Support Systems:

1. Michigan Hanger Co., (O-Strut).

2. Thomas & Betts (Superstrut).

3. Unistrut Corp.

2.02 MATERIALS AND COMPONENTS:

A. Rigid Metal Conduit:

1. Provide galvanized rigid metal conduit, each with a coupling on one end and thread protector on other end.

2. Hot-dip galvanize rigid steel conduit over entire length, along interior and exterior surfaces, including threads. Conduit shall conform to UL 6.

B. Flexible-Metal Conduit:

1. Provide flexible-metal conduit for use in dry areas and match fittings, size, and material to rigid conduit to which it is connected. Flexible-metal conduit shall conform to UL 1.

2. Provide liquid-tight flexible-metal conduit for use in damp areas consisting of flexible-metal conduit, with liquid-tight, sunlight-resistant jacket extruded over the conduit. Provide stainless steel, braided flexible conduit in NEMA 4 and NEMA 4X, corrosive areas. On larger than 1-1/4 inch (30 mm), furnish separate

external ground wire. Liquid-Tight flexible-metal conduit shall conform to UL 360.

C. Polyvinylchloride (PVC) Conduit:

1. Provide PVC conduit, Schedule 40 and Schedule 80 conforming to NEMA Standard TC-2 and UL-651.

2. Fittings and Conduit Bodies: NEMA TC 3 as recommended by the conduit manufacturer.

D. Boxes:

1. In NEMA 1, NEMA 12, and NEMA 3R areas, provide standard, sheet-metal, outlet and junction boxes constructed of code-gauge, galvanized sheet steel. Size each box as required by the Connecticut Electrical Code.

2. Provide boxes containing fixture studs for hanging fixtures. Use concrete-tight boxes for installation in concrete. Do not use shallow boxes unless building construction is such that it is impossible to use standard-depth boxes.

3. Provide cast boxes with covers or device plates suitable for the area classification. Use cover screws of stainless steel or high brass for iron boxes.

4. Provide polyvinylchloride boxes for use as junction boxes and provide high impact strength fiberglass-reinforced polyester boxes for use as device boxes, pull boxes, and terminal boxes for use with polyvinylchloride conduit. Size each box as required by the NEC.

5. In NEMA 4 and NEMA 4X areas, provide 316L stainless stel outlet and junction boxes. Size each box as required by the Connecticut Electrical Code.

E. Fittings:

1. Provide cast-iron fittings of malleable iron or a mixture of gray iron and cast steel.

2. Provide suitable expansion fittings where conduits cross expansion joints. Equip these fittings with grounding straps, clamps, and copper bonding jumpers.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Perform all work in accordance with the NEC.

B. Use no conduit less than 3/4-inch (20 mm) in diameter, unless otherwise indicated.

C. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's printed instructions.

3.02 SEISMIC RESTRAINTS:

A. For conduits and other raceways installed in open areas, not adjacent to and secured to structural elements, and 2 inch (50 mm) outside diameter or greater, support such raceways using seismic restraints rated for the applicable project earthquake criteria.

B. Methods of Restraining Raceways:

1. Utilize threaded rod with rod stiffeners and transverse channel braces at approximately 45 degrees angle, at 15 feet (4.5 m) on center, maximum, and on one side of rod support.

2. Utilize longitudinal bracing with channel braces at 30 feet (9.1 m) on center, maximum.

3. Strap raceways directly to transverse channel braces, using pipe strap with both ends of strap bolted into the channel brace.

4. Do not rigidly brace raceways to different parts of a building that may respond differently during an earthquake. Seismic restraints shall not limit expansion and contraction of the raceway support system.

5. Provide flexible connections for conduits 2 inch (50 mm) outside diameter or greater than when terminating to fixed equipment to prevent loss of raceway integrity in the event of an earthquake.

3.03 INSTALLATION OF FITTINGS:

A. Install expansion fittings wherever conduits cross structural expansion joints. Keep the fittings in line with conduit, and install with regard to temperature so that full working range of expansion is available.

B. Do not install fittings to replace elbows and pull boxes, unless space or other problems make use of fittings necessary. Use oversize fittings whenever large cable is installed, in order to maintain proper bending radius.

C. Terminate ends of all floor conduits installed for future use with couplings and readily removable plugs set flush with finished floor surface. Cap spare wall conduits at wall where they enter building.

D. Equip ends of all conduits with conduit fittings. Fit conduits terminating at power distribution equipment, or in box above or below, with grounding type bushings, or solidly ground by locknuts or other acceptable fittings. Connect each grounding bushing to ground bus by a bare or green-covered copper wire. Do not use ground wire smaller than 12 AWG. Install ground wire larger than 12 AWG when required by NEC. Where

conduits terminate in unprotected areas or where bonding is required over expansion joint, flexible conduit or equivalent; use ground wires 6 AWG. copper or larger.

E. Terminate conduits entering gasketed sheet-metal boxes or gasketed sheet-metal equipment enclosures with gasketed hubs.

F. Terminate conduits entering non-gasketed sheet-metal boxes or enclosures with double locknuts and insulated bushings, or with acceptable equivalent.

G. Join raceways with fittings listed for the purpose. Make joints tight. Use raceway fittings compatible with raceway and suitable for use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings, except as otherwise indicated.

1. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.

2. Use insulating bushings to protect conductors.

3. Tighten set screws of threadless fittings with suitable tool.

3.04 INSTALLATION OF RACEWAYS:

A. Install exposed raceways parallel or at right angles to walls and ceiling beams. Make all changes in directions with listed bends, elbows, and pull boxes. Space parallel runs uniformly throughout. Secure in place by hangers and fasteners. Ground raceways by connection to properly grounded enclosures, bonding, or other means, to obtain permanent low resistance path to ground throughout installation. Ensure that raceway sections in single run and in parallel runs are of same type and finish.

1. Run parallel or banked raceways together, on common supports where practical.

2. Install raceways level and square and at proper elevations.

B. Support raceways concealed above suspended ceilings from slab above ceiling in same manner as exposed raceways. Do not support raceways from ceiling supports.

C. Provide cast-in-place inserts in concrete to support all runs, unless otherwise permitted. Use stainless steel sleeve type concrete anchors for installing boxes, and conduit supports. Provide Type 316 stainless steel nut, bolts, and washers, for use with concrete anchors.

D. Support conduits by hangers or pipe straps spaced according to NEC, but in no case more than 10 feet (3 m) on centers.

E. Provide hot-dipped galvanized supports for galvanized conduit.

F. When specified on the Contract Drawings, install conduits in slabs as close to middle of concrete slabs as practicable without disturbing reinforcement. Do not use conduit with

outside diameter exceeding one-third of slab thickness. Do not place conduits closer than three diameters on centers, except at cabinet locations where slab thickness is increased as permitted by the Contracting Officer.

G. Where conduits are concealed in bottom floor slab, place in concrete slab and not in fill below slab. Install in middle third of the slab thickness where practical, and leave at least 4 inches (100 mm) of concrete cover.

1. Secure raceways to reinforcing rods and to prevent sagging or shifting during concrete placement.

2. Space raceways laterally to prevent voids in the concrete.

3. Run conduit larger than 1-inch (25 mm) trade size parallel to or at right angles to main reinforcement. When at right angles to reinforcement, place conduit close to slab support.

H. Stub-Up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs, and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit. Flexible metal conduit may be used 6 inches (150 mm) above the floor. Where equipment connections are not made under this Contract, terminate ends of floor conduits installed for future use with couplings and readily removable plugs 8 inch (250 mm) above finished floor surface. Cap spare wall conduits at wall entrance to building.

I. Provide sleeves passing through exterior walls and slabs which are wall entrance seals of watertight construction. For new construction, furnish watertight seal between slab and sleeve, and between sleeve and conduit or cable similar to O.Z./Gedney Type "FSK". For existing construction, furnish watertight seal for use in core bit drilled holes that provides seal between concrete and conduit or cable similar to O.Z./Gedney Type "CSM1". Use wall-entrance seals of malleable iron with watertight sealing gland which may be tightened any time after installation.

J. Do not use dissimilar metals in conjunction with each other. Use an insulation between adjoining surfaces so as to eliminate direct contact and any resultant electrolysis. Maintain electrical continuity of system. Use bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators or washers, or other acceptable materials as insulation.

K. Install fittings to match raceway being used.

L. Install expansion fittings wherever conduits cross structural expansion joints at connections between buildings. Keep fittings in line with conduit, and install with regard to temperature so that full working range of expansion is available.

M. Where conduits pass through firewalls, grout hole around the conduit to the full depth of the material penetrated.

N. Provide separate raceways for all low voltage instrumentation raceways (50 volts and below) from control and power raceways.

O. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely, and install the locknuts with dished part against the box; use two locknuts, one inside and one outside the box.

P. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.

Q. Install pull wires in all empty raceways. Use 14 AWG zinc-coated steel or monofilament plastic line having not less than 200 lb (890 N) tensile strength. Leave not less than 12 inches (300 mm) of slack at each end of the pull wire.

R. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot water pipes. Install horizontal raceway runs above water and steam piping.

S. Complete raceway installation before beginning conductor installation.

T. Use temporary closures to prevent foreign matter from entering raceway.

U. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.

V. Where metal conduits rise through floor slabs in wet areas, provide PVC Coated Rigid conduits for a distance of 6 inches (150 mm) above and below slab grade.

3.05 BENDS:

A. Make all bends carefully to prevent distortion of circular cross section. Field bend conduit shall have an inside radius of not less than nine diameters.

B. Where bends of less than nine diameters are necessary, use standard factory elbows. Size conduit to permit cable-bending radius within the factory elbow of at least eight times cable diameter.

C. Allow no conduit greater than 50 feet (15.2 meters) to have more than two 90 degree bends or equivalent thereof between pulling points. For conduits less than 50 feet (15.2 meters) in length, allow only three 90 degree bends between pulling points.

3.06 CUTTING, THREADING AND CONNECTING:

A. Make all field cuts in conduits squarely, file cut ends, ream to remove rough edges and thread in accordance with NEC. No running thread permitted. Make all connections mechanically strong and tight, and with acceptable connectors. Where conduit surface

coating is damaged or removed in the cutting, threading or reaming process, restore the surface to its original condition.

3.07 CONDUIT CLEANING:

A. Clean all conduit carefully before and after installation, ream ends free of burrs, and free inside surfaces from all imperfections likely to injure cable.

B. After installation of each complete new conduit run, snake the run with band to which is attached a tube cleaner with cylindrical mandrel of a diameter not less than 85 percent of nominal diameter of conduit. Remove and replace all conduit through which mandrel will not pass.

C. Use a sponge with steel brush to clean steel conduit and use a sponge with nylon brush to clean PVC conduits.

D. After cleaning, protect ends of all conduit with standard caps to prevent entrance of water, concrete, debris, or other foreign substance.

3.08 CONDUIT DRAINAGE:

A. Where practicable, pitch conduit to drain to outlet boxes, or install so as to avoid trapping moisture. Where dips are unavoidable in exposed conduits, install fitting with drain hole at low point.

3.09 INSTALLATION OF BOXES:

A. Unless otherwise indicated, install sheet metal boxes only in dry, accessible locations. Install cast-metal boxes in exterior concrete or masonry walls, in floor slabs, in basements, all other below grade locations and elsewhere as indicated. Cast metal boxes shall be used (unless otherwise indicated) where vapor-tight fixtures are required, for all surface mounting of wall switches and receptacles and for all outdoor use. Install pull boxes for motor control centers and large ceiling hung boxes where indicated.

B. Install boxes in conformance with all the requirements of NEC. Install boxes designed for type of construction involved. Support boxes in same manner as required for conduit. Size boxes to provide bending radius for wire or cable of at least eight times diameter or in accordance with NEC, whichever is larger.

C. Center all outlets in panels, or spaces and adjust to structural finish. Where specific locations are not indicated, locate outlets with respect to equipment served.

D. Place all outlet boxes, junction boxes and pull boxes, in accessible locations when they are installed above or behind plastered ceilings, furred spaces, or suspended ceilings. Install access panels of suitable size. Mark all access panels for all boxes so panels can be readily located in future. Mark, using metal tabs or plastic buttons which cannot mark ceilings or walls, appropriate for type of construction being used.

E. Assemble cast-metal boxes with threaded conduit hubs in such manner that conduit connections and gasketed covers are watertight. Close all unused threaded openings with pipe plugs and compound.

F. Provide cast boxes with covers and device plates suitable for the area classification. Install screws of stainless steel or high brass for iron boxes.

3.10 FLEXIBLE CONNECTIONS TO MOTORS AND EQUIPMENT:

A. At all motors and electrically operated equipment to which conduit connections are made, install with a complete connection between end of conduit and terminal box of motor or other equipment.

B. Install the conduits in locations permitting direct connection to motors.

C. Make connections between rigid raceway and motor or equipment subject to vibration and adjustment using flexible conduit. Make each connection with at least one quarter bend so that no vibration can be transmitted beyond flexible connection.

D. Install flexible metal conduit, fittings, and accessories in dry areas in accordance with requirements of NEC.

E. Install liquid-tight flexible metal conduit in damp and corrosive areas. Locate conduit to reduce the possibility of damage to the exterior coating. Use fittings that screw into flexible conduit and provide gaskets.

F. Use maximum of 6 feet (2 m) of flexible conduit for recessed and semirecessed lighting fixtures and; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquid tight flexible conduit in wet or damp locations. Install liquid-tight flexible metal conduit in areas subject to wetting due to fire protection sprinklers or broken or ruptured water line. Locate conduit to reduce the possibility of damage to the exterior flexible conduit jacket. Use fittings that screw into flexible conduit and provide gaskets. Install separate ground conductor across flexible connections.

3.11 TELEPHONE RACEWAY INSTALLATION:

A. Install conduit system between all telephone outlets, terminal boxes, and cabinets. Provide pull cable and leave in conduit for telephone system cable.

B. Telephone and Signal System Raceways: Install in maximum lengths of 150 feet (60 m) and with a maximum of two 90 degree bends or equivalent. Install pull or junction boxes to comply with these requirements. Route signal system raceways a minimum of 12 inch (300 mm) separation from power raceways.

3.12 PROTECTION:

A. Provide protection and install in accordance with manufacturer printed instructions. The conduit and raceway equipment manufacturers, to ensure that coatings, finishes, and enclosures are without damage or deterioration at completion of project.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC or paint finishes with matching touch-up coating recommended by the manufacturer.

3.13 FINAL SYSTEM ACCEPTANCE:

A. Upon completion of installation of system, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions and at no additional cost to the Contracting Officer.

B. Label all raceways and boxes in accordance with the requirements of Section 16050.

3.14 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 16120

ELECTRIC WIRES AND CABLES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide wires and cables for complete electrical systems as indicated and specified.

1.02 REFERENCES:

A. American Society for Testing and Materials International (ASTM):

1. B3: Soft or Annealed Copper Wire.

2. B8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

3. B33: Tinned Soft or Annealed Copper Wire for Electrical Purposes.

B. Insulated Cables Engineers Association, Inc. (ICEA)/National Electrical Mfg's Association (NEMA):

1. S-61-4021/WC 5: Thermoplastic Insulated Wire & Cable.

2. S-66-524/NEMA WC 7; Cross-Linked-Thermosetting-Polyethylene Insulated Wire and Cable.

3. S-68-516/WC 8: Ethylene-Propylene-Rubber-Insulated Wire & Cable.

C. National Fire Protection Association (NFPA):

1. 70: National Electrical Code (NEC).

D. American National Standards Institute (ANSI)/Telecommunications Industry Association (TIA)/Electronic Industries Association (EIA):

1. ANSI/TIA/EIA-568-B; Commercial Building Telecommunications Cabling Standards.

E. Underwriters Laboratories, Inc. (UL):

1. 44: Thermoset-Insulated Wires and Cables.

2. 83: Thermoplastic-Insulated Wires and Cables.

3. 854: Service Entrance Cables.

1.03 SUBMITTALS:

A. Submit the following shop drawings in accordance with Section 01300:

1. Submit shop drawings and manufacturer's product data for all cables, terminations, terminal blocks, lugs, connectors, fire proofing tape, identification tags, etc. in accordance with the requirements of Division 16, Section 16050.

2. Submit the following data for fire stop material:

a. Manufacturer’s Listed Systems Designs.

b. Manufacturer’s Product Data Sheets.

c. Manufacturer’s Materials Safety Data Sheets.

d. Manufacturer’s printed instructions for installation on each proposed product. Identify where each material will be used at the project site.

e. Manufacturer’s prefabricated devices providing descriptions for identification at the project site.

3. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.

a. Failure to include a copy of the marked-up specification sections will result in rejection of the entire submittal without further review and consideration until the marked-up specifications are re-submitted with the entire package.

1.04 DELIVERY STORAGE AND HANDLING:

A. Comply with the requirements specified in Section 01610.

B. Deliver wire and cables in full reels protected against injury. Deliver reels with factory attached UL approved tags showing the manufacturers name and the type of insulation, size, and length of wire in each coil or reel.

C. Accept wire and cable on site in manufacturer's packaging. Inspect for damage.

D. Store and protect in accordance with manufacturer's instructions.

E. Protect from weather. Provide adequate ventilation to prevent condensation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. 600V Cable:

1. Okonite.

2. Southwire.

3. American Insulated Wire.

B. Control and Metering Wire:

1. Belden Wire and Cable.

2. Alpha Wire.

3. Coleman Cable.

2.02 MATERIALS AND COMPONENTS:

A. Furnish copper conductors. Material and stranding of conductors to conform to ASTM B3, ASTM B33, and to ASTM B8, for the appropriate class.

B. Uncoated, soft or annealed copper wire conforming to ASTM B3.

C. Wires and Cables for Maximum 600-Volt Power Circuits: For No. 8 AWG gauge and smaller provide type THWN/THHN. Where used in lighting or receptacle branch circuits provide No. 12 AWG gauge and No. 10 AWG gauge as solid conductor. Provide other wire with Class C stranding. Provide No. 6 AWG gauge and larger as XHHW-2 with Class B stranding. Provide wires and cable conforming to UL 83.

D. Wires and Cables for Control, Indicating, Metering, or Alarm Circuits: Single and multi-conductor control cable, copper conductors, Class B or C stranding. Insulation; 600-volt polyethylene, polyvinylchloride, or EPR. Continuous rating of 90C dry and 75C wet. Color coding conforming to Table K-2, ICEA/NEMA S-61-4021/WC 5.

E. Shielded Cable for Instrumentation Wiring: 7-strand copper conductors, size No. 16 AWG. Insulate conductors individually with color coded polyethylene or polyvinylchloride. Twist pairs with varying lay (if more than one pair) and cover with cable tape and copper or aluminum coated Mylar shielding tape and tinned copper drain wire. Jacket: polyvinylchloride. Cables: rated 600 volts and 90 degrees C.

F. Category 5e Cable: Category 5e cable shall consist of 4 twisted pairs of different lay and ground wires, enclosed by an overall conductive mylar backed aluminum foil shield. This shall be enclosed by an overall thermoplastic jacket. The cable shall meet the applicable requirements of ANSI/TIA/IEA-568-B.

PART 3 - EXECUTION

3.01 GENERAL:

A. Perform work in accordance with the National Electrical Code.

B. Provide power cable identification as follows:

System Voltage	Neutral	Phase A	Phase B	Phase C
208/120V	White Black	Red	Blue	
240/120V	White- Gray Stripe	Black- Blue Stripe	Red- Blue Stripe	None
480/277V	Gray	Brown	Orange	Yellow

C. Use green to identify insulated ground conductors.

NOTE: Colored insulation, tapes or sleeves may be used to provide color coding. Insulated ground conductors must have green covering.

D. Permanently post means of identification of grounded and ungrounded conductors for each nominal voltage system at each panelboard and motor control center.

E. In power and multiconductor cables manufactured without a grounding conductor identify one of the multiconductors as the equipment grounding conductor at each cable end and at every point where the conductors are accessible.

3.02 INSTALLATION OF WIRING:

A. Unless otherwise indicated, use no conductor smaller than No. 12 AWG for power, No. 14 AWG for control, and No. 16 AWG for shielded applications.

B. Install conductors continuous from outlet to outlet and make no splices except within outlet or junction boxes.

C. Install cable in underground raceway system without splices. There shall be no splices between connection points unless otherwise indicated.

D. Draw all conductors contained within a single conduit at the same time.

E. Apply wire pulling compound to conductors being drawn through conduits. Use pulling compound, Minerallac No. 100, Y-er-Eas, Yellow 77, High Performance Polywater Cable Lubricant or acceptable equivalent.

F. Use no cable bend with radius of less than eight times its diameter.

G. Wires and cables installed without prior submittal review are subject to removal at no additional expense.

3.03 CONDUCTOR IDENTIFICATION:

A. Label each wire at both termination points. Carry individual conductor or circuit identification throughout, with circuit numbers or other identification clearly stamped on terminal boards and printed on directory cards in distribution cabinets and panelboards.

B. Identify each wire in junction boxes, cabinets, and terminal boxes where total number of control, indicating, and metering wires is three or more and no terminal board is provided, including all power wire. Where no termination is made use a plastic-coated, self-adhesive, wire marker and where termination is made use a, plastic, pre-printed sleeve wire marker.

C. In cases similar to above where terminal boards are provided for the control, indicating, and metering wires, identify all wires including motor leads and other power wires too large for connection to terminal boards, by sleeve wire markers as specified above.

D. In manholes and handholes, identify each power wire by laminated plastic tag located so it is easily seen. Control wires to be bundled and marked as listed in conduit and wire schedule.

3.04 CONNECTORS, TERMINAL LUGS AND BOARDS:

A. For wiring of circuits consisting of No. 10 or No. 12 AWG solid wires, such as for lighting branch circuits, use self-insulated pressure type connectors for all splices or joints.

B. Terminate all wires connected to terminal boards, terminal blocks, or to other similar terminals by means of ring and tongue, nylon self-insulated, tin-plated copper pressure terminals.

C. Terminal boards shall be 600 volts and rated for 125 percent of the ampacity of the connected circuit. They shall have screw terminals, with white marking strips for wire identification, of the 4-, 6-, 8-, or 12-pole type, as necessary.

D. Wire connections for which terminals are not supplied, for example, at solenoids or motor terminal junction boxes:

1. 10 AWG and smaller: Use self insulated pressure-type connectors.

2. 8 AWG and larger: Use insulated, mechanical type with set screw or follower bearing directly on the wire. Split bolt connectors are not acceptable.

E. Clearly and permanently mark terminal strips with ink or indelible pencil. Mark each wire consistently throughout entire system, using notation of wires given on manufacturer's wiring diagrams wherever possible.

3.05 FIELD TESTING:

A. Field test wires as specified herein in accordance with Section 16998.

B. Submit results of all cable tests on forms indicating cable size, voltage, and date with name of tester and witness.

3.06 CONTRACT CLOSEOUT:

A. Provide in accordance with Section .

END OF SECTION

SECTION 16160

PANELBOARDS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide panelboards rated 600 volts or less and 1200 amperes or less.

B. Provide with circuit breakers and cabinets complete, as indicated and specified.

C. Surge Protection Devices (SPD) shall be integral to the panelboard cabinet. SPDs shall be as specified in Section 16400.

1.02 REFERENCES:

A. Federal Specifications (FS):

1. QQ-S-365B: General Requirements for Silver Plating, Electro Deposited

2. W-C-375B: Automatic Circuit Breakers.

3. W-P-115A: Panel, Power Distribution.

B. National Electrical Manufacturers Association (NEMA):

1. 250: Enclosures for Electrical Equipment (1000 volts maximum)

2. AB 1: Molded Case Circuit Breakers

3. PB 1: Panelboards

C. National Fire Protection Association (NFPA):

1. 70: National Electrical Code (NEC)

D. Underwriter's Laboratories, Inc. (UL):

1. 50: Cabinets and Boxes

2. 67: Panelboards

3. 86A: Wire Connectors and Soldering Lugs for Use with Copper Conductors

4. 489: Circuit Breakers, Molded Case and Circuit Breaker Enclosures

1.03 SUBMITTALS:

A. Submit shop drawings and manufacturer's product data in accordance with requirements of Section 16050.

B. Submit time current characteristic curves, short circuit rating, and data for each circuit breaker type and rating.

C. Submit the following for Mini Power Centers:

1. Dimension drawing and Weights

2. Transformer ratings including:

a. kVA

b. Primary and secondary voltage

c. Taps

d. Primary and secondary continuous current

e. Insulation class and temperature rise

f. Sound level

3. Component ratings including:

a. Voltage

b. Continuous current

c. Interrupting ratings

4. Cable terminal sizes

5. Product data sheets

6. Connection diagrams

7. Installation information

D. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check marked to indicate specification compliance.

1. Failure to include copy of the marked-up specification section will result in return of the entire submittal without further review and consideration until the mark-up specification are re-submitted with the entire package.

1.04 QUALITY ASSURANCE:

A. Provide in accordance with Section 01400 and as specified.

B. All panelboards shall be designed, manufactured and assembled in accordance with the referenced standards.

C. Listing and Labeling: All panelboards shall be listed and labeled by Underwriter's Laboratories, Inc. (UL), or other nationally-recognized testing laboratory (NRTL).

D. Service Entrance panelboards shall be UL/NRTL-labeled as suitable for that purpose.

E. Single-source Responsibility: Provide panelboards products that are new, and from the same manufacturer for each building or job. Panelboard components shall be from the same manufacturer, or listed as an assembly thereof.

PART 2 - PRODUCTS

2.01 PANELBOARD MANUFACTURERS:

A. Manufacturers acceptable contingent upon products' compliance with the specifications:

1. Eaton Cutler-Hammer Products.

2. General Electric Company.

3. Schneider Square D.

4. Or Equal.

2.02 PANELBOARDS:

A. Factory assembled deadfront type panelboards.

B. Furnish panelboards complete with main and branch circuit breakers.Only provide main lugs only if indicated.

C. Furnish panelboards with full capacity separate ground bus, separate insulated neutral bus and furnish panelboards connected to a 3 phase, 4 wire service or single phase, 3-wire service as indicated.

D. Provide panelboards with the voltage, frequency and current ratings as indicated conforming to NEMA Standard PB1, Federal Specification W-P-115A. U.L. 67, and the NEC.

E. Furnish the panelboard main and neutral buses, with minimum 98 percent conductivity tinned copper bus provided with bolted type lugs as necessary.

F. Drill buses to fit either "A", "B" or "C" Phase connectors, and ensure that connectors are inter-changeable and installed in a distributed phase sequence.

G. Prevent terminal lugs from turning per NEMA standard PB 1 and ensure they are suitable for the conductor material and size.

H. Provide main bus-bracing for each panel board adequate for 10,000 amperes symmetrical short circuit at 240 or 208 volts and 65,000 amperes symmetrical short circuit at 480 volts.

I. Where the word “space” occurs on panel schedules, provide all necessary hardware in the space, including connection straps, mounting brackets, and filler plates so that only the addition of a future circuit breaker is required. Panelboard connection straps shall be rated a minimum of 100A.

J. Provide integral Surge Protection Devices (SPD) in accordance with Section 16400 where indicated on the drawings.

K. Provide dry contacts for remote indication as indicated on the contract drawings.

2.03 CIRCUIT BREAKERS:

A. Each circuit breaker shall be bolted into position in the panelboard, whether by direct bolted connection to the bus or by being bolted to the panelboard frame. Each circuit breaker shall be replaceable without disturbing adjacent units. Plug-on circuit breakers held in place only by spring force of the bus lug and the pressure of the deadfront are not acceptable.

B. Furnish frame sizes, trip settings and number of poles as indicated. Clearly and visibly mark circuit breakers with ampere trip rating. Furnish breakers meeting the requirements of F.S. W-C-375B and NEMA AB1.

C. Furnish all breakers with quick-make, quick-break, toggle mechanisms and thermal-magnetic, inverse time-limit overload and instantaneous short circuit protection on all poles, unless otherwise indicated. Automatic tripping indicated by the breaker handle assuming a clearly distinctive position from the manual ON and OFF position. Furnish breaker handle that is trip-free on overloads.

D. Do not use single pole breakers with handle ties or bails in lieu of multi-pole breakers.

E. For each panelboard, furnish quantity four handle lock devices for individual breakers to prevent the manual opening of the selected breakers. Turn devices over to Contracting Officer at completion of the project work.

F. Ensure that voltage and interrupting rating of all breakers in a panelboard is not less than voltage and short circuit rating of the panelboard main buses, as indicated. Furnish breakers suitable to operate satisfactorily at the frequency indicated.

G. Furnish ground fault interrupter (GFI) circuit breakers for certain circuits as indicated on the drawings.

H. Furnish single pole breakers with full module size. Do not install two pole breakers in a single module.

I. Furnish time-current characteristic curves and catalog information and data for each size of breaker furnished.

2.04 CABINETS:

A. Provide cabinets with NEMA enclosure type in accordance with the area classification schedule and without knockouts. Drill cabinets only for the exact conduit entrances and mounting bolts.

B. Finish cabinet fronts, trims and surface-mounted boxes in ANSI No. 61 or 49, light-gray enamel over a rust-inhibitive primer. Attach the fronts (exterior trims) to the boxes or interior trims, by quarter-turn, indicating trim clamps. Design cabinets for surface or flush mounting as indicated.

C. Unless otherwise specified, construct panelboard cabinets of code-gauge galvanized, sheet steel and equip with gutters of ample size for the risers and outgoing circuits. Ensure that the cabinets do not exceed 78 inch in height.

D. Trims for branch circuit panelboards shall be supplied with a hinged door over all circuit breaker handles. Doors in panelboard trims shall not uncover any live parts. Doors shall have a semi flush cylinder lock and catch assembly. Door-in-door trim shall be provided. Both hinged trim and trim door shall utilize three point latching. No tools shall be required to install or remove trim. Trim shall be equipped with a door-actuated trim locking tab. Equip locking tab with provision for a screw such that removal of trim requires a tool, at the Contracting Officer's option. Installation shall be tamper resistant with no exposed hardware on the panelboard trim.

2.05 MINI POWER CENTER:

A. The Contractor shall furnish and install three-phase general purpose individually mounted mini-power center of the two-winding type, self-cooled, as specified herein and as shown on the contract drawings.

B. The mini-power center and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of UL, ANSI and NEMA.

C. Operation and Maintenance Manuals

1. Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

D. Ratings

1. kVA and voltage ratings shall be as shown on the drawings.

2. Units shall be designed for continuous operation at rated kVA, for 24 hours a day, 365 days a year operation, with normal life expectancy as defined in ANSI C57.96.

3. Transformer sound levels shall not exceed the following ANSI and NEMA levels for self-cooled ratings:

   Up to 9 kVA 40 db
   10 to 30 kVA 45 db

E. Construction

1. Each mini-power center shall include a primary main breaker, an encapsulated dry-type transformer, and a panelboard with secondary main breaker.

2. Primary main, secondary main, and feeder breakers shall be enclosed with a padlockable hinged door.

3. Mini-power centers shall be suitable for service entrance application and labeled as such.

4. Insulation Systems

   a. Transformers shall be insulated with a 180 degrees C insulation system and rated at 115 degrees C temperature rise.

   b. Required performance shall be obtained without exceeding the above-indicated temperature rise in a 40 degrees C maximum ambient, with a 30 degrees C average over 24 hours

   c. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635

5. Core and Coil Assemblies

   a. Transformer core shall be constructed with high-grade, non-aging, silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10% above the nominal tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical grade copper with continuous wound construction.

   b. The core and coil assembly shall be completely encapsulated in a proportioned mixture of resin and aggregate to provide a moisture proof,

shock-resistant seal. The core and coil encapsulation system shall minimize the sound level.

c. The core of the transformer shall be grounded to the enclosure

d. Provide two (2) 5% FCBN taps.

F. Bus

1. Secondary bus shall be copper.

G. Wiring/Terminations

1. All interconnecting wiring between the primary breaker and transformer, secondary main breaker and transformer and distribution section shall be factory installed.

2. All transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring.

H. Main devices

1. Each mini-power center shall include a primary main breaker with an interrupting rating of 65kA at 277/480 volts; and a secondary main breaker with an interrupting rating of 10kA at 120/208 volts, and a panelboard.

I. Feeder Devices

1. The secondary distribution section shall accommodate one-inch bolt-on breakers with 10 kA interrupting capacity.

J. Enclosure

1. The enclosure shall be made of heavy-gauge steel and the maximum temperature of the enclosure shall not exceed 90 degrees C.

2. The enclosure shall be totally enclosed, nonventilated, NEMA 3R, with lifting provisions.

2.06 FACTORY TESTING:

A. Standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.

B. Mini Power Center:

1. Ratio tests at the rated voltage connection and at all tap connections

2. Polarity and phase-relation tests on the rated voltage connection

3. Applied potential tests

4. Induced potential tests

5. No-load and excitation current at rated voltage on the rated voltage connection

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Mount panelboards, plumb and rigid without distortion of the box. Mount such that the height of the top operating handle does not exceed 6 feet 7 inches from the floor.

B. Hang each door of the cabinet on semi- or fully-concealed hinges with a combination catch and lock.

C. On cabinets 48 inches high and over, install a 3 point catch assembly latching at top, bottom and approximate middle.

D. Verify all panelboard locks are keyed alike.

E. Provide typed directory card filled-out to clearly indicate the load served.

F. Door hinge to be on the side opposite escape route if applicable.

G. Install Mini Power Center in accordance with the manufacturer's recommended requirements and the Contract Drawings.

3.02 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 16220

ELECTRIC MOTORS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Low voltage electric motors and accessories, furnished under other Sections, and which are a part of equipment assemblies shall be in conformance with the requirements specified in this Section, unless otherwise noted. This section includes performance, and descriptive type specifications.

B. Unless otherwise specified or approved, all electric motors furnished and installed shall conform to the requirements specified herein.

1. Motors connected to Variable Frequency Drives shall be inverter duty rated in accordance with the requirements of NEMA MG-1.

2. Motors shall be premium efficient type per NEMA MG-1.

1.02 RELATED WORK:

A. Division 11: Equipment

B. Division 15: Mechanical

C. Section 16050: Electrical Work – General

D. Section 16260: Low Voltage Variable Frequency Drives

E. Section 16450: Grounding

F. Section 16998: Field Inspection and Acceptance Tests

1.03 REFERENCES:

A. Institute of Electrical and Electronics Engineers (IEEE).

1. 85: Test Procedures for Airborne Sound Measurements on Rotating Electric Machinery.

2. 112: Test Procedures for Polyphase Induction Motors and Generators.

3. 841: Service Duty Totally Enclosed Fan Cooled (TEFC) Squirrel Cage Induction Motors.

B. National Electric Manufacturer's Association (NEMA):

1. MG-1: Motors and Generators.

2. WP-1: Enclosed Electric Motor.

C. National Fire Protection Association (NFPA):

1. 70: National Electrical Code (NEC).

D. Connecticut Electrical Code

E. Underwriters Laboratories, Inc. (UL)

F. American Bearing Manufacturers Association (ABMA)

G. American National Standard Institute (ANSI)

1.04 SUBMITTALS

A. Shop drawings: Submit the following in accordance with Section 01300.

B. Submit shop drawings and manufacturers' product data in accordance with the requirements of Section 16050.

C. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.

1. Failure to include a copy of the marked-up specification sections will result in return of the entire submittal without further review until marked-up specification are resubmitted with the entire package.

D. Submit motor data with the associated driven equipment submittals.

1. Descriptive literature and motor characteristics.

2. Shop drawings and descriptive data to include:

a. Complete list of all motors to be furnished.

b. Outlines, dimensions, weights, and wiring diagrams.

c. Location of main and accessories boxes with size of conduit entrance.

d. Efficiency and power factor at 1/2, 3/4 and full load.

e. Bearing design data and grease requirements.

f. Nameplate data.

g. Shop test report.

h. Field acceptance test report.

i. Full load current.

j. Strip heaters KW and voltage ratings.

k. Built in overload protection device.

l. Starting restrictions, acceleration time-current curve of motor starting load.

m. Horsepower versus current curves.

n. Motor thermal limit or damage curves.

o. Service factor.

p. All motor data use in Section 16359 submittals of electrical system studies.

3. Submit Pump, Motor and VFD Coordination Certificate.

4. Submit certified copies of all factory shop test results.

5. Submit list of recommended spare parts and mainteneance tools for each type of motor.

1.05 QUALITY ASSURANCE

A. Provide in accordance with Section 01400 and as specified.

B. Motors to comply with the latest reference standards specified.

C. Routine tests shall be performed on representative motors, and shall include the information described on NEMA MG1-12.54 Report of Test Form for Routine Tests on Induction Motors. Efficiency shall be determined in accordance with IEEE Publication No. 112, Method B. Power factor shall be measured on representative motors.

1.06 STORAGE AND HANDLING

A. Provide in accordance with Section 01610 and as specified.

B. Storage:

1. Inspect and inventory items upon delivery to site.

2. Store and safeguard equipment and material as recommended by equipment manufacturer.

3. Protect motors from moisture at all times.

PART 2 - PRODUCTS

2.01 MOTOR MANUFACTURERS:

A. General Electric Company.

B. Reliance Electric.

C. U.S. Motors.

2.02 ELECTRIC MOTOR RATINGS:

A. Voltage Ratings:

1. Unless otherwise specified, motors with ratings of 1/2 to 350 hp (0.37 to 261kW) shall be rated 460-volt (nameplate rating), three-phase, 60-Hertz; motors of 1/3 hp (0.25 kW) or less to be rated 115-volt, single-phase, 60 Hertz.

B. The following specific motor requirements shall be in the equipment specifications:

1. RPM.

2. Motor enclosure type.

2.03 MOTOR REQUIREMENTS:

A. Every motor shall be of sufficient capacity to operate the driven equipment under all load and operating conditions without exceeding its rated nameplate current or power or its specified temperature limit at rated voltage. Each motor shall develop ample torque for its required service throughout its acceleration range at a voltage 10 percent below nameplate rating. Where indicated on the electrical drawings to be operated on a

reduced voltage starter, the motor shall develop ample torque under the conditions imposed by the reduced voltage starting method.

B. The motor shall have sufficient capacity to operate the driven equipment as given in the equipment detail specifications. The motor shall not be required to deliver more than its rated nameplate horsepower, at unity (1.0) service factor, under any condition of mechanical or hydraulic loading.

C. Type of Motors:

1. All motors shall be NEMA Design B or of a type having starting characteristics and ruggedness as may be necessary under the actual conditions of operation and, unless otherwise specified, shall be suitable for full-voltage starting.

D. Insulation:

1. All motors shall have Class B (fractional horse power only) and Class F insulation for all other size motors.

2. Insulation systems shall be manufacturer's premium grade, resistant to attack by moisture, acids, alkalies and mechanical or thermal shock for 480 volt motors. Provide 80 degrees C, Class B rise or better by resistance at 100 percent load and provide a Class F insulation system, suitable for an ambient temperature motor operation of 0 to 40 degrees C at no more than 3,300 feet (1,000 m) above sea level for inverter duty motors. This temperature rise shall be met when motors are operated and controlled with the VFD(s). The motor insulation system shall have full capability to handle the common mode voltage conditions imposed by the VFD.

3. Insulation for inverter duty motor windings shall meet or exceed the Pulse Endurance Index for magnetic wire and shall not be injured when exposed to repeated pulse type waveforms, repetitive high voltage transients, switching frequency and rate of rise of the pulse. Class H varnish shall be used.

E. Enclosures:

1. Motors shall have a steel or cast iron frame and a cast iron or stamped steel conduit box, as specified below. Conduit box shall be split from top to bottom and shall be capable of being rotated to four positions. Synthetic rubber-like gaskets shall be provided between the frame and the conduit box and between the conduit box and its cover. Motor leads shall be sealed with a non-wicking, non-hygroscopic insulating material. A frame mounted pad with drilled and tapped hole, not less than 1/4-inch (6 mm) diameter, shall be provided inside the conduit box for motor frame grounding.

2. Totally Enclosed, Fan-Cooled: TEFC Motors shall have a TEFC enclosure with a steel or cast iron frame, cast iron end brackets, cast iron conduit box, 1.15 service factor at 40 degrees C, tapped drain holes (corrosion resistant plugs for frames 286T and smaller and automatic breather/drain devices for frames 324T and larger) and upgraded insulation by additional dips and bakes to increase moisture resistance.

3. Totally enclosed non-ventilated: TENV motors shall include the same rating and accessories as specified for TEFC motors.

F. Special Purpose Motors:

1. Chemical duty motors shall be provided with severe duty rating. Motors shall be of the corrosion resistant type conforming to motors designated by the manufacturer as Corro-Duty, Mill and Chemical, Custom Severe Duty, or similar quality designation. Severe duty motors shall have a cast iron frame, cast iron end brackets, cast iron conduit box and 1.15 service factor at 40 degrees C and tapped drain holes (corrosion resistant plug for frames 286T and smaller and automatic breather/drain devices for frames 324T and larger).

2. Hermetically sealed air conditioning units, elevators, hoists, cranes and other devices complying with special safety codes shall be furnished with motors, control equipment, accessories and safety devices for approved, safe, and efficient operation, in accordance with the manufacturer's standards and to be rated for the duty cycle as specified for the driven equipment. Minimum service factor 1.15 above 3 hp.

3. Inverter duty rated: Motors for operation on variable frequency drives shall meet current power quality levels published in NEMA MG1, Part 31. Enclosures shall be equal to those furnished for severe duty or explosion proof motors. Motor shaft and bearings shall be insulated. Internal service factor shall be 1.15 that of the nameplate. Ventilation system shall be designed for maximum heat transfer. Stator laminations shall be stagger-stacked and stamped from high grade electrical steel to minimize eddy-current losses and heat build-up caused by inverter induced harmonics. Rotors shall be configured to minimize skin-effect heating.

G. General:

1. Motors shall comply with the latest NEMA Standards Publication No. MG1 for Motors and Generators, unless otherwise specified.

2. Bearings shall be of the self-lubricating type, designed to ensure proper alignment of rotor and shaft and to prevent leakage of lubricant.

   a. Bearings for open motors shall be of the sleeve or ball type, as specified under the respective items of mechanical equipment.

   b. Bearings for totally enclosed and explosionproof motors shall be of the ball type.

   c. Bearing minimum L-10 fatigue life in hours at 100 percent load shall be 50,000.

   d. Bearing grease shall be of the 120 degrees C thermal capability type.

3. Vertical motors shall be provided with thrust bearings adequate for all thrusts to which they can be subjected in operation.

4. All three phase two speed motors shall be of the two-winding design.

5. All three phase motors shall be provided with a 1.15 service factor.

6. All VFD driven motors shall be provided with isolated bearings and motor shaft grounding rings.

7. Three phase motors shall be of cast iron construction including frame and end brackets.

8. Totally enclosed motors shall be provided with automatic breather and drain

9. Motor nameplates shall be stainless steel.

10. Motor Terminal Boxes and Leads:

    a. Motors shall be furnished with oversize conduit terminal boxes to provide for making and housing the connections, and with flexible leads of sufficient length to extend for a distance of not less than 4 inches beyond the face of the box. The size of cable terminals, and terminal box conduit hoses shall be as permitted by the Contracting Officer. An acceptable type of solderless lug to be furnished. Totally enclosed and explosionproof motors to have cast-iron terminal boxes.

    b. A grounding terminal shall be provided in the main terminal box and a bronze grounding bolt to be furnished at the conduit side of the motor frame.

H. Motor Efficiencies:

1. Three phase motors rated 1 hp (0.75 kW) and larger shall be of the premium efficiency, "Design E", type per Table 12.1 of NEMA MG1 Part 12. Motors shall have a NEMA Nominal Efficiency not less than the values referenced in NEMA MG1. Efficiency values shall be based on tests performed in accordance with IEEE Publication No. 112, Method B. Motors with horsepower or rpm's not listed shall conform to comparable standards of construction and materials as those for listed motors.

I. Shop Painting:

1. Unless otherwise specified, motors shall be given a shop application of paint filler or enamel sealer, a flat coat of undercoater for enamel, and two coats of enamel or, in lieu of this treatment, other corrosion-resistant treatment customary with the manufacturer.

J. Motor Data:

1. Provide five certified copies of characteristic curves of each motor furnished, except 115-volt motors. Curves shall be supplied as a part of the driven equipment submittal.

K. Motor Shop Tests:

1. Motor shop tests shall be made in accordance with the IEEE Test Codes as specified in the NEMA MG1 Standards for Motors and Generators. NEMA report-of-test forms to be used in submitting test data.

2. Motor efficiency shall be determined by use of IEEE Standard 112 Test Method B, and by use of MGI-12.53 a and b.

3. For induction motors larger than 5 HP, up to and including 50 HP copies of routine tests reports of electrically duplicate motors shall be furnished.

L. Spare Parts:

1. Furnish one spare bearing of each type for each motor size and type.

2. Provide recommended spare parts list.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. After motor installation but before connection to power wiring, test motor winding insulation in accordance with the applicable Division 16 requirements.

B. After connection to power wiring, check for operating temperature, correct rotation, vibration, alignment and operating current drawn under load.

3.02 TESTING

A. Inspect physical and mechanical condition.

B. Inspection for correct anchorage, mounting, grounding, connection and lubrication.

C. Verify tightness of accessible bolted electrical connectioned by calibrated torque-wrench method in accordance with manufacturers published data.

D. Verify the asbsense of unusual mechanical or electrical noise or signs of overheating during initial test run.

E. Submit all motor test results for review and record.

F. Provide testing in accordance with Section 16998.

3.03 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 16260

LOW VOLTAGE VARIABLE FREQUENCY DRIVE UNIT

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide complete active front end, solid state AC to AC inverter type variable frequency drive (VFD) units with IGBT (Insulated Gate Bipolar Transistors) and appurtenances including drive reactors, DC chokes, harmonic filters, enclosures, and certain auxiliary items in one integral line-up, as indicated and as specified, to provide a complete operating system.

B. Coordinate the VFD units with the driven equipment manufacturers.

C. VFD units shall be manufacturer's standard technology and in production for no less than 5 years.

D. Provide control system operation, input and control signals, status signals and devices in accordance with Section 13300, as specified herein and as indicated by the Contract drawings.

E. Coordinate VFD input harmonic filter with results of final harmonics study outlined in Paragraph 2.02.

F. Provide each VFD unit as one complete line-up, complete with main circuit breaker, inverter section, power converter, harmonic filter, output filter, and control circuit as indicated. Floor mounted VFD units provided shall be secured to a concrete pad. VFD units shall not have dimensions larger than what is indicated on the Contract drawings.

1.02 RELATED WORK:

A. Division 1: General Requirements

B. Division 11: Equipment

C. Section 13300: Utility Control Instrumentation System

D. Division 15: Mechanical

E. Division 16: Electrical

1.03 REFERENCES:

A. Underwriter's Laboratories Inc. (UL):

1. UL-508 Electrical Industrial Control Equipment.

B. National Electrical Manufacturers Association (NEMA): MG 1.

C. National Fire Protection Association (NFPA):

1. NFPA-70 National Electric Code.

D. Connecticut Electric Code.

1.04 SUBMITTALS:

A. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.

1. Failure to include a copy of the marked-up specification sections will result in return of the entire submittal without further review and consideration until the marked-up specification are resubmitted with the entire package.

B. Shop Drawings: Provide a complete list of equipment components, and materials, including manufacturer's descriptive and technical literature, and catalog cuts. Provide complete wiring, system interconnection and schematic diagrams for the equipment and controls furnished including external interlocked and controlled components, equipment layout, time versus current curves for protective devices and any other details required to demonstrate that the system and the required external controls have been coordinated and will function as specified and indicated.

1. Provide data to verify that drives can be used for motor lead lengths up to 100 feet without output filters. Include information from the VFD manufacturer or output filter manufacturer stating that the motor terminal voltage limitations as defined by NEMA Standard MG-1 are met.

2. Provide enclosure drawings and details showing all dimensions and construction details.

3. Submit a statement from each driven equipment manufacturer indicating that the VFD drive submitted is compatible with driven equipment and is rated for the specified application.

4. Harmonic Analyses Report: Provide harmonic analysis report as outlined in Paragraph 2.02.

5. Provide installation and anchoring details to meet earthquake requirements as specified and indicated on the structural drawings.

6. Submit manufacturer’s printed installation instructions.

7. Spare Parts Data: Submit a list of spare parts.

8. Operating and Maintenance Instruction Manuals:

   a. Furnish:

      (1) Operating instruction manuals outlining step-by-step procedures required for system startup and operation.

      (2) Manufacturer's name, model number, service manual parts list.

      (3) Brief description of equipment and basic operating features.

      (4) Maintenance instruction manuals outlining maintenance procedures.

      (5) Troubleshooting guide listing possible reasons for breakdown(s) and repair(s).

      (6) Point-to-point connection wiring diagram for the system.

9. Performance Test Reports: Upon completion of installed system, submit in booklet form all shop and field tests performed to prove compliance with specified performance criteria.

1.05 QUALITY ASSURANCE:

A. Provide services of Service Technician, specifically trained on type of equipment specified.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

B. ABB

2.02 HARMONIC ANALYSIS:

A. The VFD manufacturer shall provide a detailed harmonic analysis as described under this section.

B. The VFD system shall be provided such that there is less than 5% voltage total harmonic distortion at the point of common coupling (PCC). Current distortion at the terminals will be in accordance with Table 2.02A.

TABLE 2.02A
MAXIMUM HARMONIC CURRENT
DISTORTION IN PERCENT ISC/IL

ODD HARMONIC

Ratio	5 to 9	11 to 15	17 to 21	23 to 33	35 +	TDD
Less than 20	4.0	2.0	1.5	0.6	0.3	5.0
20 to 50	7.0	3.5	2.5	1.0	0.5	8.0
50 to 100	10.0	4.5	4.0	1.5	0.7	12.0
100 to 1000	12.0	5.5	5.0	2.0	1.0	15.0
1000 +	15.0	7.0	6.0	2.5	1.4	20.0

Notes:

1. Even harmonics are limited to 25% of odd harmonics.
2. DC offset distortions not allowed.
3. Ratio = Isc/IL where

   Isc = Maximum short circuit current at PCC.

   IL = Maximum demand load current at PCC (fundamental frequency component)

C. The harmonic analysis performed shall be based on the following:

   1. Point of common coupling shall be at the 480 VAC bus immediately upstream of the main distribution panel MDP and distribution panel DP-1 at the Long Hill Pump Station and Talcott Booster Station, respectively. Provide separate studies for each site.

   2. Obtain the available fault current information and upstream transformer data from the electrical utility and provide to the VFD manufacturer to perform the analysis for each location.

   3. Harmonic analysis shall be performed for two cases.

      a. When the system is fed by the electrical utility.

      b. When the system is fed by the onsite generator.

D. The studies shall include an explanation of all assumptions, sources of data, methodologies and formulas used in the study and a summary of the study results.

E. Based on the harmonic study results, supply the VFD units with any additional filtering equipment required to meet the harmonic requirements specified herein.

F. The Long Hill Pump Station study shall include the following VFDs:

1. High Capacity Pump P1-VFD (50 HP)

2. High Capacity Pump P2-VFD (50 HP)

3. The study shall assume 50 kVA of linear loads.

G. The Talcott Ridge Booster Station Study shall contain

1. Talcott Booster Pump TBS-1 (2 HP)

2. Talcott Booster Pump TBS-2 (2 HP)

3. The study shall assume 20kVA of linear loads.

2.03 PROVISIONS:

A. Service conditions shall be as follows:

1. Ambient Temperature Range: 0 deg. C to 40 deg. C.

2. Operational Humidity: Up to 90 percent non-condensing.

3. Environment: As indicated on enclosure schedule.

4. Altitude: Below 3,300 ft. above sea level.

5. Input Power:

a. Nominal voltage - 460 volts (plus 10 percent or minus 10 percent), 3-phase, 3 wire

b. Nominal Frequency - 60 Hertz (plus or minus 2 Hz.)

B. Drive Systems:

1. General:

a. Furnish solid state variable frequency, microprocessor type with Pulse Width Modulated (PWM) output wave form converter. The VFD shall employ an AC to AC converter, a DC bus choke, DC bus capacitors and

Insulated Gate Bipolar Transistors (IGBT) as the output switching device to convert nominal 480 volts, 3 phase, 60 Hertz, 3 wire input power into adjustable-frequency 3 wire system at 0 to 480 volts, 3 phase, 0 to 60 Hertz output power.

b. Motor control circuits shall be wired in accordance with the requirements specified herein and as indicated.

c. Ensure the compatibility of the drive and control system serving the motor and driven equipment. This includes the responsibility for verifying all loads, torque, speed, and performance requirements provided by the pump and motor manufacturers.

d. Provide constant torque drives or variable torque drives based on the type of the driven equipment load.

e. Provide VFD control so that there is accurate zero to full load torque control at low frequencies, including zero speed, with torque repeatability accuracy of 2% or better and torque response time less than 20 ms.

f. Provide on drive thermal magnetic type, 480 volts circuit breaker rated for 65 kA symmetrical to be used as main disconnecting device and fixed diode input rectifier for a constant power factor.

g. RMS harmonic output of the drive not to provide more than 5 percent increase in motor heating over similar operation of the motor with zero harmonics in the current.

h. The unit shall withstand drive output terminal line-to-line and line-to-ground short circuits without component failure during start-up and during operation. Drive to safely shutdown until short is cleared.

i. Provide drives with NEMA rating in accordance with the Area Classification schedule.

j. Provide drive output such that the motors have a base rating voltage less than or equal to 600 volts and that the peak instantaneous voltage shall be limited to 1600 volts or less, with a voltage rise time greater than or equal to 0.1 micro-seconds per NEMA Standard MG-1, Part 31.40.4.2.

k. The drive unit shall be of modular design to provide for ease and speed of maintenance.

l. Control circuits shall be isolated from power circuits. Unit to accept a 4-20 mA DC speed control signal from an isolated, ungrounded transmitter with unit in remote mode and from local door-mounted manual

speed potentiometer or micro-processor type keypad with unit in local mode. The input 4-20 mA signal to be optically isolated from the drive run control circuit. Furnish door-mounted switch on the enclosure for local/remote mode. Manual speed potentiometer or keypad controls to have adjustable minimum speed setting of 10 to 80% of full speed and maximum speed setting of 50 to 100% of full speed. The total speed setting to follow a linear time ramp, adjustable from 1-300 seconds for acceleration and deceleration control. Provide output 4-20mA signal for VFD speed statues.

m. Harmonic filters shall be provided with contactors and controlled by the VFD to remove them from the line when the drive is not operating. Contactors shall be provided with spare contacts for remote alarm and to energize status lamp at VFD enclosure.

n. VFD shall be capable of full rated output when powered by incoming voltage with Total Harmonic Distortion (THD) in excess of 10%.

o. Furnish series choke and capacitors on DC bus to reduce ripple in rectifier output and to reduce harmonic distortion reflected into incoming power feeders.

p. Size enclosure to dissipate heat generated by VFD within limits of specified service conditions. Provide integral fans or cooling systems. VFD enclosures to have keypad controls located on exterior of enclosure. Provide visual alarm indicator on cabinet door.

q. Provide oversized cable lugs for incoming and outgoing cables. Cable lugs size shall be per cables as indicated.

2. Performance characteristics:

a. Continuous current rating (amps): Minimum of 110 percent of motor rated full load amps, continuous.

b. Acceleration time to top speed, 1-60 seconds, adjustable.

c. Deceleration time from top speed, 1-60 seconds, adjustable.

d. Frequency stability: +/- 0.5% (at 25 degrees C, +/- 10 degrees C) after reaching operating temperature.

e. Output voltage: Proportional to frequency with low speed boost.

f. Combined drive/and filtering efficiency, defined as VFD output KW divided by VFD input KW, shall meet the following requirements at the specified operating points:

(1) 96 percent minimum at 60 Hz VFD output and 100 percent load.

(2) 92 percent minimum at 50 Hz VFD output and 60 percent load.

g. VFD fundamental power factor shall be 0.95 or higher at all speeds and loads.

h. The VFD shall be capable of sustaining continued operation with a 30% dip in nominal line voltage.

i. Losses to be utilized in drive system efficiency calculation shall include the input isolation transformer, harmonic filter and power factor correction if applicable. Auxiliary controls such as internal VFD control boards and cooling fans shall be included in all loss calculations.

3. Drive Protection:

a. General :

(1) Fault detection and trip circuits shall protect VFD and connected motor against line voltage transients, single-phase, power line over-voltage and under-voltage, output over-voltage and over-current, and VFD over-temperature. The VFD shall employ three (3) current limit circuits to provide trip free operation. The slow current regulation limit circuit shall be adjustable to 125% of the VFD's variable torque current rating. The rapid current regulation limit shall be adjustable to 170% of the VFD's variable torque current rating. The current switch off limit shall be fixed at 225% of the VFD's full load current rating.

b. Internal Protection: Provide circuitry as follows:

(1) Current limiting, fast acting, semiconductor input fuses for protection of internal power semiconductors.

(2) Instantaneous output over-current trip max. - 200 percent.

(3) DC bus and control circuit transformer fusing.

(4) Grounded control chassis.

(5) Under and over voltage trip, 3 phases.

(6) Motor overload protection, with solid state relays.

(7) Main circuit breaker, with door interlocked handle. Provide means to allow entry into panel by authorized personnel. Circuit breaker to be rated 65,000 AIC.

(8) Fault reset push button.

(9) Line to ground faults.

(10) Input metal oxide varistor and input line reactor for transient protection.

(11) VFD over-temperature.

c. Troubleshooting: Provide diagnostic aids to indicate cause of fault; used to assist in troubleshooting circuit problems. Isolated Form C contacts for remote indication of alarms to include the following:

(1) Over/under voltage indication.

(2) Over-current trip indication.

(3) DC bus charged indication.

(4) Fault detection indication.

(5) Recycle start indication (to indicate that the unit tried to pick up load for three previous tries and failed).

d. Provide power loss ride through capability which will allow the logic to maintain control due to load inertia without faulting.

C. Auxiliary Systems:

1. Provide variable frequency drive unit with appropriate power circuitry and auxiliary contacts, etc. for energizing and controlling the variable frequency drive as indicated.

D. Control Features:

1. Provide VFD control circuit as indicated on Contract Electrical Drawings.

2. Accept a grounded, isolated, 4-20 mA input remote speed control signal from an external device.

3. Provide a 4-20 mA output signal proportioned to VFD output frequency for remote speed indication.

4. Jog permissive input. When activated along with remote run contact, VFD will run at a pre-set speed.

E. Devices:

1. Provide operating, monitoring or alarm indicating devices, door mounted, as indicated on Contract Electrical Drawings and as follows:

a. System speed control selector switch (LOCAL/AUTO) (When in LOCAL position, speed controlled by manual speed potentiometer).

b. Manual speed potentiometer or keypad controls to set speed in manual mode.

c. Speed indicating meter in percent speed to indicate speed of the powered motor.

d. Control relays as indicated.

e. Alarm and status lights. Provide LED cluster type.

F. Tie all instrument transformer outputs to motor protection relay.

2.04 SHOP TESTING:

A. Provide a factory performance test for each variable frequency drive unit. The test to consist of simulating the expected load to be driven.

B. Provide a factory control and alarm test on each drive unit by simulating each control signal and each alarm function to verify proper and correct drive unit action.

C. Provide certified documentation of all tests performed.

D. Provide above stated tests in addition to routine factory tests.

PART 3 – EXECUTION

3.01 INSPECTION:

A. Examine VFD location for preparation in accordance with manufacturers written instructions. Check conduits and raceway location for connection to units.

B. Visually inspect delivered unit(s) and accessories for conformance with specification and drawings.

C. Verify availability of appropriate pacing signal and program motor protection relay settings.

3.02 INSTALLATION:

A. The VFDs shall be installed as indicated and in accordance with the manufacturer's installation instructions.

B. Factory-trained service technician, other than sales representatives, shall supervise field installation, inspect, make final adjustments and operational checks, make functional checks of spare parts, and prepare a final report for record purposes. Adjust control and instrument equipment until this equipment has been field tested.

3.03 FIELD TESTING:

A. Perform testing checkout, and start-up for variable frequency drive equipment under technical direction of manufacturer's service technician.

B. Coordinate all testing with electrical testing performed under Section 16998.

C. Field Tests:

1. Test each drive over the total speed range that it will be required to operate through for the load being driven for two hours. Determine for each drive, motor, and load combination the following at minimum speed, maximum speed, and at 1/3 and 2/3 points between the minimum and maximum speeds:

   a. Input power (kW), voltage, current and RMS power factor on the line side of the drive isolation device.

   b. Output to the driven load in kilowatts.

   c. For each drive, measure the harmonic voltage distortion and harmonic current distortion for each harmonic at the main distribution bus for maximum and minimum load conditions.

   d. Measure the total harmonic voltage distortion and total harmonic current distortion at each PCC, while all drive loads are running. The test results shall confirm the harmonic study results and have to shall prove that harmonic distortion limits specified in Paragraph 2.02 have been met. If testing results are not within the specified limits, provide additional filtering equipment to meet the harmonic distortion limits specified.

2. Test each drive by using the actual control signal for remote and local operation.

3. Test each driver alarm functions.

4. Perform all tests in the presence of the Contracting Officer’s representative.

5. Perform the above test in addition to the manufacturer's normal field tests and driven equipment testing as specified in Division 11.

6. Submit final test report with summary comparing field test data with harmonic analysis design calculated values for each drive.

END OF SECTION

SECTION 16400

SURGE PROTECTION DEVICES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide Surge Protection Devices (SPDs) components integral to the electrical distribution system equipment as indicated on the drawings. The distribution system includes 240/120V, 480/277V, and 208/120 panelboards.

B. The components shall provide protection for electrical and electronic devices against the damaging effects of surges, transients and electrical line noise.

1.02 REFERENCES:

A. American National Standard Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE):

1. C62.41.1: IEEE Guide on the Surges Environment in Low-Voltage (1000V and Less) AC Power Circuits

2. C62.45: Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits

B. Military Standard (MIL):

1. 220A: Radio Frequency Interference and Electromagnetic Interference

C. National Electrical Manufacturers Association (NEMA):

1. 250: Enclosures for Electrical Equipment (1000 volts maximum)

2. LS 1: Low Voltage Surge Protection Devices

D. National Fire Protection Association (NFPA):

1. 70: National Electrical Code (NEC).

E. Underwriters Laboratory (UL):

1. 1449: Standard for Safety, Surge Protective Devices - Third Edition.

2. 1283: Standard for Safety, Electromagnetic Interference Filters

1.03 SUBMITTALS:

A. Submit the following in accordance with Section 01300:

1. Shop drawings, manufacturer's product data, and component ratings in accordance with this section and the requirements of Section 16050.

2. SPD type, model number, system voltage, phases, modes of protection, Maximum Continuous Operating Voltage (MCOV) Voltage Protection Rating (VPR), Short Circuit Current Rating (SCCR), and Nominal Discharge Current (In).

3. Provide outline drawings and internal wiring diagrams.

4. List all required installation criteria including circuit breaker trip rating to meet UL 1449, Third Edition.

5. Identify all cable sizes, distance limits and accessory devices when SPD units are to be provided in separate enclosures, where applicable.

6. For informational/purposes only, submit installation instructions and separate from all other submittals.

7. UL 1449 listing and summary of factory test data.

1.04 QUALITY ASSURANCE:

A. SPD units and all components shall be designed manufactured and tested in accordance with the latest applicable UL Standard ANSI/UL 1449 Third Edition.

1.05 DELIVERY, STORAGE AND HANDLING:

A. Provide in accordance with Section 16050 and as specified.

B. Shipping:

1. Ship equipment and materials, except where partial disassembly is required by transportation regulations or for protection, complete with identification and quantity of items.

2. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.

3. Deliver spare parts after installation but before start-up of system as specified. Deliver to Contracting Officer after completion of work.

C. Storage:

1. Inspect and inventory items upon delivery to site.

2. Store and safeguard equipment, material and spare parts.

1.06 WARRANTY AND SERVICE:

A. Provide in accordance with Section 01740 and as specified.

B. The Surge Protection Device (SPD) manufacturer is to warranty the components against defective materials and workmanship for a period of five years following delivery from the manufacturer.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Surge Protection Device components.

1. Eaton/Cutler-Hammer.

2. Phoenix Contact.

3. Siemens.

4. General Electric Company.

2.02 PROVISIONS:

A. Environmental Requirements:

1. Operating Temperature: minus 40 degrees C to 60 degrees C.

2. Relative Humidity: 5 to 95 percent.

3. Operating Altitude: 0 to 12,000 Feet.

4. Audible Noise: Less than 35 dBA at 3 feet.

B. Electrical Requirements:

1. The maximum continuous operating voltage of all suppression components utilized is not to be less than 115 percent of the nominal operating voltage at the installed location.

2. ANSI/UL 1449 3rd Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 3rd Edition VPR for the device shall not exceed the following:

Volts	L-N	L-G	N-G	L-L
240/120	700V	700V	700V	1000V
208Y/120	700V	700V	700V	1000V
480Y/277	1200V	1200V	1200V	1800V

3. The SPD components are to be rated as follows:

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
CATEGORY	Application	Per Phase	Per Mode
C	Service Entrance Locations (e.g., 480VAC Distribution boards, 240/120 Distribution boards)	250 kA	125 kA
B	Distribution Panelboards (e.g., 480 Distribution Panelboards)	160 kA	80 kA
A	Branch Locations (e.g., panelboards)	120 kA	60 kA

4. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye	●	●	●	●
Delta	N/A	●	●	N/A
Single Split Phase	●	●	●	●
High Leg Delta	●	●	●	●

2.03 OPERATION:

A. The suppression system shall incorporate a hybrid designed Metal-Oxide Varistors (MOV) surge suppressor. The system shall not use silicone avalanche diodes, air gaps or other methods of suppression.

B. Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be 50 dB at 100 kHZ.

C. SPD shall provide surge current diversion between each phase conductor and the neutral conductor, between each phase conductor and ground and between the neutral conductor

and ground. For delta systems, the SPD shall have components directly connected between each phase conductor and between each phase conductor and ground.

D. The SPD shall provide a low impedance path for surge current using oversized conductors with equal impedance paths to each suppression element. Plug-in style connections or printed circuit boards for use in the path of surge current shall not be used.

E. Operating Parameters:

1. The maximum response time shall not exceed 1 nanosecond.

2. Provide with a noise filtering system capable of managing noise levels produced by electro-magnetic interference and radio frequency interference. The noise filtering system shall reject a minimum of 50db at 100 kHz as measured by the 50 Ohm Insertion Loss Method (Military Standard 220A).

3. The parallel system components shall operate over a minimum frequency range of 47 Hertz to 63 Hertz.

4. The SPD components shall limit total harmonic distortion produced to less than one percent.

5. SPD component ratings to be per UL 1449.

6. Each unit shall be factory tested at the maximum continuous operating voltage and short circuit tested, prior to delivery.

F. Product Components:

1. Protection and Filtering Elements:

a. The SPD components shall consist of replaceable protection modules designed to suppress and divert transient voltages and surge currents. Each protection module shall contain one or more individually fused metal oxide varisters capable of withstanding over 1000 surges of Category C (IEEE/ANSI C62.41.1) current rated at 10,000 amperes.

b. Each protection module shall contain filtering elements capable of providing noise attenuation.

c. The SPD components shall substantially limit transient waveform rise-time characteristics. The components are to be configured as parallel connected, current carrying elements designed to enhance the surge suppression and diversion performance of the protection modules.

2. Provide individual fusing to allow the SPD to be isolated during fault conditions.

3. Provide red and green solid-state status lights which indicate operational status of each unit and visual diagnostic monitoring of each component and module. Provide audible alarm to activate on fault condition, with a silence switch and push-to-test alarm switch.

4. Provide surge counter with battery backup to retain memory upon loss of AC power.

5. Provide remote status monitoring with form C dry contacts monitoring all phases.

2.04 SHOP TESTING:

A. Perform factory performance testing on each unit. The test to consist of the following:

1. High voltage impedance test.

2. Current test.

B. Tests shall be in accordance with the following standards:

1. ANSI/IEEE C62.41.1 Cat. A, B, & C.

2. ANSI/IEEE C62.45.

3. Military Standard 220A.

4. Underwriters Laboratory UL 1449.

C. Submit certified documentation of all factory tests performed.

D. Perform above tests in addition to standard factory tests.

2.05 SPARE PARTS:

A. Provide in accordance with Section and as specified.

B. Provide one spare protection module of each type for on-site spare parts purposes.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Visually inspect delivered unit(s) and accessories for conformance with drawings and specifications. Replace all components found to exhibit defects.

3.02 INSTALLATION:

A. Install unit in compliance with the manufacturers printed instructions. All electrical installation work shall be in accordance with UL Listing Requirements and applicable National or Local Electrical Codes.

B. For units mounted adjacent to electrical distribution equipment, verify conduit and wire for the SPD components are as specified by the SPD manufacturer and installed in strict accordance with the National Electrical Code.

C. Verify UL 1449, third edition or fourth edition, label is provided on each unit.

3.03 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 16402

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide complete underground distribution system as indicated and specified.

B. Conform to lines, grades, elevations, and dimensions. Resolve interferences with other underground conduit, piping or equipment, either new or existing with the Contracting Officer. Match components suitable for proper installation.

C. Provide concrete encasement of duct system where indicated. Include forms and reinforcing in installation. Perform work in accordance with Section 16050.

D. Provide Schedule 40 polyvinylchloride (PVC) conduit for power and control circuits and furnish and install rigid galvanized steel conduits for instrumentation, and communication.

1.02 REFERENCES:

A. National Fire Protection Association (NFPA):

1. 70: National Electrical Code (NEC).

1.03 SUBMITTALS:

A. Submit the following shop drawings in accordance with Section 01300:

B. Submit shop drawings and manufacturers' product data in accordance with requirements of Section 16050.

C. Provide "Record" drawings.

PART 2 - PRODUCTS

2.01 MANUFACTURER'S COMPLIANCE:

A. Manufacturer's acceptance contingent upon products' compliance with specifications.

2.02 MANUFACTURERS:

A. Polyvinylchloride (PVC) Conduit:

1. Specified in Section 16110.

B. Rigid Steel Conduit, Galvanized:

1. Specified in Section 16110.

2.03 MATERIALS AND COMPONENTS:

A. Conduit Spacers: Provide conduit spacers made of plastic to maintain spacing between conduits.

B. Concrete: Minimum compressive strength, 3,000 psi (20 MPa).

C. Hot-dipped galvanized steel conduit used underground to be painted with bituminous paint.

PART 3 - EXECUTION

3.01 INSTALLATION OF CONDUITS:

A. Lay conduits, indicated to be direct buried in the ground, in trench on 3 inch bed of sand and cover with an equivalent 3 inch bed of sand. Ensure that no rocks come in contact with conduit during backfilling. Dig trenches to depth and location indicated.

B. Provide minimum separation of power and control conduits of 3 inches both vertically and horizontally. Build ductbank layer by layer, backfill and compact each layer to provide support for next layer.

C. Separate power and control ducts from instrument ducts by a minimum of 12 inches.

D. Backfill ductbank in layers and tamp or "puddle" as directed by the Contracting Officer. Provide yellow ductbank marker tapes, reading "Caution - Electrical Lines Below", over entire length of ductline. Locate tapes 12 inches below grade. Provide a tape for every 12 inches of ductline width.

E. Install conduit, indicated to be encased in concrete with spacers and reinforcing, as specified and as indicated. Rigid galvanized steel conduits to be painted with bituminous paint.

F. Install conduit runs following routing on drawing and running in straight lines. Where deviation from a straight line becomes necessary, install bends of radius which allow for rodding and installation of cable.

G. Accomplish changes in direction of runs exceeding total of 10 degrees, either vertical or horizontal, by long sweep bends having minimum radius of curvature of 25 feet. Manufactured bends can be used at ends of short runs of 100 feet or less, and then only at or close to the end of run. Provide long sweep bends made up of one or more curved or straight sections and/or combinations thereof. Install manufactured bends with minimum radius of 36 inch where larger radius cannot be used.

H. Lay ductlines to minimum slope of 4 inches per 100 feet and slope to manholes and handholes, as indicated. Ductlines are to slope away from buildings.

I. Install spacers at intervals of approximately 4 feet and stagger between tiers of ducts to provide not less than 12 inches of longitudinal separation. Install base spacers to provide at least 3 inches between bottom of trench and underside of bottom conduits. Completely fill space with concrete. Firmly wire conduits and spacers together before concrete is placed.

J. Ductbanks are to be formed, unless trench conditions allow for neat placement of concrete with specified clearances.

K. Prior to placing of concrete, remove all dirt, sand, and any other debris from between conduits and from trench bottoms. Hold conduits in place to prevent floating or accidental movement.

L. Stagger joints in conduits at least 6 inches. Do not allow couplings to rest on bottom of trench. Install couplings for plastic conduit in accordance with manufacturer's recommendations.

M. Install concrete encasements so minimum clearance of 12 inches from concrete to parallel pipes, lines, structures, etc., is maintained. Where ducts cross, minimum clearance of 6 inches is required. Do not allow the top of concrete to be less than 30 inches below finished grade or paving. Submit special conditions which may require lesser clearances or special conditions which may require greater than 30 inches depth to Contracting Officer for acceptance.

N. Where a connection is made to existing ductline, bond or dowel concrete encasement to existing encasement. Use waterstop between ductpours and between manholes or buildings and ductwork as indicated.

O. Do not use power-driven vibrators for spading of concrete around ducts.

P. Roll and grade backfill, and restore surface to condition equal to the site finish grade, or as otherwise indicated.

Q. Locate ductbank markers at ends of all ductbanks except at manholes or handholes, at approximately every 200 feet along duct run, and at each change in direction of duct run. Place markers approximately on ductbank. Install markers 6 inches square or round section by 3 feet long made of Class B concrete. Imprint the letter "D" or cast it on top of the marker. Install top of duct markers flush in paved areas, protruding no more 2-inches above finished grade in unpaved areas. In finished lawns, allow marker to protrude 1/2-inch.

R. Keep conduits clean of concrete, dirt, and other substances during the course of construction. After the ductlines have been completed, pull a standard flexible mandrel not less than 12 inches long, having a diameter approximately 1/4-inch less than the inside diameter of the conduit, through each conduit, after which pull a brush with stiff

bristles through each conduit to make certain that no particles of earth, sand, or gravel have been left in the line. Replace conduit runs that do not allow the passage of the mandrel at no additional cost to the Contracting Officer. Pneumatic rodding may be used to draw in the lead wire. Install in spare conduits a pull wire or rope, and plug and seal spare conduits after cleaning.

3.02 RECORD DRAWINGS OF UNDERGROUND WORK:

A. Provide one set of marked copies of contract drawings, showing exact routing and depths of all underground conduit, duct handholes and manholes. Provide scaled plot plans, showing principal outline of buildings and structures. Reference conduits, ducts, and manholes, and all bends deviating from straight line, dimensionally from fixed objects or structures.

3.03 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 16415

AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. This section includes materials and installation of the automatic transfer switch ATS-1.

B. Provide a 480VAC, 3-phase, 3-wire automatic transfer switch. Provide with minimum short circuit rating of 65KAIC.

1.02 REFERENCES:

A. National Fire Protection Association (NFPA):

1. 70: National Electrical Code (NEC).

2. Connecticut Electrical Code

B. National Electrical Manufacturers Association (NEMA):

1. ICS 2: Industrial Controls and Systems Controllers, Contactors, and Overload Relays Rated 600 Volts.

C. Underwriters Laboratories (UL):

1. 1008: Automatic Transfer Switches.

1.03 SUBMITTALS:

A. Submit shop drawings and manufacturers' product data in accordance with the requirements of Section 16050.

B. Shop Drawings: Submit the following as specified herein:

1. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.

a. Failure to include a copy of the marked-up specification sections will result in return of the entire submittal without further review and consideration until the marked-up specification are resubmitted with the entire package.

C. Submit complete list of equipment and materials., including manufacturer's descriptive data including ratings, circuit diagrams, dimensional data, conduit entry restrictions, and a list of accessories.

D. Spare Parts Data: Provide a recommended spare parts list.

1.04 OPERATION AND MAINTENANCE MANUALS:

A. Submit operation and maintenance manuals in accordance with Section16050.

1.05 MANUFACTURER'S SERVICES:

A. Provide manufacturer's services at the jobsite for the minimum labor days listed below, travel time excluded:

1. One labor day to check the installation and advise during start-up, testing, and adjustment of the transfer switch.

PART 2 - PRODUCTS

2.01 TRANSFER SWITCH:

A. Transfer switch shall be in a free standing enclosure with a NEMA rating in accordance with the Area Classification Schedule. Transfer switch shall have number of poles, amperage, and voltage ratings as shown in the drawings. Withstand current rating shall not be less as indicated on the contract drawings.

B. Switch shall be listed per UL 1008.

C. Transfer switch shall be electrically operated and mechanically held in each direction by a single operating mechanism momentarily energized from the source to which the load shall be transferred. Accomplish mechanical locking in each direction without the aid of latching solenoids, toggle mechanisms, or gear arrangements. Total operating transfer time shall not exceed one-sixth of a second.

D. An overload or short circuit shall not cause the switch to go to a neutral position. Do not use main contact structures not originally manufactured for transfer switch service (molded case circuit breakers or contactors). Inspection and replacement of all contacts (stationary and arcing) shall be possible from the front of the switch without any disassembly of operating linkages or power conductors. Provide a handle to permit no-load manual operation.

E. Provide transfer switch with current limiting fuses to provide the specified short circuit rating.

2.02 ACCESSORIES:

A. Provide a solid-state sensing and control logic panel. Include the following operational characteristics:

1. Adjustable (0.5 to 6.0 seconds) time delay on engine starting to override momentary dips in normal source, set at 1 second.

2. Full phase voltage relay supervision of the normal source with at least one close differential relay to detect "brownout" condition, set at 70 percent dropout and 90 percent pickup.

3. Voltage/frequency lockout relay to prevent premature transfer, set at 90 percent voltage and 90 percent frequency.

4. Engine starting control contacts (one normally open and one normally closed).

5. Adjustable (2 to 25 minutes) time delay on retransfer to normal, set at 20 minutes.

6. Unloaded running time delay for generator cool down (adjustable 0.1 to 10 minutes), set at 5 minutes.

7. Transfer to emergency time delay (adjustable 1 to 300 seconds), set at 1 second.

8. Programmable generator automatic exercise.

B. Provide a system test switch (momentary type) on the front of the enclosure.

C. Manual push button to bypass the time delay on retransfer.

D. Indicating lights to indicate source to which the load is connected.

E. Indicating light to indicate presence of normal power source.

F. Auxiliary contacts for remote indication of switch position, one normally open and one normally closed contact for normal power and emergency position.

2.03 MANUFACTURERS:

A. The transfer switch shall be as manufactured by:

1. Kohler

2. Cummins

3. Or Equal

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Secure transfer switch rigidly to wall and floor or mounting pad with anchor bolts or Phillips Drill Company concrete anchors. Anchor bolts or concrete anchors shall be 316 stainless steel.

3.02 FIELD TESTING:

A. Field test per manufacturer's recommended standard test procedure.

B. Field test and calibrate timing and monitoring logic. All adjustments shall be within 5 percent of the previously specified set points.

C. Field test and calibrate the in-phase monitor. Demonstrate that the switch transfers when source phase differences are within 20 degrees under varying generator speeds.

3.03 CONTRACT CLOSEOUT:

A. Provide in accordance with Division 1 Specification requirements.

END OF SECTION

SECTION 16450

GROUNDING

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide a single, complete, integrated grounding system, including conductors, raceways, and connections, indicated and specified, and in accordance with the National Electrical Code Article 250 and the National Electrical Safety Code.

B. Include electric equipment enclosures, ground grid systems with ground rod and water pipe connections; structural steel, and lightning protection system.

C. Include grounding conductors completely inter-connecting water supply pipe, ground rods, ground grid, ground buses, other distribution equipment, and other groundable equipment.

1.02 REFERENCES:

A. American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE):

1. ANSI/IEEE C2: National Electrical Safety Code.

B. American Society for Testing and Materials International (ASTM):

1. B3: Standard Specification for Soft or Annealed Copper Wire.

2. B8: Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

3. B33: Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.

C. Institute of Electrical and Electronics Engineers (IEEE):

1. Standard 81: Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potential of a Ground System.

D. National Fire Protection Association (NFPA):

1. 70: National Electrical Code.

2. 780: Lightning Protection Code.

E. Underwriters Laboratories (UL):

1. 467: Standard for Grounding and Bonding Equipment.

1.03 SUBMITTALS:

A. Submit the following shop drawings in accordance with Section 01300:

B. Submit shop drawings and manufacturers' product data in accordance with requirements of Section 16050.

C. Submit catalog and dimensional data for the following:

1. Ground rods

2. Exothermic welding

3. Connecting hardware

D. Submit grounding system test results.

PART 2 - PRODUCTS

2.01 MANUFACTURER'S COMPLIANCE:

A. Manufacturer's acceptance contingent upon products' compliance with the specifications.

2.02 MANUFACTURERS:

A. Ground Rods:

1. ERICO Products Inc.

2. Galvan Electrical Products.

3. Nehring Electrical Works.

B. Exothermic Welding:

1. ERICO Products, Inc.

2. American Brass Mfg. Co.

3. Orgo-Thermit, Inc.

C. Connecting Hardware:

1. American Brass Mfg. Co.

2. Thomas and Betts

3. Anderson Electric Corp.

2.03 MATERIALS AND COMPONENTS:

A. Conductors:

1. Provide copper grounding conductors bare or insulated, sized as indicated. When not indicated on the drawing provide in accordance with the NEC. Provide protection of conductors in locations where physical damage would result from direct exposure.

2. Ground and bond wires for substations, main panels and distribution points, and ground rod connections shall be annealed bare copper conforming to ASTM B3, stranded, with 98 percent conductivity.

3. Equipment ground conductors run with circuit conductors and grounding electrode conductor shall be 600 volt with green insulation, unless noted otherwise on the Contract documents.

4. Unless noted otherwise, all conductors No. 8 AWG and larger shall be stranded, Class B in accordance with ASTM B8.

a. Uninsulated conductors shall be bare copper in accordance with ASTM B3, tinned in accordance with ASTM B33.

b. Use tinned-coated in corrosive environments including when buried in earth or embedded in concrete.

B. Connectors and Fasteners:

1. Provide ground clamps which are UL listed for use on copper or brass pipes.

2. Provide ground clamps, for use on iron pipes, of galvanized or malleable iron, or of standard noncorrosive material for use on iron pipes.

3. Provide ground clamps, for use on pipes, with rigid metal base providing good contact by proper seating on the pipe. Do not use strap type clamps.

C. Ground Rods:

1. Ground rods shall conform to the requirements of NFPA 70 and UL Standard 467.

2. Ground rods shall be copper-clad steel rods not less than 3/4 inch in diameter and not less than 10 feet long per section.

3. Ground rods shall be clean and smooth with the following characteristics:

a. Cone-shaped point on the first section.

b. Die-stamped near the top with the name or trademark of the manufacturer and the length of the rod in millimeters or feet.

PART 3 - EXECUTION

3.01 EXOTHERMIC WELDING:

A. Welding shall be by the exothermic process.

B. Within the welding procedure, include the proper mold and powder charge and conform to the manufacturer's recommendations.

C. Welding processes shall be the exothermic fusion type that will make a connection without corroding or loosening.

D. The welding process shall join all strands and not cause the parts to be damaged or weakened.

E. Completed connection or joint shall be equal or larger in size than the conductors joined and have the same current-carrying capacity as the largest conductor.

F. Paint buried ground connection with a bitumastic paint.

3.02 INSTALLATION OF GROUNDING CONDUCTORS:

A. Install grounding conductors so that they will not be exposed to physical damage. Install connections firm and tight. Arrange conductors and connectors so no strain on connections.

B. Run grounding conductors associated with direct burial cables in common trenches above cables except as indicated otherwise.

C. Bury equipment grounding conductors 30 inches deep. Bring loops or taps up for connection to equipment or other items to be grounded.

D. Where raceways are used to contain and protect grounding conductors, install in accordance with Sections 16110 and 16402.

E. Where bare grounding conductors are contained within metallic raceways, bond ends of raceways to conductors.

F. Install loop type, low impedance, grounding system interconnecting all components so at least two grounding connections are provided for each major item of electrical equipment. Ensure that severing of any single grounding conductor in this system does not remove grounding protection on any major item.

G. Connect structural steel to the external perimeter loop of grounding conductors installed around all sides of building foundation, buried at least 30 inches below grade. Connect to each vertical column by loop or tap. Connect two opposite points on external loop to two different points on grounding system.

H. Buried and concealed ground connections shall use exothermic welding.

I. Make accessible connections to structural members by exothermic welding process or by bolted connector. Connections to equipment or ground bus by bolted connectors.

3.03 INSTALLATION OF GROUND RODS:

A. Install ground rods in manholes in accordance with requirements specified under the section Underground Distribution Systems. Connect each grounding conductor entering a manhole to ground rod by exothermic weld.

B. Install ground rods where indicated. Install the top of the rod 12 inch below the ground surface.

C. Make connection to overall grounding system as indicated.

D. Ensure that final resistance of interconnected ground system is 5 ohms, or less. Measure ground resistance in normally dry conditions, and not less than 48 hours after rainfall.

3.04 EQUIPMENT GROUNDING:

A. Ground each piece of electrical equipment by means of a grounding conductor installed in raceway feeding that piece of equipment. Grounding conductors installed in conduit with insulated conductors to be furnished with green, 600 volt insulation. Ground conductors are in addition to and not to be considered as the neutral wire of the system.

B. Connect power transformer cases and neutrals to grounding system. Connect neutral ground connection at transformer terminal. Provide two separate, independent, diagonally opposite, connections for power transformers so removal of one connection will not impair continuity of other.

C. Connect two separate ground connections from ground grid to ground bus of switchgear assemblies, motor control centers, switchboards and all outdoor substation and transformer equipment. Ensure that each connection for item of equipment is from different section of ground grid.

D. Connect a grounding conductor between panelboard and grounding system. Where a grounding bar is furnished with panelboard, connect grounding conductor to bar.

E. Conduits entering metal enclosures shall utilize bonding type locknuts and grounding bushings. Locknuts that gouge into the metal enclosures are not acceptable.

F. Where conduits are not effectively grounded by firm contact with a grounded enclosure, apply grounding bushings on at least one end of conduit run. Conduit connections shall be wrench tight.

G. Connect grounding conductors from equipment in area where ground bus is required to ground bus. Connect ground bus to grounding system. Mount ground bus on 600 volt pedestal insulators.

H. Connect lightning arresters to ground system by suitable conductors. Where lightning arresters are furnished with electrical equipment and grounding connections are not inherently provided, ensure that suitable separate grounding conductor connects lightning arresters with system ground.

I. Connect generator neutral to grounding system by a grounding conductor. Connect grounding conductor to generator disconnect enclosure and generator neutral on generator side of disconnect. Ground generator frame with two separate independent connections, so removal of one connection will not impair continuity of other.

J. Ground each street lighting standard by ground rod driven near base of standard, in accordance with requirements of the National Electric Safety Code. Connect ground rods to grounding conductor brought with street lighting feeder cable.

K. Ground transformers, lightning arresters, insulators and other appurtenances, installed on poles, poles and timber structures, or metal structure. Run grounding conductors between poles or structure and ground rods. Protect grounding conductor by molding applied for at least 8 feet above ground, with both molding and conductor stapled. Install ground rod where indicated and driven until top of rod is 1 foot below ground.

L. Ground wire fences when used to enclose electrical equipment or when overhead electrical lines cross fence. Unless otherwise indicated, provide grounding by buried outside peripheral ground loop; connections to each corner fence post and nearby ground rod; flexible connections to each gate; and at least two connections to grounding system from approximately opposite positions on fence.

M. Connect individual ground rods to the grounding loop using the direct burial grounding cable.

3.05 SIGNAL GROUNDING:

A. Ground signal surge protection and shields of twisted, shielded cable using a signal bonding conductor. The signal bonding conductor shall be a continuous path from the instrument surge protection or shield to the grounding electrode conductor. The signal bonding conductor shall be isolated from the equipment grounding conductor for its entire path.

B. Where convenient several signal bonding conductors may be conbined, providing that all the following conditions are met:

1. The combined signal bonding conductor shall have the equivalent cross section of the conductors that it was combined from or three times the cross section of the largest conductor that it was combined from, whichever is less.

2. The combined signal bonding conductor shall be isolated from the equipment grounding conductor.

3. Where two signal bonding conductors are combined use a three port insulated splice.

4. Where three or more signal bonding conductors are combined, use a copper bus mounted on 600 volt insulators. Attach each conductor to the bus using an insulated ring tongue lug and screw terminal.

3.06 FIELD TESTING:

A. Refer to Section 16998 for testing requirements.

B. Test grounding systems for ground resistance. Total resistance from any point on the ground network to the building counterpoise must not exceed 3 ohms.

C. Ground resistance and counterpoise tests must be made during dry weather and no sooner than 48 hours after rainfall. Conditions of soil and weather shall be documented on test forms.

D. Conduct tests using the ratio method that measures the ratio of the resistance to earth of an auxiliary test electrode to the series resistance of the electrode under test and a second auxiliary electrode. Perform measurements in accordance with IEEE Standard 81.

E. Indicating instrument must be self-contained and include a direct-current generator, synchronized current and potential reversers, crossed-current and potential coils, direct-reading ohmmeter, series resistors, and range-selector switch. Calibrate direct-reading ohmmeter for ranges of 0 to 20 ohms and 0 to 200 ohms.

F. Place auxiliary grounding electrodes in accordance with instrument manufacturer's recommendations but not less than 50 feet (15 m) apart, in accordance with IEEE Standard 81.

G. Perform continuity test on all power receptacles to ensure that the ground terminals are properly grounded to the facility ground system.

H. Furnish copies of test reports on ground system.

3.07 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 16601

LIGHTNING PROTECTION

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide lightning protection system on the Cherry Hill Storage Tank. The system shall consist of air terminals, conductors, ground terminals, interconnection conductors, arresters, and other connectors or fittings for a complete system.

B. All systems are to be provided and installed by trained Service Technicians having five (5) years active experience. Provide proof of previous MASTER LABEL installations receiving the U.L. “C” plate of acceptance.

1.02 RELATED WORK

A. Division 1: General Requirements

B. Section 16050: Electrical Work – General

C. Section 16450: Grounding

D. Section 16998: Field Inspection and Acceptance Tests

1.03 REFERENCES:

A. Underwriters’ Labratories, Inc. (UL):

1. UL-96: Lighting Protection Componenets

2. UL-96A: Installtion Requirements for Lighting Protection Systems

B. National Fire Protection Association (NFPA):

1. NFPA-70: National Electrical Code.

2. NFPA-780: Lightning Protection Code.

3. Conneticut Electrical Code.

1.04 SUBMITTALS:

A. Shop Drawings: Submit the following in accordance with Section 01300 and as specified herein:

1. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.

a. Failure to include a copy of the marked-up specification sections will result in return of the entire submittal without further review and consideration until the marked-up specification are resubmitted with the entire package.

2. List of equipment and materials, including manufacturer's descriptive and technical literature, catalog cuts, installation instructions.

3. Detailed shop drawings, drawn to scale, indicating type, placement, and location of protection devices, including cable attachments, grounding, mounting and any other details integral with the system.

4. Spare Parts Data: Provide a list of recommended spare parts for the material and equipment to be provided, including current unit prices and source of supply.

5. Inspection and Maintenance: Provide a written recommended inspection and maintenance procedure, including periodicity of inspections.

A. As-Built Drawings: Provide a complete set of "as-built" drawings showing the location of all grounds as well as a detailed layout of type, size, location and method of installation of all downleads, roof cables, bonding leads and connections, air terminals, and in the case where structural steel is used for downleads, the method and location of all roof and ground connections to the steel must be clearly detailed.

1.05 QUALITY ASSURANCE

A. Provide in accordance with Section 01400 and as specified herein.

B. Conduit size and wire quantity, type and size shall be useable for the equipment supplied.

C. Provide systems furnished and installed by trained Service Technicians.

D. Provide UL listed components.

1.06 DELIVERY STORAGE AND HANDLING:

A. Provide in accordance with Section 01610 and as specified herein.

1.07 REQUIREMENTS OF REGULATORY AGENCIES:

A. Conform to UL 96 and NFPA-78.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

A. National Lightning Protection.

B. Lightning Master Corp.

C. Alltec Corp.

D. Or equal.

2.02 MATERIALS:

A. Class I Materials: Provide conductors, fittings, and fixtures to protect ordinary buildings and structures not exceeding 75 feet (23 m) in height.

B. Materials, Class I. Table I gives sizes and weights for air terminals, and main and secondary conductors. Secondary conductors which are used for bonding and interconnecting metallic bodies to the main conductor, and which will not be required to carry the main lightning current, may be reduced in size to No. 6 AWG copper. Provide main conductor size for interconnection to metal water systems, steam or hot water heating systems, or other metallic masses having a low resistance to ground.

C. Table I: Class I Material requirements:

		Copper	
Type of Conductor		Standard	Metric
Air Terminal, Solid	Diameter	1/2 inch	9.5 min
Air Terminal, Tubular	Diameter		15.9 mm
	Wall Thickness	.032 inch	0.8 mm
Main Conductor, Cable	Size ea.	17 AWG	
	Strand Wgt.	187 lbs/1000 ft.	478 g/m
	Per Length	57,400 cm	29 square mm
	Cross Sect. Area		
Main Conductor, Solid	Thickness	16 AWG	
Strip	Width	1 inch	25.4 mm
Secondary Conductor,	Wire Size	17 AWG	
Cable	Number of Wires	14	14
Secondary Conductor,	Thickness	16 AWG	
Solid Strip	Width	1/2 inch	12.7 mm

D. Class II Materials: Provide conductors, fittings and fixtures necessary to protect ordinary buildings and structures exceeding 75 feet (23 m) in height; or one of any height which has a structural steel brame that may be substituted for lightning down conductors. Table II gives sizes and weights for air terminals and secondary conductors for Class II structures.

E. Table II: Class II Material Requirements:

		Copper	
Type of Conductor		Standard	Metric
Air Terminal, Solid	Diameter	1/2 inch	12.7 mm
Main Conductor, Cable	Size ea.	16 AWG	
	Strand Wgt.	375 lbs/1000 ft.	558 g/m
	Per Length	115,000 cm	58 square mm
	Cross Sect. Area		
Secondary Conductor,	Wire Size	17 AWG	
Cable	Number of Wires	14	14
Secondary Conductor,	Thickness	16 AWG	
Solid Strip	Width	1/2 inch	12.7 mm

F. Where any part of a protection system is exposed to mechanical injury, provide protection using molding or tubing with non-metallic clamps. If ferrous metal pipe or tubing is used around the conductor, connect the conductor electrically to the pipe or tubing at both ends.

G. Furnish all conductors of stranded tinned copper, annealed to 98 percent conductivity, unless specifically otherwise stated by the Contract Documents. Provide all fittings, connectors, clamps and fasteners of high corrosion resistant materials that can be used for the intended environment and compatible with copper conductors.

H. Provide all fastening devices compatible with surface materials they are to be attached. Direct copper to aluminum contact is not allowed.

I. Copper-clad steel shall have a copper covering permanently welded to the steel core, in such proportions that conductance is 30 percent of the conductance of an equivalent cross section of solid copper.

J. Where the installation requires aluminum materials, aluminum is acceptable as a substitute for copper in lighting protection, with the stipulations that: (a) aluminum shall not be used underground, in contact with ground or where air may be laden with corrosive elements, such as ocean air; (b) when an aluminum system is joined with copper or copper-clad grounds, the union shall be made with bimetal connectors; (c)

precautions be taken at connections with dissimilar metals; and (d) cable conductors be of electrical conductor grade aluminum.

K. Materials such as galvanized steel is not acceptable.

2.03 AIR TERMINALS

A. Air terminals shall be provided and located to intercept a direct lightning strike.

B. Aire terminals shall be ½ inch as indicated. Air terminals shall extend above the projected object between 10 inches and 36 inches. If over 24 inches high, air terminals shall be braced.

C. Air terminals up to 24 inches high shall be spaced at intervals of 20 feet or less; those 24 inches or higher shall be spaced 25 feet or less. Terminals shall be placed on the ridges of gable, gambrel, and hip roofs of ordinary or high slope, and at the perimeters of flat or low-slope roofs. A shed roof with a high or normal slope shall be considered as half of a gable roof. There shall be an air terminal within two feet of the end of each ridge or each corner of a flat or low-slope roof.

D. Air terminals shall be placed within two feet of the edge along the perimeter of a flat or low-slope roof. A low-slope roof is one which is 40 feet wide or less and has a pitch of 1/8 or less; or is over 40 feet wide and has a pitch of 1/4 or less. The center of such a roof shall have intermediate air terminals at intervals not exceeding 50 feet.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Provide all material, equipment, and labor to install the lightning protection system as indicated and as specified. Equipment shall be installed by Service Technician specifically trained on installing lightning protection.

B. Main conductors shall: (a) interconnect air terminals in a direct or closed-loop roof system; (b) serve as downleads from the roof system to the ground system; (c) connect metal bodies of inductance or conductance to the main conducting system; and (d) serve as ground electrodes in some cases, or to connect ground rods in certain other cases.

C. Bend of conductor shall form an included angle of 90 degrees and have a radius of bend of 8 inches (203 mm).

D. Interconnect all conductors, air terminals to form a two-way pasth from each air terminal horizontally or downward to connections with ground terminals.

E. Conductors may be coursed through air without support for a distance of 3 feet or less. With a 5/8 inch rod or its equivalent as a support, fastened at each end, a conductor may be coursed through air for a distance not to exceed 6 feet.

F. Install roof conductors to interconnect all air terminals and provide a two-way path to ground horizontally or downward from the base of each terminal.

G. Metal roofing and siding, eave troughs, downspouts, and other metal parts are not acceptable as substitutes for lightning conductors.

H. Install two down conductors on any kind of structure. Location depends on placement of air terminals, size of structure, most direct coursing, security against displacement and location of metallic bodies, water pipes, and ground conditions. Separate down conductors. For structures over 200 feet in perimeter, install one additional down conductor for each additional 100 feet of perimeter or fraction thereof.

I. The structural steel columns on the outside perimeter of the structure shall not be utilized as the main down conductor from roof to ground for the lightning protection system. No parts of the structural steel structure shall substitute for lightning down conductors. The steel columns around the outside perimeter of the structure shall be grounded at every other column and in no case shall average over 60-ft. apart. A through the roof connector shall be installed where a conductor penetrates the roof, by the Lightning Protection Subcontractor. The through the roof connector shall be 1/2-in stainless steel threaded rod equipped with neoprene washers and stainless nuts for a watertight seal.

J. Terminate each down conductor at a ground rod.

K. Use connector fittings on all lightning conductors at “end-to-end” “tee” or “Y” spalices. Attach them so as to withstand a pull test of 200 pounds. Make fittings for connection to metal tracts, gutters, downspouts, ventilators, chimney extensions, or other metal parts about the structure tight to the object by compression under bolt heads. Both crimp type and exothermic weld splicers of stamped or cast metal are acceptable under Class I requirements. Do not use crimp type clamps and splicers in Class II installations. Use exothermic welds for all below grade system connections.

L. Attach conductors to the building or other object upon which they are placed. Use fasteners not subject to breakage. Furnish nails, screws and bolts, with which fasteners are attached, of the same material as the conductor or of such nature that there will be no electrolytic corrosion in the presence of moisture because of contact between the different parts. Space conductor fasteners not more than 3 feet apart on all conductors.

M. All requirements covering exposed systems apply to concealed installations. Conductors are coursed the same except that they may be coursed behind the exterior wall facing, in concealed or embedded conduit, or embedded directly in concrete.

N. Materials, installation methods and procedures are to be in accordance with UL-96 and 96A, NFPA 780, NEC and local electrical codes. Provide for and obtain a “U.L. Certificate of Compliance” for the Work performed.

3.02 SYSTEM TESTING:

A. Perform system testing as part of the grounding system tests identified in Sections 16450 and 16998.

END OF SECTION

SECTION 16900

ELECTRICAL CONTROLS AND MISCELLANEOUS ELECTRICAL EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide and connect the electrical control equipment and miscellaneous electrical equipment, including such instruments and devices indicated and specified. Device enclosures for electrical equipment as indicated and specified.

B. Control panel enclosures and devices specified herein are provided under those specification sections which invoke this section for control panel requirements or as indicated on electrical drawings.

C. Provide equipment in accordance with the area classification schedule on the electrical contract drawings.

1.02 REFERENCES:

A. American Society for Testing and Materials International (ASTM):

1. D178: Standard Specification for Rubber Insulating Matting

B. National Electrical Manufacturers Association (NEMA):

1. 250: Enclosures for Electrical Equipment (1000 volts maximum).

2. ICS 1: Industrial Control and Systems General Requirements

3. ICS 2: Industrial Controls and Systems Controllers, Contactors, and Overload Relays Rated 600 Volts.

4. ICS 4: Terminal Blocks for Industrial Use.

C. National Fire Protection Association (NFPA):

1. 70: National Electrical Code (NEC).

D. Underwriter's Laboratories, Inc. (UL):

1. 467: Standard for Grounding and Bonding Equipment.

2. 486A: UL Standard for Safety Wire Connectors and Soldering Lugs for Use with Copper Conductors.

3. 489: Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.

1.03 SUBMITTALS:

A. Submit the following shop drawings in accordance with Section 01300.

B. Submit shop drawings and manufacturers' product data in accordance with the requirements of Section 16050.

C. Wiring diagrams to show control interface points provided with other equipment.

D. Shop drawings to include:

1. Outline drawings with elevations.

2. Equipment arrangement drawings.

3. Anchor bolt location drawings.

4. Electrical schematics and wiring diagrams.

5. Electrical fuse/circuit breaker characteristic.

6. Equipment performance curves and data.

7. Bill of installation/assembly materials.

8. Equipment weights.

9. Completed manufacturer’s data sheets.

10. Sustainable design submittals.

1.04 SPARE PARTS:

A. Comply with the requirements specified in Section 01610.

1.05 QUALITY ASSURANCE:

A. Comply with the requirements specified in Section 01400.

B. Sustainability Standards Certifications.

1.06 DELIVERY STORAGE AND HANDLING:

A. Comply with the requirements specified in Section 01610.

PART 2 - PRODUCTS

2.01 MANUFACTURERS FOR ELECTRICAL DISTRIBUTION EQUIPMENT:

A. Siemens.

B. General Electric Company.

C. Eaton/Cutler-Hammer.

D. Square D Company.

E. Appleton Electric Company.

F. Crouse-Hinds Company.

G. O-Z/Gedney.

2.02 SAFETY DISCONNECT SWITCHES:

A. Provide heavy duty type, safety switches, with external operating handles, 3 PST, rated 600 volt, 60 Hertz with ampere rating as indicated, and having provisions for padlocking.

B. Provide fuses for safety switches as indicated.

C. Heavy duty safety switches to be UL listed, File E 2875 and 154828, and meet or exceed NEMA Standard KS1.

2.03 PUSHBUTTON AND SELECTOR SWITCH STATIONS:

A. Provide HAND-OFF-AUTO switches, push buttons, tumbler switches and other accessory devices as necessary for the control of motors and other electrical equipment or devices.

B. Provide pushbutton and selector switch stations designed for heavy-duty service and with momentary or maintaining contacts as indicated or as necessary for starting and stopping of equipment with 10 amp contact ratings.

C. Provide heavy duty switches and pushbuttons, Square D Company, Class 9001 or approved equal. Indicating lights to be led cluster type.

2.04 MANUAL MOTOR STARTERS:

A. Provide manual motor starters where indicated and for 120 volt, 60 Hertz fractional horsepower motors.

B. Provide each manual motor starter with overload heater or heaters of suitable capacity for motor running overcurrent protection for motor it controls. Provide manual starters

as single or 2 pole, as necessary, and with toggle mechanisms indicating OFF and ON positions.

2.05 CONTROL PANELS AND ELECTRICAL ENCLOSURES:

A. Provide control panels and other equipment, as indicated. Ensure that dimensions, NEMA rating, construction and mounting of equipment are as indicated.

B. Provide enclosures with back panels constructed of at least 14 gage (1.90 mm) steel and provided with terminal blocks for connection of external wiring. Provide door and body stiffeners in panels over 36 inches (915 mm) in length. NEMA 4X panels are to be provided with hand operated quick disconnects of stainless steel material.

C. Provide UL listed and NEMA rated pushbuttons, indicator lights and switches of heavy duty, oil tight types. Provide relays of industrial types, with 120 volt, 60 Hertz operating coils, and contacts rated for intended service. Power from fused control power transformers.

D. Provide nameplates for each panel and each device on panel. Nameplates of laminated plastic material, at least 3/32-inch (2.4 mm) thick, and with white letters on a black background.

E. Secure nameplates with self-tapping, Type 316 stainless steel metal screws.

F. Terminal Blocks:

1. Provide terminal blocks rated for 600 volts with screw type terminals.

2. Terminal blocks to be one piece with full barriers.

3. Provide General Electric EB-25 terminal blocks or equal.

G. Provide print pocket on inside of enclosure and include as-built drawings for the Municipality’s use.

H. Where visual strobe or warning lamps are required, provide heavy duty beacon, Edwards Signal Catalogue No. 93 or approved equal.

I. Where audible horn alarms are required, provide Edwards Signal 870P or approved equal.

J. Where equipment and devices are to be installed in hazardous locations, provide equipment and components suitable for the environment.

K. Where intrinsically safe wiring is required within the panels, the following requirements shall be met:

1. Within enclosures, conductors or intrinsically safe (IS) circuits shall be separated at least two inches (50 mm) from conductors of any non-intrinsically safe circuit. Within the enclosure the conductors shall be secured.

2. Intrinsically safe wiring shall not be routed in the same conduit as non-IS wiring.

3. Terminals in panels with IS wiring shall be identified in a manner that will prevent unintentional interference with the control circuits during testing and servicing.

L. All indicating lamps to be LED cluster type.

2.06 CONTACTORS AND RELAYS:

A. Provide mechanically held, heavy duty type contactors (relays) for lighting control, rated 30 amps, 600 volts, with number of poles as indicated.

B. Provide contactor in the required NEMA enclosure suitable for wall mounting. Provide circuit breaker or fuse protection on each ungrounded pole. Provide contactor similar to Square D Company, Class 8903, Type LX or approved equal.

C. Provide control power transformer with primary and secondary fuse protection. Control power to be 120 volts, single phase.

D. Provide timing relays by Allen Bradley, Series 700 or equal.

E. Provide industrial grade relays, NEMA rated, Square D Company, Class 8501 or equal.

2.07 NAMEPLATES:

A. Provide nameplates for equipment (including pushbutton and selector switch stations) listed in this section and other controls furnished under this contract, to designate the equipment controlled and their function.

B. Nameplates shall be laminated black bakelite with 1/4-inch (6 mm) high, white, recessed letters. Securely attach to the equipment with Type 316 stainless steel screws, or rivets. Adhesives, glue or cements will not be permitted.

C. Provide all junction boxes, pull boxes, disconnect switches and control panels with a nameplate to designate the system wiring contained within.

D. Install nameplates in a location near or on the equipment or devices.

2.08 MANUAL TRANSFER SWITCH

A. Transfer switch shall be installed in the electrical enclosure.

B. Transfer switch shall be double-pole and double throw manual switch.

C. Switch shall be heavy-duty 600V rated, 3-pole with NEMA 12 enclosure.

D. Transfer switch shall have a withstand current rating not less than 10,000 ampre rms symmetrical.

E. Switch shall be listed per UL 1008 as a recognized component for emergency systems and be rated for all classes of loads.

PART 3 - EXECUTION

3.01 WIRING OF MISCELLANEOUS DEVICES:

A. Make electrical connections required for recording and indicating instruments, and miscellaneous devices. Provide electrical supplies to metering, instrumentation, control, and alarm systems.

B. Connect HAND-OFF-AUTO switches, safety switches, tumbler switches, and other accessory devices as indicated or necessary for control of motors and other electrical equipment or devices.

C. Install conduit and wiring and make electrical connections between all instrument panels, consoles, cabinets, and external equipment and devices. Panels, cabinets, etc., are indicated.

3.02 WIRING OF EQUIPMENT FURNISHED UNDER OTHER SECTIONS:

A. As specified in Section 16050, install conduit, wiring, and connections for equipment and devices furnished under other Sections of specifications, and as indicated.

B. Refer to section 16998 for Field Testing and Acceptance.

C. Refer to mechanical specifications and drawings for locations of pressure-operated control switches, float switches, butterfly valves, solenoid operated valves, sump pumps, metering instruments, control panels, alarm actuating contacts, indicating lamps, limit switches, and other devices requiring wiring or interconnections with equipment supplied under Electrical Sections of these specifications.

3.03 CLOSEOUT ACTIVITIES:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 16998

FIELD INSPECTION AND ACCEPTANCE TESTS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Perform electrical system tests to demonstrate that each component of each system is in proper working order and in accordance with applicable codes, manufacturer's instructions, drawings, and specifications. Tests are in addition to, and no substitution for, factory tests of individual equipment.

1. Perform insulation and ground resistance tests before operating tests.

2. Determine proper rotation of motors before permanent connections are made.

B. Testing shall be performed to:

1. Provide initial acceptance tests and recorded data that can be used as a bench mark for future routine maintenance and trouble shooting by facility operating staff.

2. Ensure a successful start-up with a minimum of last minute interruptions and problems.

3. Determine the suitability of the equipment and systems for energization and placing into operating service.

4. Provide assurance that each system component is not only installed satisfactorily but performs, and will continue to perform, its function in the system with reasonable reliability throughout the life of the facility.

C. Provide all supervision and labor, materials, tools, test instruments or other equipment or services and expenses required to test, adjust, set, calibrate, functionally and operationally check all work and components of the various electrical systems and circuitry throughout the installation. Provide sufficient personnel to assist in any additional checks they may require for acceptance, start-up, run-in and placing the equipment and systems into continuous service.

D. The tests and inspections performed shall in no way relieve the Contractor of the responsibility for the performance of the tests, check outs, and inspections specified under other sections of the specification during construction.

E. The listings and descriptions of the tests, and checks described herein shall not be considered as complete and all inclusive. Additional normal standard construction (and sometimes repetitive) checks and tests may be necessary throughout the job, prior to final acceptance by the Contracting Officer.

F. Pay all costs for tests including expenses incident to retests occasioned by defects and failures of equipment to meet specifications.

1. Replace wiring and equipment found defective, or failing to meet specified requirements, without charge, unless written acceptance for repair is given by the Contracting Officer.

2. Unless otherwise specified, the Contracting Officer will supply electric power necessary for tests.

1.02 REFERENCES:

A. All inspections and tests shall be in accordance with the following applicable codes and standards latest revisions except as provided otherwise herein.

1. All Standard, Special and Supplemental Conditions of the Contract.

2. Association of Edison Illuminating Companies (AEIC).

3. American National Standards Institute (ANSI):

a. Z244-1: American National Standard for Personnel Protection

4. American Society for Testing and Materials International (ASTM).

5. Insulated Cable Engineers Association (ICEA).

6. Institute of Electrical and Electronic Engineers (IEEE).

a. C2: National Electrical Safety Code

7. National Electrical Manufacturer's Association (NEMA).

8. International Electrical Testing Association (NETA):

a. ATS: Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

9. National Fire Protection Association (NFPA):

a. 70: National Electrical Code

b. 70B: Electrical Equipment Maintenance

c. 70E: Electrical Safety Requirements for Employer Workplaces

d. 101: Life Safety Code

e. 780: Lightning Protection Code

10. Occupational Safety and Health Administration (OSHA):

    a. Part 1926; Subpart V, 1926.950 through 1926.960

11. State and Local Codes and Ordinances.

B. All inspections and tests shall utilize the following references:

1. Project Design Specifications

2. Project Design Drawings

3. Project Electrical System Studies

4. Manufacturer's instruction manuals applicable to each particular apparatus

1.03 SUBMITTALS:

A. Submit the following shop drawings in accordance with Section 01300.

1. Submit test plans and test data in accordance with the requirements of Section 16050.

2. Submit evidence of NETA membership, experience and staff qualifications.

3. Submit in 3-ring notebook, test plans for each system and piece of equipment to be inspected and tested. Provide sample test data sheets with blanks identified where test data will be recorded, test instrument identification, calibration date, and blanks provided to identify the person performing the test and the person witnessing the test.

4. Submit test results.

1.04 SCHEDULING:

A. The Contractor shall be responsible for the preparation of proposed procedures and schedules for all inspections, tests, settings and calibrations specified or otherwise required prior to or during the check out for start-up and acceptance of all the electrical components, equipment and systems. This work shall be coordinated and to be compatible with both the work of other crafts and the project schedule. The above must be organized and submitted with all proposed testing and check out forms. The procedures shall provide specific instructions for the checking and testing of each component in addition to the system functional checks. Tests and inspections shall be scheduled as the job progresses and may require repetition in greater detail at a later stage of construction. All procedures submitted shall include job safety rules proposed.

B. Equipment shall be inspected and tested to determine its condition. See other applicable sections of the specifications and contract documents for required checks and responsibilities.

C. At any stage of construction and when observed, any electrical equipment or system determined to be damaged, faulty, or requiring repairs shall be reported to the Contracting Officer. Corrective action may require prior approval.

D. Prior to check out and testing for start-up, ensure that all equipment and wiring is properly and permanently identified with nameplates and other identification as specified elsewhere. Check and tighten all terminals and connection points, remove all shipping blocks and hardware, thoroughly clean all equipment, repair all damaged or scratched finishes, inspect for broken and missing parts and review and collect manufacturer's drawings and instructions for submittal to the Contracting Officer. Make routine checks and tests as the job progresses and as necessary to insure that all wiring and equipment is properly installed and wired.

E. All testing and checkout work shall be performed with fully qualified personnel skilled in the particular tests being conducted. This is essential for obtaining and properly evaluating data while the tests are in progress and for insuring that important facts and questionable data are reported.

F. All inspections, tests, and calibrations shall be reported in writing on forms submitted for review under Submittals. The recorded data form shall have the signatures of the persons conducting the tests and authorized witnesses. The forms shall be designed to serve as the test and inspection checklist for inspection requirements. "As-found" and "as-left" test data shall be recorded and reported in writing.

G. The sequence of all tests and checks shall be such that the equipment can be energized immediately after the completion of the applicable tests.

H. When applicable electrical tests and inspections specified herein, or otherwise required are completed and results reported and reviewed then the Contractor may consider that portion of the electrical equipment system or installation electrically complete. The Contractor shall then affix appropriate dated completion or calibration labels to the tested equipment. The Contractor shall notify the Contracting Officer of electrical completion. If the Contracting Officer finds completed work unacceptable, the Contractor will be notified in writing of the unfinished or deficient work which shall be corrected by the Contractor. The Contractor shall notify the Contracting Officer in writing when all exceptions have been corrected. If later in-service operation or further testing determines problems attributable to the Contractor, these shall be corrected by the Contractor or suitable arrangements shall be made to suit operating circumstances.

PART 2 - PRODUCTS

2.01 TESTING EQUIPMENT:

A. Calibration:

1. Furnish all material, test equipment, and power sources required for testing, calibrating and check out. All calibration and setting checks by the independent

testing laboratory shall be performed with laboratory calibrated test instruments of appropriate accuracy. This test equipment shall have calibrations traceable to the National Bureau of Standards. Testing laboratory dated calibration labels shall be visible on all test equipment. Calibrations over 6 months old will not be acceptable on field test instruments. The accuracy of all test instruments shall be at least twice that of the accuracy of the equipment, device, relay or meter under test. All testing instruments shall be checked to insure satisfactory operation prior to proceeding with the tests. Serial and model numbers of the instruments used shall be recorded on the test forms.

2. Make necessary openings in circuits for testing instruments and place and connect all instruments, equipment, and devices, necessary for the tests. Upon completion of tests, remove instruments and instrument connections and restore all circuits to permanent condition.

2.02 TESTING:

A. Coordination:

1. Coordinate activities, and cooperate with others on project, to ensure that systems are energized when required, loads applied, and other requirements of Section are carried out on timely, coordinated basis.

2. Conduct tests in presence of the Contracting Officer. Notify the Contracting Officer seven calendar days or more in advance when any test to be performed, and do not start tests without the Contracting Officer's permission.

3. Other Sections of specifications require services of one or more manufacturer's representatives, to ensure that equipment supplied has been installed properly and adjusted to proper working order. Advise representative of all applicable tests in this Section, so that work will be coordinated, and tests combined where feasible.

4. It is important that equipment warranties or guarantees not be voided by testing and checkout work. The checks and tests to normally be supplemental to and compatible with the manufacturer's installation instruction leaflets and literature. Where deviations are apparent, the manufacturer's review shall be obtained prior to testing. Reasonable cooperation shall be extended to permit witnessing by the manufacturer's representative if so requested. Where any questionable repairs, modifications, significant adjustments, tests or checks are to be made, the Contractor shall contact the Contracting Officer to determine if the work should be performed by or with the manufacturer's representative.

B. Preparation:

1. Make up no high and/or medium-voltage connections at service entrance, transformers, substations, motors, medium voltage motor control centers, switchgear and generator permanently until correct phase rotation of all equipment is determined. Install and insulate these connections temporarily, if necessary,

while determining proper rotation. Make permanent connections after proper rotation has been established and subsequent to completion of insulation resistance and dielectric tests.

PART 3 - EXECUTION

3.01 INSULATION TESTS OF EQUIPMENT, CABLE, AND CIRCUITS:

A. General:

1. Perform DC insulation tests of the type specified on electrical equipment, apparatus and cables under any one or more of the conditions described as follows: At the time equipment such as motors, transformers, power circuit breakers and switches, bus duct, and similar electrical equipment is :

a. Delivered to the site for care, storage, and/or installation,

b. Prior to energization and/or placing into service and acceptance by the Contracting Officer,

c. When damage to the insulation is suspected or known to exist,

d. After repairs or modifications to the equipment affecting the insulation,

e. Routinely as necessary to determine or evaluate the condition of the insulation, especially moisture conditions, to determine the need for drying, cleaning or other maintenance work or protection,

f. Where lightning or other surge conditions are known to have existed on the circuit.

2. Insulation tests are required to be performed by the testing firm at various stages of construction. The equipment, cable and systems that require testing, the maximum test voltages, and the type tests required shall be in accordance with the applicable paragraphs of NETA.

3. List each circuit and measured resistance as test data.

4. Maintain record of all insulation resistance values. Identify conductor, or equipment, date that value was taken and resistance value. Arrange information in suitable neat tabular form and submit to the Contracting Officer.

3.02 SPECIFIC TESTS AND INSPECTIONS:

A. General:

1. The following specific items of work shall be performed by the Contractor. The list is not all inclusive, nor does it define how the tests and checks are to be made.

Refer to applicable sections of NETA and equipment specifications for additional details. The equipment and cable shall be deenergized and isolated as necessary to perform the tests.

2. The Contractor shall perform all tests and inspections as defined in the other sections of this specification. Tests and inspections required by these sections are not necessarily repeated under specific equipment in Paragraph 3.02

3. All equipment received for the job and for which the Contractor is responsible to be stored and cared for per the manufacturer's instructions. It is the Contractor's responsibility to obtain such information even where the instructions are not shipped with the equipment.

B. Equipment Test and Inspection During Construction and Prior to Acceptance Testing:

1. Complete inspection and electrical tests requirements per NETA ATS:

(1) Switches

(2) Circuit Breakers

(3) Surge Arresters

(4) Instrument Transformers

(5) Metering Devices

(6) Panelboards and Distribution Panels

(7) Variable Frequency Drives

(8) Mini-Power Centers

2. Grounding Systems:

a. All grounding loops and major equipment grounds shall be tested to remote earth or directly referenced to an extremely low resistance (approximately 1 ohm) reference ground bench mark. Visual inspection of all systems, raceway and equipment grounds shall be made to determine the adequacy and integrity of the grounding. All ground testing results shall be properly recorded, witnessed, and submitted.

b. Ground tests shall be performed in accordance with NETA ATS, Section 8.13 using a J. G. Biddle Company low resistance, Null balance type, ground testing with ‘ohmmeter with test lead compensation in place. The test instrument shall be the type which compensates for potential and current rod resistances.

c. Test each ground rod and submit tabulation of results to the Contracting Officer. Include identification of electrode, date of reading and ground resistance value in results.

d. Test each entire grounding system for continuity of connections and for resistance. Ensure that ground resistance of conduits, equipment cases, and supporting frames does not vary appreciably from that of system as whole and does not exceed 5 Ohms.

e. Where ground test results indicate the need for additional grounding conductors or rods that are not indicated on drawings or specified, additional grounding provisions shall be initiated to obtain the acceptable values. The Contractor shall be responsible for the proper installation of the grounding shown on drawings or specified and for the correction of improper installations as determined by inspections and tests.

3. Protective Relays and Metering:

a. Prior to final check out as described in Paragraph 3.03, visually inspect and correct, where appropriate, all relays, meters, wiring and related circuitry for tightness of connections, physical damage, compliance with specifications and Vendor data, mechanical condition, freedom of movement, and presence of or possibility of moisture, dust, or other contaminants.

b. Clean, check, and pre-set all protective relays.

c. Complete inspection and electrical tests per NETA ATS. Section 7.9.

C. Wire and Cable:

1. Before energizing, the continuity and insulation resistance of every circuit external to equipment shall be measured with a megger from each wire to all others and ground and test results recorded on forms. Tests shall normally be conducted at voltages 500 volts or lower. High potential testing will normally be performed by the independent testing laboratory as described in Paragraph 3.03.

2. Insulation resistance measurements shall be taken of the following: (Refer to Paragraph 3.01 for additional information.)

a. Motor Feeders: With motors disconnected, measure and record insulation resistance from load side of contactors or circuit breakers. Repeat this test after motors are connected and just before energizing at lower voltage as limited by the maximum test voltage for the motor.

b. Power Panel Feeders: Measure and record insulation resistance with circuit breakers, lighting transformers and panelboards connected, but with lighting branch circuit breakers or switches open.

c. Power Panel Branch Circuits: Measure and record insulation resistance after all lampholders, receptacles, fixtures, etc., are connected but before lamping.

d. Feeder Circuits: Measure and record insulation resistance with connections to circuit breakers made up but with breakers open and loads not connected.

3. All cables and wires shall be checked for proper identification numbering and/or color coding.

D. Overhead Conduit Systems:

1. The overhead conduit system shall be checked for proper installation by using the following check list: (This list not to be considered all inclusive but as a guide for inspection).

a. Conduits are supported on appropriate independent supports (i.e., not on process piping, pipe ways, or piping hangers).

b. Exposed conduits are run in a neat workmanlike manner, parallel or perpendicular to structural members.

c. Conduits are routed as far away from possible fire hazards and heat sources as practical.

d. Conduits are supported at the required intervals.

e. Pull boxes and fittings are installed so that covers are easily removable. Verify that all covers are installed and tightly bolted with gaskets provided where needed.

f. Number of bends in the conduit does not exceed 270 degrees without a pull box installed.

g. Circular cross sectional area is uniform at conduit bends. Single bends do not exceed 90 degrees.

h. Conduits are terminated in threaded hubs or bushings to prevent damage to wire.

i. Conduits joints have joint compound of the type specified and are tight and conduit ends are properly reamed and threaded not to engage less than 5 threads.

j. Pull fittings are of adequate size such that cable can be installed and replaced at a later date without the bending radius of the cable being less than code or manufacturer's requirements.

k. Seal fittings and/or sealing compound is installed at moisture barriers to prevent entry of moisture into equipment and/or where shown on plans.

l. Drains and conduit seals are installed on vertical conduit runs entering devices, equipment, and enclosures to prevent entrance of moisture.

m. Flexible conduit is installed at motors and other equipment as specified or required. Verify that all cabling and conduit runs are properly identified at each end.

E. Underground Conduit Systems:

1. Underground conduit systems shall be inspected and checked for compliance with standard practices, plans and specifications as the job progresses.

2. Upon construction completion of the underground conduit banks or runs and prior to backfill, the routing and the elevation and depth below grade shall be checked and any deviations from plans and/or specification to be recorded and in addition noted on record drawings.

F. Relay Panels, Operator and Instrument Control Panels, Communications Systems, Static Equipment, Programmable Controllers, Micro-Processors, Battery Systems and Other Miscellaneous Equipment:

1. Upon receipt of equipment, each item shall be inspected for damage, loose or missing parts.

2. Upon completion of equipment installation, all equipment and their control devices shall be visually and functionally tested for tightness of connections and for proper operation. In the case of battery systems, static inverters and the like, manufacturer's recommended test and installation manuals shall be reviewed and complied with. In the case of operator, instrument, and relay panels and cabinets or devices used solely for control, each circuit, where possible, shall be functionally tested for proper operation and conformance with drawings. Where functional testing is deemed undesirable by the Contracting Officer from a safety or plant operational standpoint, then continuity and terminal connection verification checks will be adequate. The Contractor shall insure that instruments and associated components cannot be energized until instructed by the Contracting Officer. For functional, operational, and calibration checks of instrument loops, refer to the instrument installation specifications.

3. Panelboard electrical checks shall be as included in the Wire and Cable section of this specification, Paragraph 3.02.D. Panelboards to be checked for proper circuit identification on the door schedule.

G. Sealing of Openings: The Contractor shall inspect the entire job with the Contracting Officer to insure that all openings are properly sealed as specified elsewhere.

H. Record Drawings: The Contractor shall maintain a master set of record drawings that shows changes and any other deviations from the base drawing. The markups shall be made as the changes are done. At the conclusions of the job, these master record drawings shall be complete and delivered to the Contracting Officer for forwarding to the design group.

I. Electrical system apparatus to be surveyed to include:

1. Small service transformers, and power transformers.

2. Power distribution panels and centers.

3. Static power supply equipment.

4. Lightning arresters.

5. Rotating equipment.

6. Bus ducts.

3.03 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 01700.

END OF SECTION