

FOR INFORMATIONAL PURPOSES ONLY - DO NOT USE TO BID

PROPOSAL

TO BE COMPLETED BY CONTRACTORS SUBMITTING A BID ON S3P312-05G						
ITEM NO.	APPROX. QUANTITIES	ITEMS BID WITH AMOUNT BID WRITTEN IN WORDS				
1.	Lump Sum	Knott Drive Pump Station Improvements <hr/> DOLLARS CENTS	N/A	N/A		
2.	Lump Sum	Morgan Park Pump Station Improvements <hr/> DOLLARS CENTS	N/A	N/A		
3.	Lump Sum	Viola Drive Pump Station Improvements <hr/> DOLLARS CENTS	N/A	N/A		
4.	Lump Sum	Roslyn Village Pump Station Improvements <hr/> DOLLARS CENTS	N/A	N/A		

CONTRACT NO. S3P312-05G

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PROPOSAL

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PROPOSAL

FOR INFORMATIONAL PURPOSES ONLY - DO NOT USE TO BID

CONTRACT NO. S3P312-05G

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PROPOSAL

ALLOWANCES

It is expressly understood and agreed that the total Bid presented in this Proposal is the basis for establishing the amount of the Bid Security and includes the following allowances:

- Item No. 5: An allowance of two hundred fifty thousand dollars (\$250,000.00) for unforeseen conditions, as specified in Section 01210 – Allowances.
- Item No. 6: An allowance of sixty thousand dollars (\$60,000.00) for water meter installation, as specified in Section 01210 – Allowances.

All in accordance with the requirements of Division 1, Special Conditions; Section 01010, Summary of Work; Section 01210, Allowances; and Section 01500, Temporary Facilities and Controls.

Final Contract Payment for allowance items shall be based upon actual payments, and not on the approximate amounts cited herein.

DETERMINATION OF LOW BID

Determination of low Bid will be made by comparing the Total Base Bid which shall include the lump sum Bid prices and allowances.

MAJOR EQUIPMENT ITEMS

The Bidder shall fill the name and address of the one proposed manufacturer for each major equipment item tabulated hereinafter. It is expressly understood that the furnishing of this information will not relieve the Bidder of any requirements of the Contract Documents and failure to fill out properly is grounds for rejection.

Specification Number	Description	Manufacturer
11316	Variable Speed Sewage Pumps	
11317	Constant Speed Sewage Pumps	
11330	Sewage Grinder Manhole	
16620	Generator Assemblies (Roslyn Village)	
16621	Generator Assemblies (Viola)	
16622	Generator Assemblies (Morgan Park)	
16623	Generator Assemblies (Knott)	

TECHNICAL SPECIFICATIONS INDEX

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01780	PROJECT RECORD DOCUMENTS
01782	OPERATION AND MAINTENANCE DATA
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02529	CONCRETE CURBS, GUTTERS AND SIDEWALKS
02604	UTILITY STRUCTURES
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02831	CHAIN LINK FENCES AND GATES

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03370	CONCRETE CURING
03400	PRECAST CONCRETE
03600	GROUTING
03930	CONCRETE REPAIR AND REHABILITATION

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NO ITEMS IN THIS DIVISION

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TECHNICAL SPECIFICATION INDEX

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NO ITEMS IN THIS DIVISION

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SUBSURFACE EXPLORATORY INVESTIGATION REPORT

(FOR INFORMATION ONLY – NOT PART OF CONTRACT S3P312-05G CONTRACT DOCUMENTS)

SECTION 01000 – SUMMARY OF WORK

PART 1 – GENERAL

1.01 SCOPE OF WORK

- A. The Work to be done under this Contract and in accordance with these Specifications consists of furnishing of equipment, superintendence, labor, skill, material and all other items necessary to provide repair and improvements at the existing Knott Drive, Morgan Park, Viola Drive, Roslyn Village pump stations located in Nassau County, New York under Contract No. S3P312-05G. Perform all Work required for such construction in accordance with the Contract Documents and subject to the terms and conditions of the Contract, complete and ready for use.
- B. The principal features of the Work to be performed and equipment to be provided for this Project under this Contract includes:
 - 1. All labor, equipment, fees, permits, and other related costs necessary to provide for the repair and improvements to the Knott Drive, Morgan Park, Viola Drive, Roslyn Village pump stations in Nassau County:
 - a. Site clearing, grubbing, sheeting, bracing, excavation, soil erosion protection, earth movement, subgrade preparation, removal of excess and/or unsuitable excavated material, and import of suitable material, as necessary to install and construct all the work
 - b. Removal and disposal of materials and equipment
 - c. Excavation support
 - d. Cast in place concrete
 - e. Installation of precast structures, piping and instruments
 - f. Install connection to force mains
 - g. Electrical and standby power systems
 - h. Controls
 - i. Site improvements and restoration
 - j. Install safety signs and label equipment
 - k. Painting
 - l. Install building ventilation systems
 - m. Install LED lighting
 - n. Install standby generator with base fuel tank
 - o. Temporary facilities
 - p. Permitting
 - q. Work under allowance items.
 - 2. The foregoing stated in Paragraph 1.1.B.1 is a general description only and shall not be construed as complete descriptions of the Work to be performed for the Project.
- C. Delays due to lack of available labor, supervision, equipment, etc. will not be acceptable.
- D. The construction sequence, as described in Section 01711, Maintenance of Facility Operations.
- E. Additional details concerning storm water permit compliance and pollution prevention plans can be found in the Federal Regulations 40 CFR 122 & 123.

1.02 GENERAL

- A. The Instructions to Bidders, Agreement, General Conditions, and Division 1, General Requirements, specifications shall apply to all Work under the Contract for this Project.
- B. Where articles of the Instructions to Bidders, Agreement, and General Conditions are repeated in the Sections of Division 1, General Requirements, it is intended to elaborate or qualify such articles. It is not intended that other articles of the above documents shall be omitted or that additional requirements set forth in the above documents and noted herein shall be excluded from Contract requirements unless specifically noted as such hereinafter.
- C. Where the words "Contract" and "Contractor" are used in Sections of Division 1, General Requirements, they shall apply equally to all parties entering into agreements with the Owner to perform Work specified herein and to all Contracts derived from said agreements.

SECTION 01000 – SUMMARY OF WORK

1.03 CONTRACT DOCUMENTS

- A. The Contract Documents consist of the Notice and Instructions to Bidders, Bid Bond, Proposal, Agreement, General Conditions, the Technical Specifications, and the Contract Drawings.

1.04 GENERAL ARRANGEMENT

- A. The Contract Drawings indicate the extent and general arrangement of the Work. The specific equipment proposed for use by the Contractor on the Project may require changes in the construction detailed on the Contract Drawings, and all such changes shall be performed in accordance with the requirements of the General Conditions, Article GC 17, "Materials and Equipment, Approvals, Substitutions and Deviations", and shall be made without additional cost to the Owner and shall include the increase in costs of the other Contracts.
- B. In the preparation of the revised plans, clearance, access, walkway widths, stairways, headroom and other building and equipment layout features shall be equal to those shown on the original Plans. All materials involved in the redesign shall conform to the applicable provisions of the Technical Specifications.

1.05 TIME OF WORK

- A. Overtime work by the Contractor necessary to conform to the requirements of Division 1, General Requirements, Section 01711, Maintenance of Facility Operations, shall be considered as normal procedure under this Contract, and the Contractor shall make no claims for extra compensation as a result thereof. The Contractor shall be prepared to work around the clock and supply multiple work crews as necessary to complete the Work including testing and acceptance as specified, within the specified time frame and the time of completion set forth in the Contract Documents.
- B. The normal working hours for the project are between 7:00 AM and 3:30 PM Monday through Friday. When required to meet the Contract Completion dates, the Contractor is advised that they shall work scheduled overtime or second shifts as needed. The Contractors shall have sufficient construction materials, labor, equipment, tools and supervision to support scheduled overtime or second shifts when required.
- C. It is understood that the Contractor has reviewed the schedule and has included in their bid sufficient monies to meet the schedule and will make no claim for extra compensation because of additional costs to meet scheduled dates.
- D. The Contractor is advised that they will be directed to take remedial action as necessary to recover lost time on any critical items as determined from the Construction Schedule.
- E. If it shall become imperative to perform Work at night, the Owner shall be informed at least 24 hours in advance of Work done during off hours. Temporary lighting and all other necessary facilities for performing and inspecting the Work shall be provided as required and as specified in Division 1, Section 01500, Temporary Facilities and Controls, or as directed by the Engineer.
- F. Unless otherwise specifically permitted, all Work that would be subject to damage shall be stopped during inclement, stormy or freezing weather. Only such work that will not cause injury to workmanship or materials will be permitted. The Contractor shall carefully protect his Work against damage or injury from the weather, and when Work is permitted during freezing weather, he/she shall provide and maintain approved facilities for heating the materials and for protecting the finished Work.
- G. The Contractor shall require permission, in writing, to perform contractual work outside the regular Owner working hours of 7:00 AM to 3:30 PM, Monday through Friday, or on official Owner holidays. This written request should be received by the Owner 24 hours in advance of beginning the work. The Contractor is responsible for coordination with the Owner and Engineer and/or his duly authorized representative, prior to the start of the work to determine the dates of observance of the official Owner holidays that may occur during the course of the Contract. The official Owner holidays are:
 - 1. New Year's Day
 - 2. Martin Luther King, Jr. Day
 - 3. Lincoln's Birthday

SECTION 01000 – SUMMARY OF WORK

4. Washington's Birthday
 5. Memorial Day
 6. Independence Day
 7. Labor Day
 8. Columbus Day
 9. Election Day
 10. Veteran's Day
 11. Thanksgiving Day
 12. Friday after Thanksgiving Day
 13. Christmas Day
 14. Failure of the Contractor to consider official Owner holidays during the preparation of their work plans and schedules shall not be cause for a delay claim against the Owner.
- H. Obtain permission from Owner, Owner's Representative and/or Owners management and staff prior to prosecuting any portion of the Work beyond the standard working days or hours. Should circumstances arise during the course of the Contract, where the Contractor works outside of the Owner's regular working hours (7:00 am to 3:30 pm, or as otherwise established for the project) or on weekends or official Owner holidays, regardless if this work is performed as a result of the Contractor's request or as required by the contract documents, or as required by the approved baseline schedule (resource loaded); the Contractor will reimburse the Owner for the cost of providing inspection and/or facility assistance, at the rate of \$175 per hour per staff member. The Owner, Owner's Representative and facility management and staff will review the scope of the operations and determine on a case-by-case basis the extent of construction oversight that may be required. Furthermore, failure of the Contractor to have considered such contingency cost in his bid price shall not be cause for an additional cost claim to the Owner.

1.06 WORK BY OTHERS

- A. None currently scheduled.

1.07 REGULATORY AGENCY ACCESS TO CONSTRUCTION SITE

- A. Whenever construction work is in progress or preparation, permit access and inspection and provide proper and necessary facilities to the representatives of the Owner, Engineer and Regulatory Agencies including, but not limited to, the New York State Department of Environmental Conservation, Nassau County Department of Health, and the New York State Environmental Facilities Corporation.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01000 – SUMMARY OF WORK

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PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes a description construction for the repair and improvements at the existing Knott Drive, Morgan Park, Viola Drive, Roslyn Village pump stations, located in Nassau County.
- B. Specific requirements for work are also indicated in individual Specification Sections and on Drawings.
- C. Related Sections: Division 1 Section "Summary of Work" for the Work covered by the Contract Documents, restrictions on use of the Project sites and work restrictions.

1.03 CONTRACT DESCRIPTION FOR PROJECT COORDINATION

- A. "Knott Drive, Morgan Park, Viola Drive, & Roslyn Village Pump Stations Improvements Project, General Construction Contract S3P312-05G" in the City of Glen Cove, New York – this Contract.
- B. "Knott Drive, Morgan Park, Viola Drive, & Roslyn Village Pump Stations Improvements Project, General Construction Contract S3P312-05G" (i.e., this contract) is a single prime general construction contract and provides for repair and improvements at four existing pump stations in Nassau County, New York.

1.04 COORDINATION WITH OTHER CONTRACTS

- A. During the progress of the Work, other Contractors may be engaged in performing other work and be awarded work under separate contracts for related work to the Work on this Project. In that event, the Contractor shall coordinate the work to be done hereunder with the work of such other contractors and the Contractor shall fully cooperate with such other contractors and carefully fit its own work to that provided under other contracts as directed by the Owner's Representative.
- B. Do not commit or permit any act which will interfere with the performance of work by any other contractor.
- C. If Owner's Representative determines that the Contractor is failing to coordinate his work with the work of other contractors as the Owner's Representative has directed, then the Owner shall have the right to withhold any payments otherwise due hereunder until the Owner's Representative's directions are complied with by the Contractor.
- D. If the Contractor notifies the Owner's Representative in writing that another contractor is failing to coordinate his work with the work of this Contract as directed, the Owner's Representative must promptly investigate the charge. If he finds it to be true, he must promptly issue such directions to the other contractor with respect thereto as the situation may be required. The Owner shall not, however, be liable for any damages suffered by this Contractor by reason of the other contractor's failure to comply with the directions so issued by the Owner's Representative, or by reason of another contractor's default in performance, it being understood that the Owner does not guarantee the responsibility or continued efficiency of any contractor.
- E. Should the Contractor sustain any damage through any act or omission of any other contractor having a contract with the Owner for the performance of work upon the site or of work which may be necessary to be performed for the proper prosecution of the work to be performed hereunder, or through any act of omission of a subcontractor of such contract, the Contractor shall have no claim against the Owner for such damage, but shall have a right to recover such damage from the other contractor under the provision similar to the following paragraph, which have been or will also be inserted in the contracts with such other contractors:
 - 1. Should any other contractor having or who shall hereafter have a contract with the Owner for the performance of work upon the site sustain any damage through any act or

SECTION 01005 – PROJECT COORDINATION

omission of the Contractor hereunder or through any act or omission of any subcontractor of the Contractor, the Contractor agrees to reimburse such other contractor for all such damages and to defend at his own expense, any suit based upon such claim and if any judgment or claims against the Owner shall be allowed, the Contractor shall pay or satisfy such judgment or claim and pay all costs and expenses in connection therewith and agrees to indemnify and hold the Owner harmless from all such claims.

- F. If any portion of the Work to be performed under this Contract depends upon the work of the Owner's forces or any other contractor, the Contractor shall inspect same and promptly give to the Owner's Representative notice of all defects in the work of such other contractor or Owner's forces. Contractor shall further notify the Owner's Representative of all delays by such other contractor as will affect the timely performance of the Work to be performed under this Contract. Failure of the Contractor to so inspect and give notice shall constitute an acceptance by him and an acknowledgement of the timely performance of work by other contractors.
- G. Notify the Owner's Representative immediately of damage to his Work as a result of work being performed by others through their neglect, ignorance, carelessness or other reasons attributable to the offending contractor.
- H. Contractor's attention is specifically directed to the fact that because of the work on other contracts within the limits of this Contract, he may not have exclusive occupancy of the territory within the limits of the Contract. Each contractor shall afford the Owner and separate contractor's reasonable opportunity for the introduction and storage of their materials and equipment and the execution of their work, and shall connect and coordinate his work with theirs as required by the Contract Documents.

1.05 GENERAL REQUIREMENTS OF CONTRACTS

- A. Work under this contract and work under separate contracts shall be closely coordinated to achieve fully operating systems. Project milestones and guidelines shall be met to coordinate the startup and sequencing of various systems. Work between the contracts shall be coordinated to provide smooth transition amongst different tasks for each contract. Related construction sequencing shall be coordinated by the Owner and/or Owner's Representative.
- B. Use of each project site shall be closely coordinated so all work can be completed without interruption. Trailer locations, staging areas and related use of site shall be coordinated between the contractors to prevent work interruption.
- C. Where common or mutual work is specified in each contract (i.e., common trenches, temporary electric connection, safety fence around excavation, etc.), work shall be performed under the "Knott Drive, Morgan Park, Viola Drive & Roslyn Village Pump Stations Improvements Project, General Construction Contract S3P312-05G". When work is separate and divisible, work shall be performed by each Contractor.
- D. Any conflicts amongst the projects shall be brought to the attention of the Owner's Representative for resolution. Decision of Owner's Representative shall be final.
- E. Extent of Contract: Unless the Agreement contains a more specific description of the work, requirements indicated on Drawings and in Specification Sections determine which contract includes a specific element of Project.
 - 1. Unless otherwise indicated, the work described in this Section for each contract shall be complete systems and assemblies, including products, components, accessories, and installation required by the Contract Documents.
- F. Temporary Facilities and Controls: In addition to specific responsibilities for temporary facilities and controls indicated in this Section and in Division 1 Section "Temporary Facilities and Controls," each contractor is responsible for the following:
 - 1. Installation, operation, maintenance, and removal of each temporary facility necessary for its own normal construction activity, and costs and use charges associated with each facility, except as otherwise provided for in this Section.
 - 2. Plug-in electric power cords and extension cords, supplementary plug-in task lighting, and special lighting necessary exclusively for its own activities.

SECTION 01005 – PROJECT COORDINATION

3. Its own storage and fabrication sheds.
4. Temporary enclosures for its own construction activities.
5. Staging and scaffolding for its own construction activities.
6. General hoisting facilities for its own construction activities.
7. Waste disposal facilities, including collection and legal disposal of its own hazardous, dangerous, unsanitary, or other harmful waste materials.
8. Progress cleaning of work areas affected by its operations on a daily basis.
9. Secure lockup of its own tools, materials, and equipment.
10. Noise control, erosion control, environmental protection and fire protection shall be in compliance with local laws, codes and regulations for its own construction activities.
11. Weather protection, dust protection, security, temporary heat, temporary light, temporary ventilation, temporary cooling, tree protection, safety fencing, protection of work, protection of existing structures and flood protection for its own construction activities.
12. Construction aids and miscellaneous services and facilities necessary exclusively for its own construction activities.
13. Site sanitary sewerage for its own construction trailer.
14. Temporary roads and paved areas for its own construction activities.
15. Project identification and temporary signs for its own construction project.
16. General waste disposal facilities areas for its own construction activities.
17. Temporary stairs areas for its own construction activities.
18. Temporary fire-protection facilities areas for its own construction activities.
19. Barricades, warning signs, and lights areas for its own construction activities.
20. Security enclosure and lockup areas for its own construction activities.
21. Environmental protection areas for its own construction activities.
22. Restoration of Owner's existing facilities used as temporary facilities areas for its own construction activities.
23. Temporary utility systems for its own construction activities.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01031 – ADDITIONS, MODIFICATIONS AND ALTERATIONS TO EXISTING BUILDINGS AND STRUCTURES

PART 1 – GENERAL

1.01 1.1 WORK INCLUDED

- A. Work includes all labor, materials, equipment and appurtenances required for the complete execution of additions, modifications and alterations to existing buildings and structures as shown on the Drawings and specified.
- B. The Contractor shall have examined all Work to be performed to the existing buildings and structures and familiarize himself with the nature and extent to which the existing buildings and structures will be damaged, items removed or re-arranged due to the Work under this Contract and that of other contracts.
 - 1. Cutting and patching shall conform to the requirements of the General Conditions, Article GC-29, "Cutting and Patching", and Section 01045, Cutting and Patching.
 - 2. Patching Work shall be performed with similar materials and in the same manner as adjoining Work. Joining between old and new Work shall be perfect and practically invisible. All due caution shall be taken to obtain a bond between old and new Work.
- C. Major portions of the Work are indicated on the Drawings for the Contract and the accompanying Specifications thereto. All Work must be complete in all respects and executed with high quality workmanship.
- D. Work to be performed due to damage caused by Contractor or his workers during demolition, removals, additions, modifications, and alterations that is not specifically indicated by details or general notes on the contract drawings may include the following:
 - 1. Removing loose rust, sealing or peeling paint from metal surfaces by scraping, sanding or wire brushing; priming and repainting metal surface (inside and outside) as specified under Section 09910, Painting.
 - 2. Cutting and modifying existing openings as necessary to receive new Work.
 - 3. Cleaning and repainting steel handrailing, brackets, sleeves, etc. Replacing existing railing with new aluminum railing, brackets, sleeves, etc.
- E. Submit detailed description of methods and equipment and sequence for additions, modifications and alterations for Engineer's review.

1.02 SITE AND BUILDINGS

- A. Prior to ordering any materials or doing any Work, verify and be responsible for the correctness of all measurements, dimensions and other conditions of each building and structure scheduled for Work as necessary and required

1.03 MATERIALS

- A. All materials to perform and complete the Work for Contract shall be new. Salvaged materials, such as brick, stone copings, granite sills, may be used under certain conditions subject to the approval of Engineer.
- B. All salvaged materials shall be sound and undamaged. Materials to be re-used shall be stored and protected as directed by Engineer. Care shall be taken to prevent damage to materials or equipment to be re-used.

1.04 SHORING, UNDERPINNING AND BRACING

- A. When necessary and required, provide underpinning and temporary shoring and bracings, all in accordance with code requirements, the Drawings, and as approved by Engineer.
- B. Shoring and bracing shall be of such form and so installed as to safely support the Work and interfere as little as possible with the progress of the Work. Suitable means shall be provided to adjust any settlement in the shoring supports. Temporary shoring shall consist of sound timbers or rolled shapes of required dimensions which shall be removed after necessity for same ceases to exist. All Work removed or damaged through installation of temporary shoring or through improper shoring shall be replaced or repaired after the shoring is removed, at no additional cost to the County.

SECTION 01031 – ADDITIONS, MODIFICATIONS AND ALTERATIONS TO EXISTING BUILDINGS AND STRUCTURES

1.05 WORK PREPARATION AND TEMPORARY ACCESS

- A. Before commencing Work, prepare a Progress Schedule in accordance with the requirements of Section 01300, Submittals and Section 01711, Maintenance of Facility Operations, in order to coordinate the Work of all trades and to insure completion on or before the completion date. The Owner and the Engineer reserve the right to revise or modify such schedules as required to expedite each phase of Work and to coordinate such Work with the partial use of the building for purposes as directed.
- B. No facility such as toilets, corridors, etc., shall be barricaded or access restricted without providing other temporary or interim means of access. It is further required that no Work specified hereinafter shall disturb or interfere with the operation of the existing mechanical installation until proposed new Work has been completed or satisfactorily installed. Exception may be made to this requirement only by written approval from Owner and Engineer.
- C. Detailed sequence of availability of areas within the present buildings where Work is to be performed under each Contract shall be in accordance with Section 01711, Maintenance of Facility Operations, but may be modified by the Contractor, upon authorization by the County and Engineer as the Work progresses.
- D. Furnish and install all temporary fire exits, fire extinguishers, hose and safety devices as may be required by authorities having jurisdiction.
- E. Work within the existing building, once started, shall be completed as quickly as practicable and each trade shall determine before Work is started that all required materials are at hand or readily obtainable to avoid delays.
- F. Shut-downs of existing services within existing buildings which may be occupied during construction will be permitted only upon approval by the County subject to at least sixty days notice in writing to the County in each case. Shut-downs will be limited to times which will result in the least interference with normal operations.

1.06 CUTTING, PATCHING, REPAIRING AND REFINISHING

- A. The Contractor will be responsible for cutting all openings in walls, floors and ceilings (indicated to remain) to accommodate alteration Work under his Contract in accordance with the requirements of the General Conditions, Article GC-29, "Cutting and Patching" and Article GC-30, "Openings and Chases" and as hereinafter specified.
 - 1. Where new openings are to occur in existing exterior and interior concrete and masonry bearing walls and structural concrete floors, notify the Engineer in writing and obtain approval prior to cutting operations. The Engineer will determine whether such openings affect the structural stability or load bearing capacities of the walls and the floors. Where embedded electrical conduits are known to exist, or where embedded conduits are found, notify the Owner to determine if the conduit can be abandoned. If the conduit connects to equipment or lighting that must be maintained in service, the Owner will direct the Contractor to install temporary conduit and cable to maintain service until existing service is no longer required.
 - 2. Core drill for individual openings passing through existing concrete slabs. Obtain authorization from the Owner prior to core drilling. Prior to core drilling, drill sufficient number of small exploratory holes to establish that the area to be core drilled is free of existing embedded conduits.
 - 3. All holes and openings to be cut in existing walls, floors and ceilings of any nature shall be geometrically correct and no larger than necessary to accommodate the new work.
 - 4. No cutting of finished or structural Work may be done without the approval of the Engineer.
- B. The Contractor shall be responsible for all finish patching operations of holes and openings in existing floors, walls, ceilings and roofs to accommodate the alteration Work under the Contract.
- C. Provide and set in place all sleeves, forms and inserts required for their Work before new walls, partitions, floors and roofs are built. All cutting and patching of new walls, partitions floors and

SECTION 01031 – ADDITIONS, MODIFICATIONS AND ALTERATIONS TO EXISTING BUILDINGS AND STRUCTURES

ceilings necessary for the reception of Work caused by failure to properly locate sleeves, forms and inserts or caused by incorrect location of Work shall be done at the expense of the Contractor involved, and shall require the approval of the Contractor whose Work is being cut, and the approval of the Engineer.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01031 – ADDITIONS, MODIFICATIONS AND ALTERATIONS TO EXISTING BUILDINGS AND STRUCTURES

+ + NO TEXT ON THIS PAGE + +

PART 1 – GENERAL

1.01 GENERAL

- A. Work Included:
 - 1. This Section covers the demolition, removal, and disposal of existing structures and equipment as indicated on the Drawings and as specified hereinafter. Furnish all labor, materials and equipment to demolish structures and equipment and to remove fixtures, anchors, supports, piping and accessories designated to be removed on the Contract Drawings.
 - 2. The Contractor's attention is directed to the fact there may be hazardous materials present within existing structures, and equipment to be demolished, removed, and disposed that will require special handling and other safe guard measures in order to minimize chemical exposure hazards to site workers and to prevent environmental impacts to offsite areas.
 - 3. The removal of all equipment and piping, and all materials from the demolition of structure shall, when released by the Engineer, be done by the Contractor and shall become the Contractor's property, unless otherwise noted, for disposition in any other manner not contrary to the Contract requirements and shall be removed from the Site to the Contractor's own place of disposal.
 - 4. Submit detailed description of methods and equipment and sequence for demolition and removal for the Engineer's review.
 - 5. Proceed with the removal of the equipment, piping and appurtenances in a sequence designed to maintain the facility in continuous operation as described in Section 01711, Maintenance of Facility Operations, and shall proceed only after approval of the Engineer.
 - 6. Any equipment, piping and appurtenances removed without prior authorization, which are necessary for the operation of the existing facility or of the work, shall be replaced to the satisfaction of the Engineer at no cost to the County.
- B. Related Sections:
 - 1. Section 01355, Hazardous Materials Control.
 - 2. Section 01711, Maintenance of Facility Operations.
 - 3. Section 02050, Demolition, Removals and Modifications.

1.02 PROTECTION

- A. General:
 - 1. Demolition and removal Work shall be performed by competent workers experienced in the various types of demolition and removal work required and shall be carried through to completion with due regard to the safety of Owner employees, workers on the Site and the public. The Work shall be performed with as little nuisance as possible.
 - 2. The Work shall comply with the applicable provisions and recommendation of ANSI A10.2, Safety Code for Building Construction, all governing codes and as hereinafter specified.
 - 3. Make such investigations, explorations and probes as are necessary to ascertain any required protective measures before proceeding with demolition and removal. Give particular attention to shoring and bracing requirements so as to prevent any damage to new or existing construction.
- B. Execution:
 - 1. Provide, erect and maintain catch platforms, lights, barriers, weather protection, warning signs and other items as required for proper protection of the public, occupants of the building, workmen engaged in demolition operations, and adjacent construction.
 - 2. Provide and maintain weather protection at exterior openings so as to fully protect the interior premises against damage from the elements until such openings are closed by new construction.
 - 3. Provide and maintain temporary protection of the existing structure designated to remain where demolition, removal and new Work is being done, connections made, materials handled or equipment moved.
 - 4. Take necessary precautions to prevent dust from rising by wetting demolished masonry, concrete, plaster and similar debris. Unaltered portions of the existing structures affected

SECTION 01039 – DEMOLITION AND REMOVAL OF EXISTING STRUCTURES AND EQUIPMENT

by the operations under this Section shall be protected by dustproof partitions and other adequate means.

5. Provide adequate fire protection in accordance with local Fire Department requirements.
6. Do not close or obstruct walkways, passageways, or stairways and do not store or place materials in passage-ways, stairs or other means of egress. Conduct operations with minimum traffic interference.
7. The Contractor shall be responsible for any damage to the exist-ing structure or contents by reason of the insufficiency of protection provided.

1.03 WORKMANSHIP

- A. The demolition and removal Work shall be performed as described in the Contract Documents. The Work required shall be done with care, and shall include all required shoring, bracing, etc. The Contractor shall be responsible for any damage which may be caused by demolition and removal Work to any part or parts of existing structures or items designated for reuse or to remain. Perform patching, restoration and new Work in accordance with applicable technical sections of the Specifications and in accordance with the details shown on the Contract Drawings. Prior to starting of the Work, provide a detailed description of methods and equipment to be used for each operation and the sequence thereof for review by the Engineer. All cutting and patching shall be performed in accordance with the requirements of the General Conditions, Article GC-29, "Cutting and Patching".
- B. All supports, pedestals and anchors shall be removed with the equipment and piping unless otherwise specified or required. Concrete bases, anchor bolts and other supports shall be removed to approximately one inch (1-in.) below the surrounding finished area and the recesses shall be patched to match the adjacent areas as shown. Wall and roof openings shall be closed, and damaged surfaces shall be patched to match the adjacent areas, as specified, as shown on the Contract Drawings, or as directed by the Engineer. Wall sleeves and castings shall be plugged or blanked off, all openings in concrete shall be closed in a manner meeting the requirements of the appropriate sections of the Specifications, as shown on the Contract Drawings and as directed and approved by the Engineer.
- C. Wherever piping is to be removed for disposition, drain the piping. Adjacent pipe and headers that are to remain in service shall be blanked off or plugged and then anchored in an approved manner.
- D. Materials or items to be demolished and not designated in Section 02050, Demolitions, Removals and Modifications, to become the property of the Owner or to be reinstalled shall become the property of the Contractor and shall be removed from the property and legally disposed of.
- E. Execute the Work in a careful and orderly manner, with the least possible disturbance to the public and to the occupants of the structures.
- F. Where alterations occur, or new and old Work join in, cut, remove, patch, repair or refinish the adjacent surfaces to the extent required by the construction conditions, so as to leave the altered Work in as good a condition as existed prior to the start of the Work. The materials and workmanship employed in the altera-tions, unless otherwise shown on the Contract Drawing or specified, shall comply with that of the various respective trades which normally perform the particular items of work.
- G. Finish adjacent existing surfaces of new Work to match the specified finish for new Work. Clean existing surfaces of dirt, grease, loose paint, etc., before refinishing.
- H. Where existing equipment are indicated to be reused, repair and refinish such equipment to put them in perfect working order. Refinishing shall be as specified in Section 02050, Demolitions, Removals, and Modifications, or and directed by the Engineer.
- I. Remove temporary work, such as enclosures, signs, guards, and the like when such temporary work is no longer required or when directed at the completion of the Work.

SECTION 01039 – DEMOLITION AND REMOVAL OF EXISTING STRUCTURES AND EQUIPMENT

1.04 CONDITION OF STRUCTURES AND EQUIPMENT

- A. The Owner does not assume responsibility for the actual condition of structures and equipment to be demolished and removed.
- B. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner so far as practicable.
- C. The information regarding the existing structures and equipment shown on the Contract Drawings is based on visual inspection and a walk-through survey only. Neither the Engineer nor the Owner will be responsible for interpretations or conclusions drawn therefrom by the Contractor.

1.05 MAINTENANCE

- A. Maintain the structures and public properties free from accumulations of waste, debris and rubbish, caused by the demolition and removal operations.
- B. Provide on-site dump containers for collection of waste materials, debris and rubbish, and he shall wet down dry materials to lay down and prevent blowing dust.
- C. At least once a week during the progress of the demolition and removal Work or as directed by the Engineer, clean the Site and properties (including sweeping roadways with mechanical street sweeper), and dispose of waste materials, debris and rubbish.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

+ + NO TEXT ON THIS PAGE + +

PART 1 – GENERAL

1.01 GENERAL

- A. This Section is supplementary to the requirements of the General Conditions, Article GC-29, "Cutting and Patching" and includes all cutting and patching of all Work under construction, completed Work and facilities installed by others, in order to accommodate the coordination of Work, install other Work, uncover Work for access, inspection or testing, or similar purposes. Demolition, removals and modifications work" is specified in Section 01039, Demolition and Removal of Existing Structures and Equipment. Execute all cutting and patching, including excavation, backfill and fitting required to:
 - 1. Remove and replace defective Work or Work not conforming to requirements of the Contract Documents.
 - 2. Remove samples of installed Work as required for testing.
 - 3. Remove all constructions required to provide for specified alteration or addition to Work by others.
 - 4. Uncover Work to provide for the Engineer's inspection of covered Work or inspection by regulatory agencies having jurisdiction.
 - 5. Connect to completed Work that was not accomplished in the proper sequence.
 - 6. Remove or relocate utilities and pipes installed by others which obstruct the Work to which connections must be made.
 - 7. Make connections or alterations to new facilities or facilities installed by others.
- B. Restore all Work by others to a state equal to that which it was in prior to cutting and restore new Work to the standards of these Specifications.
- C. Submittals:
 - 1. Prior to cutting, which may affect the integrity and design function of the Project, facility operations, or Work of another Contractor, submit written notice to the Engineer, requesting consent to proceed with cutting, including:
 - a. Identification of the Project.
 - b. Description of affected Work of Contractor and Work of others.
 - c. Necessity for cutting.
 - d. Effect on other Work and on structural integrity of the Project.
 - e. Description of proposed Work. Designate:
 - 1) Scope of cutting and patching.
 - 2) Contractor, Subcontractor or trade to execute Work.
 - 3) Products proposed to be used.
 - 4) Extent of refinishing.
 - 5) Schedule of operations.
 - f. Alternatives to cutting and patching, if any.
 - g. Designation of party responsible for cost of cutting and patching.
 - 2. Should conditions of Work, or schedule, indicate change of materials or methods, submit written recommendation to the Engineer, including:
 - a. Conditions indicating change.
 - b. Recommendations for alternative materials or methods.
 - c. Submittals as required for substitutions.
 - 3. Submit written notice to the Engineer, designating the time Work will be uncovered, to provide for observation. Do not begin cutting or patching operations until authorized by the Engineer.
- D. Provide shoring, bracing and support as required to maintain structural integrity of the Project and protect adjacent Work from damage during cutting and patching.
- E. Conform to all applicable Specifications for application and installation of materials used for patching.

SECTION 01045 – CUTTING AND PATCHING

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

PART 1 – GENERAL

1.01 GENERAL

- A. Establish at least two bench marks for use by all Contractors, in accordance with the General Conditions, Article GC 28, "Layout and Levels" and the Agreement, Article XXIX, "Character and Competency" and Article XXX, "Superintendence". The Contractor shall comply with this article.
- B. Contractor shall:
 - 1. Provide civil, structural or other professional engineering services specified, or required to execute Contractor's construction methods.
 - 2. Develop and make all detail surveys and measurements needed for construction including slope stakes, batter boards, piling and pier layouts and all other working lines, elevations and cut sheets.
 - 3. Keep a transit and leveling instrument on the Site at all times and a skilled instrument man employed or obtained whenever necessary for layout of the Work.
 - 4. Provide all material required for benchmarks, control points, batter boards, grade stakes, and other items.
 - 5. Be solely responsible for all locations, dimensions and levels. No data other than written orders of the Engineer shall justify departure from the dimensions and levels required by the Drawings.
 - 6. When requested by Engineer, provide such facilities as may be necessary for the Engineer to check line and grade points placed by the Contractor. The Contractor shall do no excavation, backfill or embankment Work until all cross sectioning necessary for determining pay quantities has been completed and checked by the Engineer.

1.02 CONTRACTOR'S FIELD ENGINEER

- A. Employ and retain at the Site of the Work a field engineer capable of performing all engineering tasks required of the Contractor. Tasks included are:
 - 1. A projection of Work to be completed the following day must be submitted to the Engineer by 4:00 PM of the preceding workday. This projection must include:
 - a. Location of all areas in which construction will be done, including the Contractor and his Subcontractors.
 - b. Major construction equipment utilized.
 - c. Equipment and materials to be installed.
 - 2. Provide all surveying equipment required including transit, level, stakes and required surveying accessories.
 - 3. Furnish all required lines and grades for construction of operations. Check all formwork, reinforcing, inserts, structural steel, bolts, sleeves, piping, other materials and equipment.
 - 4. Maintain field office files and drawings, Record Drawings, and coordinate engineering services with Subcontractors. Prepare Layout and Coordination Drawings for construction operations.
 - 5. Check and coordinate Work for conflicts and interference and immediately advise the Engineer of all discrepancies noted.
 - 6. Cooperate with the Engineer in field inspections, as required

1.03 QUALIFICATIONS OF SURVEYOR OR ENGINEER

- A. A qualified engineer or registered land surveyor, acceptable to the Engineer.

1.04 RECORDS

- A. Maintain a complete, accurate log of all control and survey Work as it progresses.
- B. On completion of foundation walls and major Site improvements, prepare a certified survey showing all dimensions, locations, angles and elevations of construction.

SECTION 01050 – FIELD ENGINEERING

1.05 SUBMITTALS

- A. When requested by the Engineer, submit a certificate signed by a registered Engineer or surveyor certifying that elevations and locations of Work are in conformance with the Contract Documents. Explain all deviations.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01072 – REFERENCE STANDARDS

PART 1 - GENERAL

1.01 When a reference standard is specified, comply with the requirements and recommendations stated in that standard, except when they are modified by the contract documents, or when applicable laws, ordinances, rules, regulations or codes establish stricter standards. The latest provisions of applicable standards shall apply to the work, unless otherwise specified. Reference standards include, but are not necessarily limited to, the following:

- A. AMCA- Air Moving and Conditioning Association, Inc.
 - 1. AASHTO - American Association of State Highway and Transportation Officials.
 - 2. ABMA- American Boiler Manufacturers' Association
 - 3. ACI - American Concrete Institute.
 - 4. ACIFS- American Cast Iron Flange Standards.
 - 5. AFBMA- Anti-Friction Bearing Manufacturers Association.
 - 6. AGA- American Gas Association.
 - 7. AGMA- American Gear Manufacturers Association.
 - 8. AIA- American Institute of Architects.
 - 9. AISC- American Institute of Steel Construction.
 - 10. AISI- American Iron and Steel Institute.
 - 11. ANSI - American National Standards Institute.
 - 12. APA- American Plywood Association.
 - 13. API- American Petroleum Institute.
 - 14. ASCE- American Society of Civil Engineers.
 - 15. ASME- American Society of Mechanical Engineers.
 - 16. ASTM- American Society for Testing and Materials.
 - 17. AWWA- American Water Works Association.
 - 18. AWS- American Welding Society.
 - 19. AWWA- American Water Works Association.
 - 20. CGA- Compressed Gas Association.
 - 21. CRSI- Concrete Reinforcing Steel Institute.
 - 22. CMAA- Crane Manufacturers' Association of America.
 - 23. DIPRA- Ductile Iron Pipe Research Association.
 - 24. EEI- Edison Electric Institute.
 - 25. EJMA- Expansion Joint Manufacturers' Association.
 - 26. Fed Spec - Federal Specifications.
 - 27. FM- Factory Mutual.
 - 28. HMI- Hoist Manufacturers' Institute.
 - 29. IEEE- Institute of Electrical and Electronic Engineers.
 - 30. IPCEA- Insulated Power Cable Engineers Association.
 - 31. NACE- National Association of Corrosion Engineers.
 - 32. NB- National Board of Boiler Pressure Vessels.
 - 33. NBS- National Bureau of Standards.
 - 34. NEC- National Electric Code.
 - 35. NEMA- National Electrical Manufacturers Association.
 - 36. NFPA- National Fire Protection Association.
 - 37. NYSDEC - New York State Department of Environmental Conservation.
 - 38. NYSDOT - New York State Department of Transportation.
 - 39. OSHA- Occupational Safety and Health Act.
 - 40. PCA- Portland Cement Association.
 - 41. PCI- Pre-stressed Concrete Institute.
 - 42. RMA- Rubber Manufacturers' Association.
 - 43. SMACCNA - Sheet Metal and Air Conditioning Contractors National Association.
 - 44. SPI- Society of Plastics Industry.
 - 45. SSPC- Steel Structures Painting Council.
 - 46. STI- Steel Tank Institute

SECTION 01072 – REFERENCE STANDARDS

47. UL- Underwriters' Laboratory.

- B. The Contractor shall, when required, furnish evidence satisfactory to the Engineer that materials and methods are in accordance with such standards where so specified.
- C. In the event any questions arise as to the application of these standards or codes, copies shall be supplied on Site by Contractor.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01141 – SITE UTILIZATION PLAN

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Site Utilization Plan requirements

1.02 SITE UTILIZATION PLAN REQUIREMENTS

- A. Prepare a Site Utilization Plan (SUP) for each site showing staging areas, parking areas, stockpile areas, debris container areas, unloading areas, and trailer areas for review by the Owner and Engineer. The length and amount of meetings necessary to develop and adopt a SUP shall be as required.
- B. Meeting(s) will be held at the site with all concerned parties to assist the Contractor in developing the criteria for the plan. During these meeting(s), all parties will present their needs and requirements for site utilization. As a minimum, each Contractor shall be allocated a portion of the available staging/parking/material storage area. Representatives from the local municipality or utility companies may be attending. The requirements of the local municipality and utility companies shall be incorporated into the SUP.
- C. Prepare a draft site plan that attempts to incorporate the needs of all concerned parties. Another meeting will then be held at the site to review and present the plan. The plan shall then be revised at that meeting and adopted for use if it is acceptable to all relevant parties. If all parties cannot agree on an acceptable plan, then the Engineer will establish the Site Utilization Plan without any claims from the Contractor.
- D. The Contractor shall understand the importance of a workable Site Utilization Plan and also understands that the Owner and Engineer may be required to select a plan to adopt that is not ideal to the planned construction activities anticipated before the bid was submitted. The Contractor shall not submit claims for damages associated with site utilization.
- E. If a Site Utilization Plan as stipulated above is not prepared, then the Owner reserves the right to back charge the Contractor for the costs associated with having a Site Utilization Plan developed.
- F. If the Contractor fails to participate or attend the meetings scheduled to develop the Site Utilization Plan then the Contractor will forfeit any right to comment on the plan that is developed.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

++ NO TEXT ON THIS PAGE ++

PART 1 – GENERAL

1.01 DESCRIPTION

- A. The items listed below, beginning with Article 1.4, refer to and are the same pay items listed in the Bid Schedule. They constitute all of the pay items for the completion of the Work. No direct or separate payment will be made for providing miscellaneous temporary or accessory works, plant services, Contractor's or Engineer's field offices, layout surveys, job signs, sanitary requirements, testing, safety devices, approval and Record Drawings, water supplies, power, maintaining traffic, removal of waste, security personnel, Bonds, insurance, and all other requirements of the Agreement, General Conditions and the Special Conditions. Compensation for all such services, items and materials shall be included in the prices stipulated for the lump sum and unit pay items listed herein. Unless otherwise specified, no separate payment will be made for stored equipment.

1.02 RELATED PROVISIONS SPECIFIED ELSEWHERE

- A. Payments to the Contractor: Refer to the Agreement and the General Conditions.

1.03 CONTRACT NO. S3P312-05G – GENERAL CONSTRUCTION

- A. Item 1 – General Construction Knott Drive Ejector Station:
1. Payment for Item 1 will be the lump sum bid under this item and will be full compensation for completing the Work generally described in Section 01010, Summary of Work, at the Knott Drive Ejector Station, as shown on the Contract Drawings, and as specified under Divisions 1 through 16.
- B. Item 2 – General Construction Morgan Park Pump Station:
1. Payment for Item 2 will be the lump sum bid under this item and will be full compensation for completing the Work generally described in Section 01010, Summary of Work, at the Morgan Park Pump Station, as shown on the Contract Drawings, and as specified under Divisions 1 through 16.
- C. Item 3 – General Construction Viola Drive Pump Station:
1. Payment for Item 3 will be the lump sum bid under this item and will be full compensation for completing the Work generally described in Section 01010, Summary of Work, at the Viola Drive Pump Station, as shown on the Contract Drawings, and as specified under Divisions 1 through 16.
- D. Item 4 – General Construction Roslyn Village Pump Station:
1. Payment for Item 4 will be the lump sum bid under this item and will be full compensation for completing the Work generally described in Section 01010, Summary of Work, at the Roslyn Village Pump Station, as shown on the Contract Drawings, and as specified under Divisions 1 through 16.
- E. Item 5 - Allowance is described in the Proposal Section and in Section 01210. The total cost for these items shall be included in the total price.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01150 – MEASUREMENT AND PAYMENT

+ + NO TEXT ON THIS PAGE + +

SECTION 01210 – ALLOWANCES

PART 1 – GENERAL

1.01 DESCRIPTION

- A. General: The Allowance described below shall be included in the Contractor's total bid. Any amounts not expended prior to completion of the Project shall be deducted from the final payment made to the Contractor.

1.02 SCHEDULE OF ALLOWANCES

- A. Item No. 5: An allowance for costs associated with unforeseen conditions.
- B. Item No. 6: An allowance for costs associated with water meter installation.

1.03 BASIS FOR PAYMENT

- A. Item No. 5: The allowance is for costs associated with unforeseen conditions. Payment under this allowance shall be paid on the basis of the cost of labor and materials, computed in accordance with the requirements, of the Agreement, Article XX11, "Extra Work". Any funds remaining at the end will be eliminated by a credit change order.
- B. Item No. 6: The allowance is for costs associated with installation of water meters at the following pump stations. The site shall be restored to pre-construction conditions. Payment under this allowance shall be paid on the basis of the cost of labor and materials, computed in accordance with the requirements, of the Agreement, Article XX11, "Extra Work". Any funds remaining at the end will be eliminated by a credit change order.
 - Pump Stations for water meter installation
 - Central Homes
 - Dana's Highway
 - Franklin Ave
 - Glengariff Drive
 - Long Meadow Lane
 - Morgan Park
 - Shore Road
 - Titus Road
 - Viola Drive
 - Woodland Road

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01210 – ALLOWANCES

++ NO TEXT ON THIS PAGE ++

SECTION 01300 – SUBMITTALS

PART 1 - GENERAL

1.01 DESCRIPTION OF REQUIREMENTS

- A. This Section specifies the general methods and requirements of submissions applicable to Shop Drawings, Product Data, Samples, Mockups, Construction Photographs, Construction or Submittal Schedules. Detailed submittal requirements are specified in the technical Sections.
- B. All submittals shall be clearly identified by reference to Section Number, Paragraph, Drawing Number or Detail as applicable. Submittals shall be clear and legible and of sufficient size for presentation of data.

1.02 SHOP DRAWINGS, PRODUCT DATA, SAMPLES

- A. Shop Drawings
 - 1. Shop drawings as specified in individual Sections include, custom-prepared data such as fabrication and erection/installation (working) drawings, scheduled information, setting diagrams, actual shop work manufacturing instructions, custom templates, special wiring diagrams, coordination drawings, individual system or equipment inspection and test reports including performance curves and certifications, as applicable to the work.
 - 2. All shop drawings submitted by subcontractors shall be sent directly to the Contractor for checking. The Contractor shall be responsible for their submission at the proper time so as to prevent delays in delivery of materials.
 - 3. Check all subcontractor's shop drawings regarding measurements, size of members, materials and details to make sure that they conform to the intent of the Drawings and related Sections. Return shop drawings found to be inaccurate or otherwise in error to the subcontractors for correction before submission thereof.
 - 4. All details on shop drawings shall show clearly the relation of the various parts to the main members and lines of the structure and where correct fabrication of the work depends upon field measurements, such measurements shall be made and noted on the drawings before being submitted.
 - 5. Submittals for equipment specified under Divisions 11 through 16 shall include a listing of all installations where identical or similar equipment has been installed and been in operation for a period of at least one year.
- B. Product Data - Product data as specified in individual Sections include, standard prepared data for manufactured products (sometimes referred to as catalog data), such as the manufacturer's product specification and installation instructions, availability of colors and patterns, manufacturer's printed statements of compliances and applicability, roughing-in diagrams and templates, catalog cuts, product photographs, standard wiring diagrams, printed performance curves and operational-range diagrams, production or quality control inspection and test reports and certifications, mill reports, product operating and maintenance instructions and recommended spare-parts listing and printed product warranties, as applicable to the work.
- C. Samples - Samples specified in individual Sections include, physical examples of the work such as sections of manufactured or fabricated work, small cuts or containers of materials, complete units of repetitively-used products, color/texture/pattern swatches and range sets, specimens for coordination of visual effect, graphic symbols and units of work to be used by the Engineer or Owner for independent inspection and testing, as applicable to the work.

1.03 CONTRACTOR'S RESPONSIBILITIES

- A. Review shop drawings, product data and samples, including those by subcontractors, prior to submission to determine and verify the following:
 - 1. Field measurements
 - 2. Field construction criteria

SECTION 01300 – SUBMITTALS

3. Catalog numbers and similar data
4. Conformance with related Sections
- B. Each shop drawing, sample and product data shall have affixed to it the following Certification Statement including the Contractor's Company name and signed by the Contractor: "Certification Statement: by this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements." The cover sheet shall fully describe the packaged data and include a listing of all items within the package. Provide to the Resident Project Representative a copy of each transmittal sheet for shop drawings, product data and samples at the time of submittal to the Engineer.
- C. Utilize a 9 character submittal identification numbering system in the following manner:
 1. The first five digits shall be the applicable Section Number.
 2. The next three digits shall be the numbers 001 to 999 to sequentially number each initial separate item or drawing submitted under each specific Section Number.
 3. The last character shall be a letter, A to Z, indicating the submission, or resubmission of the same Drawing, i.e., "A=1st submission, B=2nd submission, C=3rd submission, etc. A typical submittal number would be as follows:

03300-008-B

03300 = Section for Concrete

008 = The eighth initial submittal under this section

B. = The second submission (first resubmission) of that particular shop drawing.

- D. Notify the Engineer in writing, at the time of submittal, of any deviations in the submittals from the requirements of the Contract Documents. All cost associated with any deviations shall be borne by the Contractor.
- E. The review and approval of shop drawings, samples or product data by the Engineer shall not relieve the Contractor from the responsibility for the fulfillment of the terms of the Contract. All risks of error and omission are assumed by the Contractor and the Engineer will have no responsibility therefor.
- F. No portion of the work requiring a shop drawing, sample, or product data shall be started nor shall any materials be fabricated or installed prior to the approval or qualified approval of such item. Fabrication performed, materials purchased or on-site construction accomplished which does not conform to approved shop drawings and data shall not be permitted. The Owner will not be liable for any expense or delay due to corrections or remedies required to accomplish conformity.
- G. Project work, materials, fabrication, and installation shall conform with approved shop drawings, applicable samples, and product data.

1.05 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule and in such sequence as to cause no delay in the Work or in the work of any other contractor.
- B. Contractor shall reference the General Conditions for additional submission requirements.
- C. Number of submittals required:
 1. Shop Drawings: See Article 1.5 below.
 2. Product Data: See Article 1.5 below.
 3. Samples: Submit the number stated in the respective Sections.
- D. Submittals shall contain:

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1. The date of submission and the dates of any previous submissions.
2. The Project title and number.
3. Contractor identification.
4. The names of:
 - a. CONTRACTOR
 - b. SUPPLIER
 - c. MANUFACTURER
 - d. Identification of the product, with the section number, page and paragraph(s).
 - e. Field dimensions, clearly identified as such.
 - f. Relation to adjacent or critical features of the work or materials.
 - g. Applicable standards, such as ASTM or Federal Standards numbers.
 - h. Identification of deviations from Contract Documents.
 - i. Identification of revisions on resubmittals.
 - j. A blank space suitably sized for Contractor and Engineer stamps as defined in the General Conditions.
 - k. Where calculations are required to be submitted by the Contractor, the calculations shall have been checked by a qualified individual other than the preparer. The submitted calculations shall clearly show the names of the preparer and of the checker.

1.06 ELECTRONIC DATA SUBMITTAL FORMAT

- A. Files shall be electronically searchable based on Owner and Engineer established standard file naming convention.
- B. Quality and Legibility: Electronic submittal files shall be made from the original and shall be clear and legible. Do not provide scans of faxed copies. Electronic file shall be made at the full size of the original paper documents. All pages shall be properly oriented for reading on a computer screen without rotating.
- C. Organization and Content:
 1. Each electronic submittal shall be one electronic file. Do not divide and submit individual submittals into multiple electronic files unless directed by Engineer.
 2. When submittal is large or contains multiple parts, provide PDF file with bookmark for each section of submittal.
 3. Submittal content shall include Contractor's letter of transmittal and Contractor's review and stamp.
- D. Electronic file format: PDF (Portable Document Format): .pdf, Adobe PDF documents; created through electronic conversion rather than optically scanned whenever possible.

1.07 REVIEW OF SHOP DRAWINGS, PRODUCT DATA, WORKING DRAWINGS AND SAMPLES

- A. The review of shop drawings, data and samples will be for general conformance with the design concept and Contract Documents. They shall not be construed:
 1. as permitting any departure from the Contract requirements;
 2. as relieving the Contractor of responsibility for any errors, including details, dimensions, and materials;
 3. as approving departures from details furnished by the Engineer, except as otherwise provided herein.
- B. The Contractor is responsible for details and accuracy, for coordinating the work with all other associated work and trades, for selecting fabrication processes, for techniques of assembly, and for performing work in a safe manner.
- C. If the shop drawings, data or samples as submitted describe variations and show a departure from the Contract requirements which Engineer finds to be in the interest of the Owner and to be so minor as not to involve a change in Contract Price or Contract Time, the Engineer may return the reviewed drawings without noting an exception.

SECTION 01300 – SUBMITTALS

- D. Submittals will be returned to the Contractor under one of the following codes.
1. Code 1 - "APPROVED" is assigned when there are no notations or comments on the submittal. When returned under this code the Contractor may release the equipment and/or material for manufacture.
 2. Code 2 - "APPROVED AS NOTED". This code is assigned when a confirmation of the notations and comments IS NOT required by the Contractor. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product.
 3. Code 3 - "APPROVED AS NOTED/CONFIRM". This combination of codes is assigned when a confirmation of the notations and comments IS required by the Contractor. The Contractor may, at his own risk, release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. This confirmation shall specifically address each omission and nonconforming item that was noted. Confirmation is to be received by the Engineer within 14 calendar days of the date of the Engineer's transmittal requiring the confirmation.
 4. Code 4 - "APPROVED AS NOTED/RESUBMIT". This combination of codes is assigned when notations and comments are extensive enough to require a resubmittal of the package. This resubmittal is to address all comments, omissions and non-conforming items that were noted. Resubmittal is to be received by the Engineer within 14 calendar days of the date of the Engineer's transmittal requiring the resubmittal.
 5. Code 5 - "NOT APPROVED" is assigned when the submittal does not meet the intent of the Contract Documents. The Contractor must resubmit the entire package revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the Contract Documents.
 6. Code 6 - "COMMENTS ATTACHED" is assigned where there are comments attached to the returned submittal which provide additional data to aid the Contractor.
 7. Code 7 - "SUBMITTED FOR THE RECORD" is assigned when the contractor has submitted information for record purposes.
 8. Codes 1 through 5 designate the status of the reviewed submittal with Code 6 showing there has been an attachment of additional data.
- E. Resubmittals will be handled in the same manner as first submittals. On resubmittals, identify all revisions made to the submittals, either in writing on the letter of transmittal or on the shop drawings by use of revision triangles or other similar methods. The resubmittal shall clearly respond to each comment made by the Engineer on the previous submission. Additionally, direct specific attention to any revisions made other than the corrections requested by the Engineer on previous submissions.
- F. Partial submittals may not be reviewed. The Engineer will be the only judge as to the completeness of a submittal. Submittals not complete will be returned to the Contractor and will be considered "Not Approved" until resubmitted. The Engineer may at his option provide a list or mark the submittal directing the Contractor to the areas that are incomplete.
- G. Repetitive Review
1. Shop drawings and other submittals will be reviewed no more than three times at the Owner's and Engineer's expense. All subsequent reviews will be performed at times convenient to the Owner and Engineer and at the Contractor's expense, based on the Owner's and Engineer's then prevailing rates. The Contractor shall reimburse the Owner and Engineer for all such fees invoiced to the Owner by the Engineer as defined in Article GC-18 of the General Conditions. Submittals are required until approved.

SECTION 01300 – SUBMITTALS

2. Any need for more than one resubmission, or any other delay in obtaining Engineer's review of submittals, will not entitle Contractor to extension of the Contract Time.
- H. If the Contractor considers any correction indicated on the shop drawings to constitute a change to the Contract Documents, give written notice thereof to the Engineer at least 7 working days prior to release for manufacture. If such notice is not received within 7 day the Contractor will not be eligible for a claim against the County for additional compensation.
- I. When the shop drawings have been completed to the satisfaction of the Engineer, the Contractor shall carry out the construction in accordance therewith and shall make no further changes therein except upon written instructions from the Engineer.

1.08 DISTRIBUTION

- A. Distribute reproductions of approved shop drawings and copies of approved product data and samples, where required, to the job site file and elsewhere as directed by the Engineer. Number of copies shall be as directed by the Engineer but shall not exceed six.

1.09 MOCKUPS

- A. Mockup units as specified in individual Sections, include but are not necessarily limited to, complete units of the standard of acceptance for that type of work to be used on the project. Remove at the completion of the work or when directed.

1.10 PROFESSIONAL ENGINEER (P.E.) CERTIFICATION FORM

- A. If specifically required in other related Sections, submit a P.E. Certification for each item required, using the form attached to this Section, completely filled in and stamped.

1.11 ADDITIONAL SUBMITTAL REQUIREMENTS

- A. Additional Contractor submission requirements are included in Article GC-14 of the General Conditions.

1.12 GENERAL PROCEDURES FOR SUBMITTALS

- A. Coordination of Submittal Times: Prepare and transmit each submittal sufficiently in advance of performing the related work or other applicable activities, or within the time specified in the individual work of other related Sections, so that the installation will not be delayed by processing times including disapproval and resubmittal (if required), coordination with other submittals, testing, purchasing, fabrication, delivery and similar sequenced activities. No extension of time will be authorized because of the Contractor's failure to transmit submittals sufficiently in advance of the Work.

SECTION 01300 – SUBMITTALS

P.E. CERTIFICATION FORM

The undersigned hereby certifies that he/she is a Professional Engineer registered in the State of New York and that he/she has been employed by

_____ to design

(Name of Contractor)

(Insert P.E. Responsibilities)

in accordance with Section _____ for the

(Name of Project)

The undersigned further certifies that he/she has performed the design of the

(Name of Project)

that said design is in conformance with all applicable local, state and federal codes, rules, and regulations, and that his/her signature and P.E. stamp have been affixed to all calculations and drawings used in, and resulting from, the design.

The undersigned hereby agrees to make all original design drawings and calculations available to the

Nassau County Department of Public Works

(Insert Name of Owner)

or Owner's representative within seven days following written request therefor by the Owner.

P.E. Name

Contractor's Name

Signature

Signature

Address

Title

Address

SECTION 01300 – SUBMITTALS

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01300 – SUBMITTALS

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PART 1 - GENERAL

1.01 DESCRIPTION

- A. The work shall consist of preparing, submitting, and maintaining a computerized CPM (Critical Path Method) progress schedule using Primavera P6 software.
- B. The purpose of the computerized CPM progress schedule is to ensure timely completion of the Contract and to establish a standard methodology for time adjustment analysis based on the principles of the Critical Path Method of Scheduling.
- C. For this specification, 'Engineer' means County authorized Construction Manager.
- D. The Contractor shall ensure that any and all computer files submitted to the Engineer are in a format that can be imported directly using Primavera P6 software, version 16.2 or later.
- E. The Contractor shall retain a CPM Consultant, approved by the Engineer, to assist in the development and preparation of the CPM schedule, and in subsequent schedule updating. The CPM Consultant shall have acceptable certifications such as AACE's Planning & Scheduling Professional (PSP), Project Management Institute's PMI-SP, or approved equal. The CPM Consultant is required to attend the Monthly Schedule Update Meetings. The Contractor is deemed to have included in the Bid price sufficient monies to pay all expenses required to develop the CPM Schedule and to guarantee its successful operation, implementation and maintenance.

1.02 DETAILS

A. PRE CONSTRUCTION SCHEDULE MEETING

- 1. The Engineer will schedule and conduct a Pre-construction Scheduling Meeting with the Contractor within ten (10) working days after Notice to Proceed. The requirements of this specification will be reviewed at this meeting. Additionally, the following topics will be discussed:
 - a. Specifics of any Contract Time-Related Clauses.
 - b. The representation in the schedule of the Time Related work.
 - c. The calendar, activity coding, and resource definition requirements unique to and consistent with the Contract.
 - d. The Contractor's schedule methodology employed, proposed work sequence and any proposed deviations of sequences from the Contract plans.
 - e. The factors that the Contractor determines to control the completion of the project and any milestone completions contained therein.
 - f. Narrative content for Initial Baseline and Monthly Updates.
 - g. Schedule submission protocol for Initial Baseline and Monthly Updates.
- 2. The Contractor's attendance at the Pre-construction Scheduling Meeting is mandatory. No field work will be allowed, with the exception of set up of the field office, until this meeting is held.

B. INITIAL BASELINE CPM CONSTRUCTION SCHEDULE

- 1. Within forty-five (45) work days following the Notice to Proceed, prepare and submit to the Engineer the Initial Baseline CPM Construction Schedule for the entire project. This submission shall include the electronic Schedule file and paper reports as required and approved by the Engineer.
- 2. The Initial Baseline Schedule must be Cost and resource loaded and shall represent the Contractor's plan to construct the project. This schedule shall include all work and activities necessary to complete the project including but not limited to activities for the preparation, submittal, review, approval, fabrication, and delivery of all procurement related items. The Initial Baseline CPM Construction Schedule must be set up to conform to the staging/phasing and other requirements defined in or required by the Contract.
- 3. The Initial Baseline Schedule shall meet all interim milestone dates and shall not extend beyond the Contract completion date.

C. SCHEDULE REQUIREMENTS

SECTION 01311 – CONSTRUCTION SCHEDULING

1. The Contractors Initial Baseline CPM Construction Schedule shall meet the following requirements:
 - a. CPM ACTIVITY NETWORK FORMAT - The schedule network shall use the Precedence Diagramming Method.
 - b. PROJECT DEFINITIONS - The following project specific properties within the schedule shall be defined:
 - 1) CALENDAR - All calendars created shall encompass and account for the total duration of the Contract time period. The standard calendar shall be 8-hour days, five days per week and shall account for holidays and non-working days as defined in the Contract documents. Additional calendars shall be created and included as required for:
 - (a) Work week (5 or 6 day). (When or if the Contractor elects to utilize a 6-day work week he shall be responsible for the county's overtime costs as applicable by the Contract requirements).
 - (b) Seasonal restrictions (asphalt, landscape, etc.).
 - (c) Concrete curing/calendar days.
 - (d) Any project specifics as required by the Engineer.
 - (e) Expected and contemplated weather conditions shall be accounted for in the schedule and described in the narrative.
 - 2) ACTIVITY CODE- As a minimum following activity codes shall be established:
 - a. Responsibility - The party responsible for each activity. Only one party can be responsible for an activity. Include Values for "Nassau County Department of Public Works (NC)", "Prime Contractor" and third parties to the Contract as appropriate (utilities, etc.).
 - b. Phase- Phasing consistent with Contract plans where each activity is performed; Include Values for "None", and "Project Wide".
 - c. Location - Location of activity work by Stationing; Include Value for "None", and "Project Wide".
 - d. Type- The type of work for each activity; Include a Value for Administrative"
 - e. Added Work- Work added to the Contract and incorporated into the schedule with the Engineers Approval.
 - f. As Required by Project - Any coding unique to or as required by the Engineer to facilitate the use and analysis of the Schedule. This coding shall be established in consultation with the Engineer at the Pre-construction Scheduling Meeting.
 - 3) RESOURCES - The Resource Dictionary shall be established as required by the Engineer. The Resource Dictionary shall be limited to Labor and Equipment. Labor may be represented by work crews. The composition of each crew must be detailed and included as an appendix to the Narrative Report. Sub-Contractors shall be represented as a labor crew(s).
 - 4) COST LOADING – Basis of cost loading will be the approved Schedule of Values.
 - 5) ACTIVITY DATA
 - a. ACTIVITY IDENTIFICATION - Each activity shall have a unique identifier. The identifier may be alpha-numeric, but at a minimum must be a unique number.
 - b. ACTIVITY DESCRIPTION - Each activity shall be unambiguously described. Descriptions such as "construct 30% of Y" are unacceptable. Activities shall be discrete to the extent necessary to accurately schedule the work.
 - c. ACTIVITY DURATION - Durations of individual work activities shall not exceed twenty (20) working days. The minimum activity duration increment is one full day. Durations of individual shop drawing review activities may exceed fifteen working days and shall be consistent with Contract Requirements. Exceptions to this will be reviewed by the Engineer on an activity-by-activity basis. If requested by the Engineer, production rates or other supporting

SECTION 01311 – CONSTRUCTION SCHEDULING

information shall be supplied justifying the reasonableness of any given activity time duration. A Method Statement including the labor, equipment, production rates and any additional information, required to achieve a given activity shall be supplied within 5 working days when requested by the Engineer.

d. **ACTIVITY RELATIONSHIPS** – Activity relationships shall be finish-to-start with no lags unless directed otherwise by the Engineer. Contractor requests for exemptions will be made on a case by case basis. Each activity with the exception of the required “Project Notice To Proceed” and “Completion” activities shall have a predecessor and a successor activity relationship.

e. **ACTIVITY START and FINISH DATES** - The earliest start date, earliest finish date, latest start date, and latest finish date shall be calculated for each activity.

f. **ACTIVITY TOTAL FLOAT** - The total float shall be calculated for each activity. Total float is the full amount of time by which the start on an activity may be delayed without causing the project to last longer.

g. **ACTIVITY CALENDARS** - The appropriate calendar assignment shall be made to each activity

h. **ACTIVITY CODES** - Coding shall be assigned to each activity from the defined activity dictionary. Each code shall have a value assigned in a given activity.

i. **ACTIVITY CONSTRAINTS** - The start or completion of any activity shall not be constrained. Exceptions to this must receive prior approval in writing by the Engineer. A “Must-Finish-By” Date for the overall project is a constraint and must be pre-approved by the Engineer.

j. **ACTIVITY RESOURCES**- The schedule shall be “Resource” loaded as required by the Engineer. The resources required to accomplish each activity shall be assigned to that activity from the ‘Resource Dictionary’

- 6) **REQUIRED ACTIVITIES** - The following activities shall be incorporated into the Schedule:

Activity ID	Activity Description	Activity Type	Logic Relationship
000010	Contract “Notice to Proceed”	Start Milestone	No Predecessors to this First Schedule Activity
999999	Completion	Finish Milestone	No Successors to this Last Schedule Activity

- 7) **DATA DATE** - The Data Date and Project Start Date in the Initial Baseline Schedule shall be the NOTICE TO PROCEED DATE. The Data Date for each Monthly Update shall be the first work day of the month.

D. REVIEW AND ACCEPTANCE OF THE INITIAL BASELINE CPM CONSTRUCTION SCHEDULE -

1. Submit to the Engineer the following items to facilitate review of the Initial Baseline CPM Construction Schedule:
 - a. **Narrative**- A statement explaining the general sequence of work in the Contractor's schedule, a detailed definition of the work on the Critical Path, a statement regarding the meeting of any Time Restrictive Clause dates, and the explanation of any other ambiguities in the schedule.
2. The following Activity Reports generated from the software shall be provided or as required and approved by the Engineer:
 - a. **Critical Path Activity Sort** - The activities that comprise the projects Critical Path. The list shall start with the first activity in the path and then ascend by Early Start date to the final activity in the path.
 - b. **Time Related Activity Sort** - For the activities necessary to complete the work within each specific Time Frame provision in the Contract, shall be listed. The list shall start with the first milestone activity and then ascend by Early Start date to the final milestone activity in the network comprising each Time Frame period. Include a Critical Path activity sort for each specific Time Frame in the Contract.

SECTION 01311 – CONSTRUCTION SCHEDULING

- c. Constraint Activity Sort - Listing of Constrained Activities and type of constraint.
 - d. Listing of Calendars and Activity Coding incorporated in the Schedule.
 - 3. Provide electronic copies of the Initial CPM Construction Schedule in format approved by the Engineer.
 - 4. The Engineer will review the Initial Baseline CPM Construction Schedule and forward any comments, revisions, or requests to the Contractor. Within ten (10) work days of the Engineer's reply, the Contractor shall make adjustment to the Initial Baseline CPM Construction Schedule in accordance with the Engineer's comments and resubmit copies for review consistent with the above directives.
 - 5. Upon final revisions, the Contractor shall submit electronic file copies of the Initial Baseline CPM Construction Schedule to the Engineer. A sort of activities scheduled to start (ES) & finish (EF) in the next update period shall be included. The Logic Diagram shall be submitted as directed by the Engineer. The final submission shall be submitted for approval within five (5) work days of the Contractor's receipt of the final comments by the Engineer.
 - 6. Approval of the Initial Baseline CPM Construction Schedule by the Engineer shall not be construed to imply approval of any particular method or sequence of construction or to relieve the Contractor of providing sufficient materials, equipment, and labor to guarantee completion of the project in accordance with the Contract proposal, plans, and specifications. Approval shall not be construed to modify or amend the completion date. Completion dates can only be modified or amended by standard contractual means.
 - 7. Failure to include in the Initial Baseline CPM Construction Schedule any element of work required for the performance of the Contract shall not excuse the Contractor from completing all work required within the completion date(s) specified in the contract.
- E. SCHEDULE UPDATES
- 1. MONTHLY PROGRESS UPDATES
 - a. Update the schedule monthly. The schedule shall be updated to include all work and progress up to and including the last working day of the month. This will establish the "Data Date". The Monthly update shall detail progress based on actual dates of activities started and completed, the percent of work completed to date on each activity started but not yet completed and the status of procurement of critical materials. The updated schedule data shall be submitted in an electronic file format acceptable to the Engineer.
 - 2. A Narrative Report is required for each update and shall provide the following information:
 - a. Contractors transmittal letter to the Engineer stating the update period and schedule "Data Date".
 - b. Work started, completed and ongoing during the update period by activity with "Actual Dates".
 - c. Description of current Critical Path and any change from previous Critical Path.
 - d. Activities added or deleted and any proposed changes in Activity Logic (Engineer's approval in writing is required).
 - e. Current Delays or Advancements
 - 1) Delayed or Advanced Activities.
 - 2) Proposed corrective action and schedule adjustments to address any Delays.
 - 3) Impact of Delays or Advancement on other activities (duration, ES, EF, LS, LF), milestone and completion dates.
 - 4) Impact of Delays or Advancement on the Critical Path.
 - f. Outstanding Items that effect the schedule and status thereof (including but not limited to):
 - (1) Permits.
 - (2) Shop Drawings.
 - (3) Change Orders.
 - (4) Reviews of submittals.
 - (5) Approvals.

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- (6) Fabrication and Delivery.
 - g. Scheduled Completion Date Status
 - (1) Contract Completion.
 - (2) Interim Milestones / Time Frame if any.
- 3. The following Activity Reports generated from the Software shall be provided:
 - a. Current Critical Path Activity Sort
 - b. Near Critical Activities Sort
 - c. Report of Activities scheduled to start (ES) & finish (EF) in the next Monthly update period.
 - d. Any other “Report” as directed by the Engineer and/or as discussed in the pre-construction scheduling meeting.
- 4. Submit Monthly Progress Updates to the Engineer within five (5) work days of the “Data Date”. The Engineer shall prepare a written response within five (5) work days of receipt of the Monthly Update approving, approving with comments, or returning for resubmission within five (5) work days.
- 5. If the Contractor fails to comply with the Monthly Progress Update submission requirements the Commissioner reserves the right to withhold any or all contract payments.
- 6. Monthly Schedule Meetings and Reports
 - a. Monthly, on a date established by the Engineer prior to the Data Date, a CPM Progress Meeting will be held, at which time the schedule update will be reviewed. The meeting shall be attended by the Engineer and representative(s) of the Contractor including the scheduling consultant. The Contractor representative(s) at the meeting shall have the competence and authority to make any necessary decisions and their statement shall commit the Contractor to the agreed procedures, sequencing of Work, coordination and time schedules.
 - b. Prior to the meeting, the CPM scheduling consultant shall obtain, through any required means including Site meetings, the necessary information to update the CPM schedule to reflect progress to date and to update/revise the schedule for the balance of the Project. The updated schedule and draft narrative report shall be furnished to the Engineer at least 48 hours prior to the meeting and be distributed by the Contractor in hard copy at the meeting for review. To update the CPM schedule, the Contractor shall:
 - 1) Enter actual start and completion dates for those Activities started and/or completed during the previous reporting period.
 - 2) For Activities in progress, indicate the Remaining Duration correlating to an accurate forecasted completion date and physical percentage complete to date (Percent Complete is to reflect the actual quantity of Work completed, and is separate from any actual or Remaining Duration calculation). Review, and revise as necessary, the network logic for the Remaining Duration of the Work from the update to the estimated completion date.
 - 3) For activities not yet started, review, and revise as required, the necessary Logic, the Durations of Work and the estimated start and completion dates.
 - 4) Enter, for each applicable Activity, actual installed quantities information.
 - c. The total Duration to be initially added to any schedule update reflecting the Change Order Activities from identification to the approval of any specific change order shall be in approved by the Engineer and shall be incorporated into the monthly schedule update following the identification of the changed Work. The forecasted construction Activities shall be logically tied to the appropriate predecessor and successor base Contract Activities and contain all required Logic, Duration, Coding and Resources/Cost Loading specified for the detailed CPM schedule activities.
 - d. In the event the Contractor begins performance in the field of Extra Work during the update period, the monthly progress schedule update shall reflect the actual start date of the Work, and any predecessor Logic ties or restraints shall be broken in order to

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accurately forecast complete of the identified Extra Work Activity. This will allow for accurate forecasting of the successor Work Activities and completion Milestones.

e. Default progress data provided from the scheduling system is not allowed. Actual start and finish dates and Remaining Durations of Activities shall not be automatically updated by default mechanisms that may be included in CPM scheduling software systems. Actual start and finish dates on the CPM schedule shall match those dates provided from the Contractor's Daily Quality Control Reports. Failure of the Contractor to document the actual start and finish dates on the Contractor Daily Quality Control Report for every in-progress or completed Activity and ensure that the data contained on the Contractor Daily Quality Control Report is the sole basis for schedule updating shall result in the disapproval of the Contractor's submittal.

f. Activities that have reported progress without predecessor Activities being completed (out-of-sequence progress) will not be allowed except on a case-by-case basis with the approval of the Engineer. A written explanation for each instance shall be included in the monthly submittal.

g. The Contractor shall not constrain the schedule with artificial Logic ties and/or constraint dates and/or any other scheduling techniques that may distort the Activity Float and Total Float associated with the critical Path Activities and the schedule in general.

F. TOTAL FLOAT OWNERSHIP

1. Total Float belongs to the Contract and shall not be considered as available for the exclusive use or benefit of either the County or the Contractor. Total Float is the number of days an activity may be delayed without extending the completion of either the project or an interim milestone. Float is available on a first-come, first-served basis to all identified "Responsible" parties in the schedule.

G. FLOAT MANIPULATION NOT PERMITTED

1. The Schedule shall not sequester float through such strategies as calendar manipulation, resource/labor manipulation or the extension of activity durations to fill up available float time. The Initial Baseline CPM Construction Schedule shall not attribute negative float to any activity.

H. CHANGES TO THE SCHEDULE

1. The Initial Baseline CPM Construction Schedule shall accurately reflect the manner in which the Contractor intends to proceed with the project. Changes to the schedule (the addition or deletion of activities, logic changes, and duration changes) shall be submitted in writing to the Engineer for approval and inclusion in the next Monthly Progress Update. The process of comparing the Schedule Update to Baseline shall be followed throughout the Contract. Revision to any contract milestones, or contractually mandated schedule provisions will not be permitted without written authorization from the Engineer.

I. CRITICAL ACTIVITIES AND BASIS FOR TIME ADJUSTMENTS

1. The measure for Time Adjustments in the schedule shall be based on the criticality, and responsibility of the delay or advancement. Criticality is defined as the presence of the delayed or advanced activity on the projects Critical Path. The Critical Path is defined to be the longest continuous chain of activities through the schedule network that establishes the minimum overall duration in the absence of constraints in the program software. Time adjustment does not mean an extension of time for this contract.

J. CHANGES TO THE CONTRACT

1. In the event a notice of a change to the Contract is received, notify the Engineer in writing within 10 (ten) calendar days of the effect of such change to the schedule. Change to the Contract includes, but is not limited to, extra work, change orders, work suspensions, changed condition, Value Engineering Change Proposal, etc. The effect of the change to the Contract on the projects Critical Path shall be stated. Any proposed revisions to the Schedule to incorporate the change to the Contract shall be stated. No changes shall be made to the Schedule without prior written approval of the Engineer. The approved changes shall be incorporated in the next Monthly Progress Update.

1.03 TIME IMPACT ANALYSIS

- A. This analysis will be performed by the Engineer (CM's scheduler) based on schedule updates as accepted in monthly schedule updates.
- B. Events, actions, and progress that cause delays or gains to the Project Schedule will be analyzed solely by the "Contemporaneous Period Analysis" method. The Contemporaneous Period Analysis evaluates delays or gains in the period in which it occurred. The analysis period for the purpose of this Specification shall be the period covered in each Monthly update to the schedule.
- C. Impact of delay will be evaluated at the completion of the project. However, an interim extension of time for payment purposes only may be granted by the Commissioner at his or her sole discretion at the end of contractual completion date.

1.04 RECOVERY SCHEDULES

- A. General Provisions for Recovery Schedules:
 - 1. When updated Progress Schedule indicates and the Engineer determines that the ability to comply with the Contract Times falls behind schedule due to delay attributed to the CONTRACTOR, the Contractor shall prepare and submit a Progress Schedule demonstrating responsible Contractor's plan to accelerate related work to achieve compliance with the Contract Times ("recovery schedule") for Engineer's acceptance.
 - 2. Submit recovery schedule within 10 work days after submittal of updated Progress Schedule where need for recovery schedule is indicated or include in next update as directed by the Engineer.
- B. Implementation of Recovery Schedule:
 - 1. At no additional cost to OWNER, do one or more of the following: furnish additional labor, provide additional construction equipment, provide suitable materials, employ additional work shifts, expedite procurement of materials and equipment to be incorporated into the Work, and other measures necessary to complete the Work within the Contract Times.
 - 2. Item 1 above is also applicable when the Contractor is required to accelerate their Work to recover lost time
 - 3. Upon acceptance of recovery schedule by Engineer, incorporate recovery schedule into the next Progress Schedule update.
- C. Lack of Action:
 - 1. The Contractor's refusal, failure, or neglect to take appropriate recovery action, or the Contractor's refusal to submit a recovery schedule and take appropriate recovery action, shall constitute reasonable evidence that CONTRACTOR is not prosecuting the Work or separable part thereof with the diligence that will ensure completion within the Contract Times. Such lack of action shall constitute sufficient basis for OWNER to exercise remedies available to OWNER under the Contract Documents.

1.05 METHOD OF MEASUREMENT

- A. The CPM (Critical Path Method) Progress Schedule will be measured for payment on a Lump Sum Basis.

1.06 BASIS OF PAYMENT

- A. The lump sum price bid for the Critical Path Method Scheduling system shall include the cost of preparation and submission of the Initial Baseline Schedule and the preparation and submission of the monthly updates.
- B. Payment will be made as follows:
 - 1. Upon submission of the Initial Baseline CPM Construction Schedule: 20%
 - 2. Upon acceptance of the Baseline CPM Construction Schedule: 20%
 - 3. The balance will be paid in equal monthly payments distributed over the Contract. These payments will be contingent on the submission of acceptable monthly updates: 60%

SECTION 01311 – CONSTRUCTION SCHEDULING

- C. No additional payment over and above the lump sum price bid will be made for addition or deletion of work, delays, or any other reason whatsoever.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01325 – CONSTRUCTION PHOTOGRAPHS

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Scope of Work:
 - 1. Supplemental conditions for photographs specified in the General Conditions, Article GC-37, Photographs.

PART 2 – PRODUCTS

2.01 PHOTOGRAPHS

- A. As provided in the General Conditions, take color photographs of the work during its progress and of the completed facilities. The photographs shall be of such views and taken at such times as the Engineer directs.
- B. The digital files shall be retained in the files of the photographer until the completion of the project and shall then be turned over to the Owner.
- C. A photograph shall be defined as one exposure.
- D. The prints shall be suitably mounted and labeled in loose-leaf type three ring binders, which have protective covers for the prints, slides and negatives. Each binder shall be sequentially numbered and show the name of the project on the binder and front cover using white on black ½ inch laminated lettering tape by Brother or equal.
- E. In addition to information noted in Article GC-37, each print shall have attached to the backing a paper label, approximately 2-1/4-in wide by 1-3/4-in high containing thereon in neat lettering:
 - 1. Contractor's name
 - 2. Date Picture Taken
 - 3. Photographer's Firm
 - a. Submit a site plan that indicates the location and photo number of all preconstruction photographs.
 - 4. Two electronic copies containing all photos taken at the site shall be supplied on 10 GB minimum media cards and submitted to the Engineer for approval.
 - 5. Underground Facility Photo Documentation
 - a. Document the location of all underground pipelines and conduits by taking digital photographs of the installed facilities prior to backfilling.
 - b. Utilizing a 12" x 18" dry erase board, write a description on the location and type of facility. The dry erase board shall be positioned adjacent to the underground facility, within the frame of the photograph, so that both the underground facility and descriptive information written on the dry erase board are legible in the construction photograph.

2.02 PHOTO FILES

- A. Minimum 5 mega pixel resolution, JPEG format.
- B. Landscape frame position.
- C. JPEG files shall be turned over to the Owner with all rights for use and reproduction of the photos files for the Owner's own use.
- D. Provide factual presentation. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01325 – CONSTRUCTION PHOTOGRAPHS

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SECTION 01342 – SAMPLES

PART 1 – GENERAL

1.01 1.1 GENERAL

- A. Submittal of Samples shall conform to the requirements of the General Conditions, Article GC 15, "Samples" and to procedures described in this Section.
- B. Samples and Shop Drawings which are related to the same unit of Work or Specification Section shall be submitted at the same time. If related, Shop Drawings and Samples are submitted at different times, they cannot be reviewed until both are furnished to the Engineer.

1.02 1.2 PROCEDURE

- A. Submission of Samples shall conform to all applicable provisions under Shop Drawing Submittal and Correspondence Procedure.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

+ + NO TEXT ON THIS PAGE + +

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Scope
 - 1. This section describes the minimum health, safety, and emergency response requirements for the activities at the site. Site activities may involve worker exposure to potentially hazardous materials.
 - 2. Implement health and safety criteria and practices sufficient to protect onsite personnel, the public, and the environment from physical and chemical hazards particular to each site.
 - 3. Furnish all labor, materials, equipment and incidentals to remediate any hazardous materials discovered during the performance of the work in this Contract.
- B. References: Where conflicts arise between requirements of the regulatory requirements listed below, the most restrictive of the requirements shall be followed.
 - 1. 29 CFR 1910 OSHA Standards; General Industry
 - 2. 29 CFR 1910.120 OSHA Standards; Hazardous Waste Operations and Emergency Response
 - 3. 29 CFR 1926 OSHA Standards; Construction Industry
 - 4. DOT Standards and Regulations 49 CFR 171 Hazardous Materials Regulations; General Information, Regulations, and Definitions
 - 5. DOT Standards and Regulations 49 CFR 172 Hazardous Materials Tables and Military Standards
 - 6. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, ACGIH
 - 7. Guide to Occupational Exposure Values, ACGIH
- C. Related Specifications
 - 1. Section 01356, Safe and Healthful Working Conditions.

1.02 REMEDIAL ACTION FOR UNFORESEEN HAZARDOUS MATERIAL

- A. When remedial action is necessary for unforeseen hazardous materials, the Engineer will submit the scope of work in writing to the Contractor. The Contractor shall then obtain proposals for the work, including prices, from three separate Owner approved certified hazardous material remediation specialists, and submit them in writing to the Engineer within ten (10) consecutive calendar days of receiving the scope of work. The Engineer may select one proposal and direct the Contractor to engage the selected remediation specialist as a Subcontractor. Remediation work shall not commence until the Contractor receives written notice from the Engineer to proceed with the work. All remediation work shall be performed by the certified remediation specialist.
- B. Some of the remediation work may be critical to maintaining construction schedules. When this occurs, a time of completion shall be indicated in the scope of work submitted to the Contractor by the Engineer, and the work shall be subject to liquidated damages as set forth in the Agreement, Article XIV, "Liquidated Damages."
- C. Disposal of wastes generated by remediation work will be based on the results of the testing performed by the Contractor. Disposal of remediated hazardous material must be at a site approved by the Owner and applicable state agency to accept such waste. Notify the Engineer at least fourteen (14) days prior to removal of the containers of hazardous material to allow for inspection of the containers and the hazardous waste manifest.
- D. Submit written evidence that the receiving waste treatment, storage, or disposal facility to receive such waste by the EPA, DEC and State or local regulatory agencies. Also submit copies of the complete manifest, signed and dated by the initial transporter, in accordance with Federal and State requirements. Completed and signed manifests from treatment or disposal facility shall be provided to the Owner within seven (7) days of disposal.

PART 2 – PRODUCTS

2.01 HEALTH AND SAFETY PLAN

- A. Have a Health and Safety Plan (HASP) prepared, prior to the start of any construction. The HASP shall be available to workers on site and be submitted to the Engineer and Owner at least two weeks before the beginning of any field work. Copies of the plan shall be provided to the Contractors' insurers and their risk managers, if any, by the Contractor.
 - 1. Abide by the work specific Health and Safety requirements as directed by the Owner.
 - 2. The provisions of the site HASP in no way relieves the Contractor of his primary obligation to provide for the safety of his employees and to ensure that all operations under this Contract are carried out so as to protect persons and property on the site and in the surrounding work area.
- B. These minimum health and safety requirements are based on the potential for physical, biological, and chemical hazards associated with the work activities, including the potential exposure to hazardous materials that may be present. The HASP shall be prepared by a Certified Industrial Hygienist (CIH) who is qualified by training and experienced to perform this work. The HASP shall be submitted to the Engineer and Owner for review. The purpose of the HASP is to establish site-specific health and safety requirements for protecting the health and safety of the Contractor and subcontractor personnel and visitors during all activities conducted on-site.
 - 1. Construction activities which need to be addressed in the HASP include, but are not limited to:
 - a. Soil excavation and grading.
 - b. Demolition.
 - c. Equipment installation.
 - 2. The HASP shall include as a minimum the following items tabulated in Paragraph 2.1.E through Paragraph 2.1.S, below.
- C. Identify the individual who shall serve as the Site Safety Officer for this project. The individual shall:
 - 1. Have a working knowledge of pertinent federal, state, and local health and safety regulations, program development and implementation, and air monitoring techniques.
 - 2. Be knowledgeable in tank cleaning procedures and protocols required by this project.
 - 3. Be certified as having completed training in first aid and CPR by a recognized, approved organization, such as the American Red Cross.
 - 4. Be continuously onsite during all operations covered by this Contract.
 - 5. Be familiar with the Site Health and Safety Plan and its requirements and be responsible for the Plan's implementation.
 - 6. The Site Safety Officer may designate an alternate to assist him, provided his alternate meets all of the above requirements. The Contractor shall submit the name, qualifications (education summary and documentation), and work experience of the Site Safety Officer, and any alternates to the Engineer prior to commencement of work at the site.
- D. Personnel Qualifications (CIH): Identify the individual who shall serve as the CIH for this project. This individual shall:
 - 1. Have a minimum of three (3) years experience in tank removal or hazardous waste field.
 - 2. Be familiar with all applicable OSHA, USEPA, and NYSDEC standards.
- E. Standards and Regulations: The HASP shall be developed in accordance with the Occupational Safety and Health Administration (OSHA) Standards and Regulations contained in Title 29, Code of Federal Regulations, Parts 1910 and 1926 (29 CFR 1910 and 1926) and all pertinent laws, rules, and regulations existing at the time of the work, including, but not limited to:
 - 1. Hazardous Waste Management System, Title 40 CFR 261-264.
 - 2. OSHA Standards, Hazardous Waste Operations and Emergency Response, Title 29 CFR 1910.120.
 - 3. OSHA Standards, Asbestos Regulations, Title 29 1910.1001.

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4. OSHA Standards, Subpart Z, Toxic and Hazardous Substance, Title 29 CFR 1926.58.
 5. OSHA Standards, Title X, Lead in Construction, 1926.62.
 6. EPA National Emission Standard for Hazardous Air Pollutants, National Emission Standard for Asbestos, Title 40 CFR, Part 51, Subpart M.
 7. OSHA Standards, Hazard Communication, Title 29 CFR 1926.59.
 8. OSHA Standards, Access to Employee Exposure and Medical Records, Title 29 CFR 1910.20.
 9. OSHA Standards, Personal Protective Equipment, Title 29 CFR 1910.133.
 10. OSHA Standards, Record Keeping, Title 29 CFR 1910.20.
 11. OSHA Standards, Respiratory Protection, Title 29 CFR 1910.134.
 12. The American National Standard Institute (ANSI) Practices for Respiratory Protection, ANSI Z38.2.
 13. OSHA Standards, Ventilation, Title 29 CFR 1910.94.
 14. ANSI Fundamentals Governing the Design and Operation of Local Exhaust System, ANSI Z9 2.
 15. Hazardous Waste Management System, Title 6 NYCRR Parts 370-373.
 16. Asbestos Safety Program Requirements, NYCRR Chapter 11, Title 10, Part 73.
 17. Industrial Code Rule 56, NYCRR Title 12, Part 56.
 18. Transportation Act, Title 49 CFR Parts 106, 107, 171-179.
 19. New York State Solid Waste Hauling and Disposal Regulations, NYCRR Title 6, Parts 360 and 364.
- F. Identification of Key Health and Safety Personnel and Alternates:
1. List key personnel and alternates for site health and safety on a project responsibility chart, which includes phone numbers.
 2. Identify roles and responsibilities of key personnel.
- G. Project Task/Operation Health and Safety Risk Analysis:
1. Identify and describe the project tasks.
 2. Provide a hazard assessment of each project task, which shall include descriptions of potential chemical, biological, and physical hazards associated with the performance of the activity.
 3. Provide a description of health and safety mitigative actions for each project task which shall include, but not be limited to, administrative control, engineering control, safe work practice controls and personal protective equipment.
- H. Personnel Training Requirements:
1. Confirm that personnel are adequately trained to conduct their job responsibilities and handle the specific hazardous situations they may encounter during the project.
 2. Provide, as required, certification of personnel training and First Aid/Cardio-Pulmonary Resuscitation (CPR).
 3. Establish procedures and training for Hazard Communication Program in accordance with 29 CFR 1910.1200.
 4. Provide information regarding training and experience of the person who will oversee excavation activities.
 5. Workers shall be certified as having completed the OSHA 10-hour construction safety and health course.
- I. Personnel Protective Equipment (PPE) and PPE Reassessment Program:
1. Describe the protective clothing and equipment to be worn by personnel during task-specific operations of the project.
 2. Describe the PPE reassessment program for the upgrading/downgrading of PPE levels associated with the task-specific operations of the project.
 3. Provide a written respiratory protection program and reassessment program, which shall be implemented during task-specific operations. The written program must include the procedure for proper selection and use of respirators, instructions on proper cleaning, storage, and inspection of respirators.

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- J. Medical Surveillance:
 - 1. Describe the program for medical monitoring for each task-specific activity.
 - 2. Confirm and provide documentation, as applicable, that all project personnel are currently under a medical surveillance program.
 - 3. Provide documentation, as applicable, that all project personnel have respiratory clearance.
- K. Site Control Measures:
 - 1. Define site control methods and site communications and include a site map delineating the control areas, if appropriate.
 - 2. Delineate the work area, including an exclusion zone (EZ), contamination reduction zone (CRZ) and the support zone, and describe the activities allowed in each zone.
- L. Engineering Control Measures:
 - 1. Identify methods to control the generation of airborne particulates and volatile organic vapors during excavation of potentially contaminated soils.
 - 2. Identify engineering control of generation of lead-containing airborne particulates when impacting materials coated with lead paint.
 - 3. Identify engineering controls (e.g., tent enclosure, wetting of surfaces) to control generation of dusts when conducting dust-generating activities indoors (e.g., demolition of concrete foundations).
- M. Decontamination Program:
 - 1. Establish decontamination procedures for personnel and equipment.
 - 2. The decontamination plan shall include provisions for hand wash facilities, and lunch/break areas, and a description of proper housekeeping practices.
- N. Air Monitoring Program:
 - 1. Describe the area air monitoring program to be conducted during all intrusive site work, soil handling, and below-grade equipment installation, when works may be exposed to potentially contaminated soils. Minimum air monitoring requirements must include continuous real time measurements for volatile organic vapors, hydrogen sulfide, dust, and LEL (methane).
 - 2. Describe the area air monitoring program to be conducted during equipment removal and demolition affecting materials coated with lead paint when airborne dusts may be generated.
 - 3. The air monitoring programs shall identify the analytical methodology required for each task-specific activity to ensure regulatory compliance.
- O. Emergency Response/Contingency Plan:
 - 1. Describe instruction and procedures for evacuation of personnel.
 - 2. Describe instructions and procedures for methods of reporting fires. If the Contractor will be conducting activities such as welding, hot cutting or burning, or working with flammable materials such as paints, glues, and solvents, provide a minimum of two Class ABC fire extinguishers (minimum 10 pounds) in the work area. Obtain a "Hot Works Permit" from the agency having authority and submit copies to the Engineer.
 - 3. Describe instructions and procedures for medical emergencies, including emergency notification and response procedures and a description of the route to the hospital.
 - 4. The medical emergency contingency plan shall include provisions for a minimum of two first aid kits (minimum 24-unit industrial first aid kit).
 - 5. Describe procedures addressing emergencies and equipment failures and barrier failures during work activities.
- P. Surveillance Methods:
 - 1. Describe safety surveillance methods.
 - 2. Provide schedules of both walk-through surveys and in-depth safety audits to be performed on site.
- Q. Safety Inspection Sheets:

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1. Provide safety inspection check-off sheets to be used on a regular basis in evaluation the site work and methods.
- R. Safety Evacuation Drill: A quarterly evacuation drill shall be held in coordination with the existing plan alarm signal under the control of the Owner. Conducting the safety drill shall be coordinated during regular scheduled work hours, but timed to minimize disruption of major contract work. Upon evacuation, the Contractor shall immediately notify the Owner and/or Resident Engineer that all personnel have evacuated.
- S. Accident Prevention: An Accident Prevention Plan and description of work-phase safety plan shall be developed and written by a CIH. Each phase of the Accident Prevention Plan shall include a description of the work activity, probable hazards related to the work, and positive precautionary measures to be taken to safeguard against and reduce or eliminate each particular hazard. In the event of an accident/injury, immediately notify the Engineer. Within two working days of any reportable accident, complete and submit to the Engineer an Accident Report.

PART 3 – EXECUTION

3.01 HAZARDOUS MATERIALS

- A. There may be materials present at the project site that may pose chemical hazards to site workers during construction activities.
- B. The Contractor shall be responsible for identifying suspect hazardous materials as they are encountered. Indication of the presence of hazardous materials, including odorous or stained soils and liquids, shall be immediately reported to the Engineer. If it is determined that the presence of hazardous material is not a threat to the health and safety of Owner and Contractor personnel, continue planned work activities. Otherwise, the Contractor will be directed to take additional health and safety precautions as appropriate.
- C. All non-disposable equipment that has been in contact with contaminated soils, lead-containing debris, or other hazardous materials, shall be cleaned prior to leaving the site. Equipment decontamination shall be performed in an area to be directed by the Engineer. The Contractor shall be responsible for containing all procedures within the perimeter of the designated decontamination area.
 1. The solid materials and rinse water collected as the result of the decontamination procedures shall be stored in appropriate containers on-site prior to disposal. Disposal of the wastes will be based on the results for testing performed by the Contractor, and will be classified as non-hazardous or hazardous waste.
 2. Rinse water that does not meet the criteria for discharge to a POTW, shall be disposed of at an appropriate treatment and/or disposal facility.

3.02 MEDICAL SURVEILLANCE

- A. Physical examinations for personnel working onsite shall be provided prior to project start-up. The examinations shall address the chemical and physical hazards to which the employees will be exposed. The medical examination results shall be evaluated by a physician practicing occupational medicine to determine that the individual is medically qualified to wear a respirator and is physically fit for the work to be performed. The physician must certify that no physical condition or disease could be aggravated by exposure to the identified hazards. The results of the medical surveillance program shall be provided to the Engineer upon request.

3.03 PERSONNEL TRAINING

- A. Personnel employed to sample tank residuals, perform hazardous materials remediation, and supervisors shall be trained and thoroughly familiar with the safety precautions, procedures, and equipment required for controlling the potential hazards associated with this project. This training shall be documented in detail and recorded in the project's records.

3.04 FIRST AID AND EMERGENCY RESPONSE EQUIPMENT AND PROCEDURES

- A. Provide for appropriate emergency first aid equipment (including ANSI-approved eye wash stations, a portable stretcher, and an industrial-type first aid kit) suitable for treatment of

SECTION 01355 – HAZARDOUS MATERIALS CONTROL

exposure to site physical and chemical hazards. Additionally, two ABC-rated fire extinguishers shall be maintained on site as well absorbent material of sufficient quantity to as collect any spill which might occur during this project. A listing of emergency phone numbers and of contact for fire, hospital, police, ambulance, and other necessary contacts shall be posted at the site of the work. A route map detailing the directions to the nearest hospital also shall be posted.

3.05 HEAT AND COLD STRESS

- A. Monitor personnel for signs of heat or cold stress, as dictated by weather conditions. In addition, all field personnel shall be instructed to observe for symptoms of heat or cold stress in themselves and fellow workers and methods to control them. Adhere to guidelines provided in the Threshold Limit Values and Biological Exposure Indices published by the ACGIH for heat and cold extremes.

3.06 ILLUMINATION

- A. Illuminate work areas to a minimum of 10 foot-candles. Lighting shall be sufficient to determine whether material spills have occurred.

3.07 ELECTRICAL SAFETY

- A. All electrical services must be grounded and equipped with and use ground fault circuit interrupter (GFCI) protected outlets. Where applicable, portable lights shall be suitable for hazardous locations and shall be connected to extension cords equipped with connectors or switches approved for hazardous locations. Such equipment, when used, shall be inspected to ensure it will not be a source of ignition. All air monitoring instrumentation shall be rated as intrinsically safe for Class I, Division I, Group D atmospheres.

3.08 SITE CONTROL AND WORK ZONES

- A. Personnel not directly involved with this project shall not be permitted to enter the work zone. For purposes of this Contract, the "Work zone" and Contractor's staging areas shall be the areas as shown on the drawings. The initial minimum level of PPE shall be in accordance with these Specifications. The boundary of the work zone shall be demarcated and posted clearly by the Contractor.

3.09 COMBUSTIBLE GAS/OXYGEN MONITORING

- A. All tanks shall be monitored for the presence of combustible vapors prior to the start of project operations. Such monitoring shall be conducted both in the tanks and in the areas surrounding the tanks, especially in excavations.
- B. If combustible gas monitoring shows that explosive levels within the tanks are less than 10% Lower Explosive Limit (LEL), those tanks may be removed and purged on the surface. However, if readings are at or above 10% LEL, the tank shall be monitored and purged in the ground, as outlined elsewhere in these Specifications.
- C. Purging shall continue until monitoring shows readings below 10% LEL. Any reading above 10% LEL outside the tanks shall result in the suspension of operations until the situation is resolved and retesting indicates the space is "safe" (explosive levels less than 10% LEL).
- D. Also, oxygen levels shall be monitored in trenches and excavations prior to allowing workers to enter, and continuously during the time the workers are present in these spaces. Any reading less than 19.5% or greater than 23% oxygen shall prevent the workers from entering until the situation is resolved and retesting indicates the space is safe for entry.
- E. Resolution of these hazardous situations may require forced ventilation of the space. Any combustible gas/oxygen monitor, provided it complies with these Specifications, may be selected.
- F. The combustible gas indicator shall be calibrated, checked, and maintained daily as per manufacturer's directions.

3.10 AIR MONITORING AND SURVEILLANCE

- A. When personnel are working on or near tanks or within trenches/excavations, implement routine air surveillance and monitoring for LEL and oxygen levels. Air monitoring and surveillance shall be required whenever personnel enter a trench/excavation, every 15 minutes during tank decontamination, or whenever site conditions indicate that fuel vapors are present. Air monitoring, when conducted, shall be performed in the breathing zone of the personnel. Air monitoring and surveillance equipment shall be described in the Health and Safety Plan.

3.11 ACTION LEVELS

- A. Based upon published results of air monitoring and surveillance for combustible gas/oxygen monitoring for similar projects, the following action levels are recommended.
 - 1. Combustible Gas Monitoring
 - a. 0 to 10% LEL: Normal operations, continue monitoring
 - b. Greater than 10% LEL: Shut down operations and equipment; ventilate area
 - 2. Oxygen Monitoring
 - a. 19.5% to 23% Oxygen: Normal operations, continue monitoring
 - b. Less than 19.5% oxygen: Shut down operations and ventilate area
 - c. Greater than 23% oxygen: Shutdown operations and ventilate area

3.12 EXCAVATION SAFETY

- A. Conduct demolition and excavating work in strict conformance with, at a minimum, 29 CFR 1926.650 through 29 CFR 1926.653, including requirements for sloping or shoring found in 29 CFR 1926.652. If the excavation must remain open during periods when the work site is unoccupied (i.e., overnight, over a weekend, and other similar off periods) provide barricades around the excavation in such a manner to alert personnel to the danger and prevent them from falling into the excavation (i.e. using road plates and barriers.)

3.13 CONFINED SPACE ENTRY

- A. If any person is required to enter the tank or an excavation greater than 4 feet, it is considered a confined space entry. The medical surveillance shall ensure that the worker is capable of entering a confined space. Workers required to enter confined space shall have the specialized training required under CFR 1910. 146 (Vol. 58, No. 9, January 14, 1993).

3.14 EATING, DRINKING, SMOKING

- A. No eating, drinking, smoking, chewing of tobacco or gum, or other hand-to-mouth activities shall be permitted in any of the work areas during the course of this project.

3.15 IGNITION SOURCES

- A. Ignition sources (e.g., cigarette lighters, matches, or other flame producing items) not required for the completion of the project, shall not be permitted in the work zones. Before any work is done that might release vapors, work areas shall be barricaded and posted, and burning or other work shall be eliminated from the area where flammable vapors may be present or may travel. No work shall be done if the direction of the wind might carry vapors into areas where they might produce a hazardous condition, or when an electrical storm is threatening the site of work. Sparks caused by friction of electrostatic effects also may be a source of ignition in flammable atmospheres, especially at low humidity. Proper grounding of metal objects and/or electrical equipment, together with the use of sparkless tools and localized adjustment of humidity, may reduce this hazard.

3.16 BREAK AREA AND SUPPORT ACTIVITIES

- A. All eating, drinking, smoking, and break facilities, as well as the Contractor's equipment storage, parking, and office shall be located outside the work zones as determined by the Site Safety Officer and approved by the Engineer.

3.17 SANITATION

- A. Ensure that all onsite personnel have ready access to soap and clean water for washing and toilet facilities.

3.18 UNFORSEEN HAZARDS

- A. Should any unforeseen or site-specific safety-related threat, hazard, or condition become evident during the performance of work at this site, it shall be the Contractor's responsibility to bring such conditions to the attention of the Engineer both verbally and in writing as quickly as possible, for resolution. In the interim, take prudent action to establish and maintain working conditions and to safeguard employees, the public, and the environment.

3.19 TERMINATION

- A. Any disregard for the provisions of these Specifications shall be deemed just and sufficient cause for termination of the Contractor or any Subcontractor without compromise or prejudice to the rights of the Contractor.

END OF SECTION

SECTION 01356 – SAFE AND HEALTHFUL WORKING CONDITIONS

PART 1 – GENERAL

1.01 DESCRIPTION

- A. This section describes the requirements for safe and healthful working conditions.

1.02 RELATED SPECIFICATIONS

- A. Section 01355 Hazardous Materials Control

1.03 PAYMENT

- A. No separate payment for the item "Safe and Healthful Working Conditions" will be made. The costs of same will be included in the Base Bid.

1.04 DEFINITIONS

- A. Safety staff shall mean the safety professional and his safety representative(s) or the safety person.

1.05 SPECIAL CONDITIONS

- A. In prosecuting the work of this Contract, provide working conditions on each operation that shall be as safe and healthful as the nature of that operation permits. The various operations connected with the work shall be so conducted that they will not be unsafe or injurious to health; comply with all regulations and published recommendations of the New York State Department of Labor and all provisions, regulations and recommendations issued pursuant to the Federal Occupational Safety and Health Act of 1970 and the Construction Safety Act of 1969, as amended, and with laws, rules, and regulations of other authorities having jurisdiction, with regard to all matters relating to safe and healthful working conditions. Compliance with governmental requirements is mandated by law and considered only a minimum level of safety performance. All work shall also be performed in accordance with safe work practice.
- B. The Contractor shall be responsible for the safety of the Contractor's employees, the public and all other persons at or about the site of the work. The Contractor shall be solely responsible for the adequacy and safety of all construction methods, materials, equipment and the safe prosecution of the work.
- C. Employ a properly qualified safety professional familiar with all work under this contract whose duties shall be to initiate, review and cause implementation of measures for the protection of health and prevention of accidents. Also employ full- time safety representative(s) whose sole duties shall be to work under the direct supervision of the safety professional, to implement the safety program for the work under this Contract.
- D. The safety staff shall be provided with an appropriate office on the job site to maintain and keep available safety records, up-to-date copies of all pertinent safety rules, regulations and governing legislation, safety data sheets, and the site safety plan including information concerning foreseeable emergency conditions, location of emergency and telephone contacts for supportive actions.
- E. Stop work whenever a work procedure or a condition at a work site is deemed unsafe by the safety staff.
- F. Issue Photo Identification badges for each employee required to be on site. Badge shop drawings and updated logs showing employee names and badge numbers shall be issued to the Engineer for approval.

1.06 SUBMITTALS

- A. Submit a Health and Safety Plan (HASP) as described in Section 01355, Hazardous Materials Control.
- B. Within 30 days of receiving a Notice to Proceed, submit the name of a safety professional, employed by the Contractor, responsible for project safety management, and of the safety representative(s) who will work under his direction.
- C. Submit a resume, along with other qualifications, of the safety person or the safety professional and the safety representative(s), to the Engineer for review and approval. The resume shall

SECTION 01356 – SAFE AND HEALTHFUL WORKING CONDITIONS

include such items as: experience, education, special safety courses completed, safety conferences attended and certification and registrations. Documentation and/or personal references confirming the qualifications may also be required. The persons proposed as safety person, safety professional or safety representative(s) may be rejected by the Engineer for failure to have adequate qualifications or other cause.

- D. Submit for information only the Contractor's written Safety Plan outlining how its workplace will prevent the spread of COVID-19.
- E. Submit for information only a copy of the affirmation that the Contractor has read and understands their obligation to operate in accordance with the New York State Department of Health Interim Guidance for Construction Activities during the COVID-19 Public Health Emergency ("Interim COVID-19 Guidance for Construction").

1.07 QUALIFICATIONS

- A. Safety Professional: Recognition as a safety professional shall be based on a minimum of: Certification by the Board of Certified Safety Professionals as a Certified Safety Professional and five years of professional safety management experience in the types of construction and conditions expected to be encountered on the site.
- B. Safety Representative: Qualifications of the safety representative(s) shall include a minimum of: five years of relevant construction experience, three years of which were exclusively in construction safety management, successful completion of a 30 Hour OSHA Construction Safety and Health training course, 40 Hour OSHA Hazardous Materials training course, Confined Space training, and at least one year membership in the American Society of Safety Engineers.
- C. Safety Person: Qualifications of the safety person must include a minimum of five years of relevant construction experience, two of which are related to safety management.
- D. The safety staff shall be completely experienced with and knowledgeable of all applicable health and safety requirements of all governing laws, rules and regulations as well as of good safety practice. The safety staff shall not include the project manager, engineer, or superintendent, or anyone else working on the project. The safety staff shall have no other duties except those directly related to safety.

PART 2 – PRODUCTS

2.01 HEALTH AND SAFETY PLAN

- A. Commit to writing a specific site health and safety plan before the start of any construction in accordance with Section 01355, Hazardous Materials Control.

2.02 ACCIDENT REPORTS

- A. Promptly report to the Engineer all accidents involving injury to personnel or damage to equipment and structures, investigate these accidents and prepare required reports and submit a monthly summary of these accidents. Submit a preliminary accident report to the Engineer by the following day at the latest.
 - 1. The summary report, due by the 10th day of the following month, shall include descriptions of corrective actions to reduce the probability of similar accidents.
 - 2. In addition, submit to the Engineer a copy of all accident and health or safety hazard reports received from OSHA or any other government agency within one day of receipt.
- B. In addition to the reports which the Contractor is required to file under the provision of the Worker's Compensation Law, submit to the Engineer on or before the tenth day of each month a report giving the total force employed on his Contract in man-days during the previous calendar month, the number and character of all accidents resulting in loss of time or considered recordable by OSHA, and any other information on classification of employees, injuries received on the work, and disabilities arising therefrom that may be required by the Engineer.
 - 1. The submittal shall also contain an audit report for the prior month, including the safety training conducted, the above equipment logs, records of the condition of the work areas,

SECTION 01356 – SAFE AND HEALTHFUL WORKING CONDITIONS

safety and health records, OSHA and ANSI Z16.1 incidence rates for frequency and severity of recordable accidents, and an evaluation of the effectiveness of the HASP with any changes necessary.

2. The safety professional (1.7 A) or safety person (1.7 C) and the Contractor shall sign this audit report. The Engineer will review these reports for Contractor's compliance with the safety provisions of the Contract.

2.03 SAFETY AND RESCUE EQUIPMENT

- A. Have proper safety and rescue equipment, adequately maintained and readily available, for any foreseeable contingency. This equipment shall include such applicable items as: fire extinguishers, first aid supplies, safety ropes and harnesses, stretchers, water safety devices, oxygen breathing apparatus, resuscitators, gas detectors, oxygen deficiency indicators, combustible gas detectors, etc.
- B. This equipment should be kept in protected areas and checked at scheduled intervals. A log shall be maintained indicating who checked the equipment, when it was checked, and that it was acceptable. This equipment log shall be updated monthly and be submitted with the monthly report. Equipment that requires calibration shall have copies of dated calibration certificates on site.
- C. Substitute safety and rescue equipment must be provided while primary equipment is being serviced or calibrated.

2.04 PROTECTIVE EQUIPMENT

- A. All personnel employed by the Contractor and his subcontractors or any visitors whenever entering the job site shall be required to wear appropriate personal protection equipment required for that area. Continuously provide all necessary personal protective equipment as requested by the Engineer for his designated representatives.

2.05 IDENTIFICATION BADGES

- A. Submit shop drawings of Identification Badge to the Engineer for approval.

2.06 HOT WORK PERMIT

- A. All hot work shall be in accordance with NFPA 51B.

COMPLETE AND SUBMIT THE NASSAU COUNTY HOT WORK PERMIT INCLUDED IN THIS SECTION AS ATTACHMENT 01356-A, LOCATED AFTER THE "END OF SECTION" DESIGNATION.

+ + NO TEXT ON THIS PAGE + +

Nassau County Department of Public Works

Hot Work Permit

Hot Work Permit Job Information

Contractor Name: _____ Location of Hot Work: _____

Permit Authorizing Individual: _____ Phone: _____

Permit Issued (Date) _____ (Time) _____ AM/PM

Permit Expires (Date) _____ (Time) _____ AM/PM

Type of hot work to be used (Source of ignition): ☐ Grinding ☐ Cutting ☐ Brazing or Soldering
☐ Welding/Burning ☐ Heating ☐ Other _____

PPE to be Used by Person Performing Hot Work: _____

Describe the Hot Work Job and Materials to be Worked on: _____

Any special hazards and/or special precautions to be taken: _____

Fire Watch Required? ☐ Yes ☐ No **Number of Fire Watches Required:** _____

Acknowledgement of Permit Review by Person Performing Work or Crew Supervisor

Acknowledgment: I participated in the work site preparation, coordinated with the PAI, reviewed this Hot Work Permit and I fully understand the work to be performed and my responsibilities. The person(s) performing the hot work understand that this permit is valid only so long as work conditions existing at the time of issuance do not change. They will stop the work and notify the PAI of any change in work area conditions which adversely affects safety. I or the person(s) performing the work are adequately trained in the safe handling and use of their equipment and applicable regulatory requirements.

Worker/Supervisor: _____ Signature: _____

Company: _____ Date: _____

Permit Authorizing Individual (PAI) Authorization

I completed the site inspection, notified the person performing the work or their crew supervisor about flammable materials or hazardous conditions which may not be obvious, and verified that the person performing (or directly supervising the crew performing) hot work has reviewed the permit and signed the acknowledgment above. (If no, hot work is not permitted)

Signature: _____ Date: _____

Notice: Post this permit in Hot Work Permit area until permitted operations are complete. Upon Completion return permit to the PAI.

Final Inspection (Fire Watch, or PAI if No Fire Watch Was Required)

I completed final inspection at the required times after completion of Hot Work and observed no signs of smoldering or combustion.

Signature: _____ Date: _____ Time: _____ (Day 1)

Day	PAI Signature	Date/Time	Acceptable		Final Insp./ Initials	Comments
			Yes	No		
2						
3						
4						
5						
6						
7						

- Permit Authorizing Individual (PAI) - The individual designated by management to [authorize hot work](#)
- [Conducts inspection](#) to verify that safeguards are in place based on site-specific conditions of flammable/ combustible materials, hazardous processes, or other potential fire hazards in the work location.
- [Ensure](#) fire protection and extinguishing equipment are available and properly located at the site.
- [Verify](#) a fire watch is at the site, if required.
- [Issues](#) a Hot Work Permit (HWP), when required.

SECTION 01356 – HOT WORK PERMIT

Hot Work Required Precautions Checklist

- 1) Inspect work area and confirm that applicable precautions have been taken in accordance with NFPA 51B (by PAI After Coordination With & Setup By Person Performing Hot Work; initially and when revalidating):
- 2) All sprinkler and/or other fire suppression systems in the Hot Work Permit area operational.
- 3) Cutting/welding equipment in good repair, free of damage or defects.
- 4) Persons conducting hot work have been trained.
- 5) All facility employees or other parties that may be potentially affected by the hot work have been notified.

REQUIREMENTS WITHIN 35 FEET OF WORK (HORIZONTAL & VERTICAL)

- 1) Flammable liquids and combustible dust/lint/oil deposits/trash removed or shielded with fire-retardant material.
- 2) Flammable vapor sources removed or flammable vapor properly tested and found to be well below the LEL.
- 3) Combustible flooring properly wetted, wet sanded or shielded.
- 4) Combustible walls, ceilings, partitions or roofing properly shielded.
- 5) Covers under work to keep sparks from lower levels and shielding/partitions to protect passer-by.

WORK ON WALLS OR CEILINGS

- 1) Combustibles have been moved away from opposite side. (If no, hot work is not permitted)
- 2) No combustible covering, interior (for sandwich-type panel) or other combustible content.
- 3) Danger from conduction of heat to adjacent rooms eliminated.

WORK ON ENCLOSED EQUIPMENT (Tanks, Containers, Ducts, Dust Collectors, etc.)

- 1) All duct and conveyor systems properly protected or shut down.
- 2) Equipment is cleaned of all combustibles, flammable vapors, liquids, or dusts. (If a flammable vapor source, conduct vapor monitoring)

FIRE WATCH

- 1) Required for the following: (a) Torch work (b) Combustibles within 35' (c) Combustibles >35', but easily ignited, (d) Wall/floor openings expose adjacent/concealed combustibles, (e) Conduction through metal can ignite other side (f) Potential for more than a minor fire.
- 2) Charged, inspected, operational fire extinguishers of an appropriate type are present.
- 3) Fire Watch trained in extinguisher and emergency alarms (fire alarm, telephone, or radio).

OTHER PRECAUTIONS

- 1) Work in a confined space requires Confined Space Entry Permit prior to hot work permit approval.
- 2) Is continuous atmospheric monitoring, smoke detection or heat detection warranted?
- 3) Ample ventilation exists or provisions made for continuous ventilation to remove smoke/vapor from work area
- 4) Process equipment/piping purged, disconnected and blanked in accordance with Lockout/Tagout procedures.
- 5) Do conditions require Re-Validation more than every 24 hours?

SECTION 01370 – SCHEDULE OF VALUES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Submit a Schedule of Values allocated to the various portions of the work, within 21 days after the effective date of the Agreement.
- B. Upon request of the Engineer, support the values with data which will substantiate the amount indicated.
- C. The accepted Schedule of Values shall be used only as the basis for the Contractor's Applications for Payment.

1.02 RELATED REQUIREMENTS

- A. General Conditions of the Construction Contract

1.03 FORM AND CONTENT OF SCHEDULE OF VALUES

- A. Contractor's standard forms and automated printout will be considered for approval by the Engineer upon Contractor's request. Identify schedule with:
 - 1. Title of Project and location.
 - 2. Engineer and Project number.
 - 3. Name and Address of Contractor.
 - 4. Contract designation.
 - 5. Date of submission.
- B. Schedule shall list the installed labor and material value of the component parts of the work in sufficient detail to serve as a basis for computing values for progress payments during construction.
- C. Identify each line item with the number and title of the respective Section.
- D. For each major line item list sub-values of major products or operations under the item.
- E. For the various portions of the work:
 - 1. Each item shall include a directly proportional amount of the Contractor's overhead and profit.
 - 2. For items on which progress payments will be requested for County approved stored materials, break down the value into:
 - a. The cost of the materials, delivered and unloaded, with all taxes paid. Paid invoices are required for materials upon request by the Engineer.
 - b. The total installed value.
- F. The sum of all values listed in the schedule shall equal the total Contract Sum.

1.04 SUBSCHEDULE OF UNIT MATERIAL VALUES

- A. Submit a sub-schedule of unit costs and quantities for:
 - 1. Products on which progress payments will be requested for County approved stored products.
- B. The form of submittal shall parallel that of the Schedule of Values, with each item identified the same as the line item in the Schedule of Values.
- C. The unit quantity for bulk materials shall include an allowance for normal waste.
- D. The unit values for the materials shall be broken down into:
 - 1. Cost of the material, delivered and unloaded at the site with all taxes paid.
 - 2. Copies of invoices for component material shall be included with the payment request in which the material first appears.
 - 3. Paid invoices shall be provided with the second payment request in which the material appears or no payment shall be allowed and/or may be deleted from the request.
- E. The installed unit value multiplied by the quantity listed shall equal the cost of that item in the Schedule of Values.

SECTION 01370 – SCHEDULE OF VALUES

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01400 – PROTECTION OF UTILITIES

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Work includes all labor, materials, equipment and incidentals required to mark out and protect all public or private utilities, including concrete encased piping, within or adjacent to the Contract area.
- B. Be familiar with the existence of aerial, surface or subsurface structures of municipal and other public or private service corporations within the construction site.
- C. A careful search has been made, in good faith, and known public or private utilities within or adjacent to the Contract area are shown in their approximate locations on the Contract Plans. However, there is no guarantee that all existing utilities have been found. All utilities may not be shown on the Contract Drawings.
- D. The Contractor's attention is also directed to the fact that during the life of the plant, the Owner and operators of utilities may make changes in their facilities.
- E. Determine the exact locations and elevations of all pertinent structures, utilities and facilities before construction work and new installations commence.
- F. Conflict between existing structures, utilities and facilities and new work shall be ascertained by the Contractor and called to the attention of the Engineer.
- G. Cooperate with the Owner and public utility corporations whose structures (aerial, surface or subsurface) are within the limits of or along the outside of the construction areas to make it possible for them to maintain uninterrupted service.
- H. Conduct operations in such a way as to delay or interfere as little as practicable with the work of utility corporations.
- I. Give the Owner and public utility corporations involved reasonable notice, but not less than 48 hours in advance of operations, which may or will affect their structures.
- J. Protect, in a suitable manner, all utilities encountered, including concrete encased piping, and shall repair any damage to structures, utilities and facilities caused by operations.
- K. If the nature of the damage is such as to endanger the satisfactory functioning of the utilities and necessary repairs are not immediately made by the Contractor, the work may be done by the respective owning companies and the cost thereof charged against the Contractor.
- L. Take these conditions into consideration in preparing the bid.
- M. It is understood and agreed that the Contractor has considered in his bid all of the permanent and temporary utility appurtenances and that no additional compensation will be allowed for any delays, inconveniences or damage sustained by him due to any interference from the utility appurtenances.

1.02 PUBLIC AND PRIVATE UTILITY MARKOUTS

- A. Provide utility markouts for all private and public utilities. The limits for these markouts shall be the project limit shown on the Engineering Drawings. Submit the proposed utility subcontractor for approval.

1.03 TEST HOLES

- A. Test holes shall be performed by air vacuum excavation key-hole technology or other non-destructive techniques on existing utilities. One call notification and permit applications shall be made prior to test hole excavation as necessary.
- B. The test holes shall be staked at the site by contractor personnel utilizing a tape or survey instrument as deemed necessary. Test hole openings shall be a minimum 8" x 8" and typically not larger than 12" x 12". Excavate to expose the utility in a careful manner with the utmost concern for the safety of personnel, the public and surrounding property. Complete a field test hole form for each excavation that indicates at a minimum parameters required by the ASCE/CI Standard 38-02, which includes: depth to the utility, outside diameter, height of conduits or encasement, utility material, pavement type/ thickness and general soil type.

SECTION 01400 – PROTECTION OF UTILITIES

- C. Place permanent marker over a reference point on the utility flush with grade. Typically, this reference point is the centerline of pipes or the edge of concrete structures. A minimum of three (3) ties shall be taken to the permanent marker. The depth to the reference point on the utility shall also be measured plumb to the permanent marker.
- D. Backfill excavation utilizing excavated materials or a self-compacting aggregate. Pavement restoration shall be made in accordance with pavement requirement in the Contract Documents.
- E. Test hole permanent markers shall be located using conventional or GPS survey equipment. The test hole markers shall be directly located to provide horizontal and vertical coordinates for the locations relative to the project coordinate system.
- F. Do not backfill test holes until directed by the Engineer. Photographs of exposed piping shall be taken by the Contractor and kept on file for the duration of the project. Duplicate prints shall be provided to the Engineer. Annotate on the back of each print the location of the photograph, the name of the exposed line, and the date it was taken. Take photographs using a digital camera. The digital file shall be provided to the Engineer. All prints shall be 4 inches by 6 inches. Trenching for new buried pipelines and excavation for facilities shall not be started until the locations of existing pipes and utilities are verified.

1.04 SUBMITTALS

- A. Submit detailed experience and qualifications description of underground utility locator service. Experience and qualifications package should include a description of the types of utility locator equipment and experience that can be provided.

1.05 AT THE CONCLUSION OF THE PROJECT, SUBMIT THREE (3) SETS OF PAPER AND ONE (1) COPY OF ELECTRONIC PLANS DOCUMENTING ALL UTILITIES LOCATED AND IDENTIFIED. ALL DOCUMENTATION SHALL BE REFERENCED TO EXISTING DATA (HORIZONTAL AND VERTICAL) PREVIOUSLY ESTABLISHED.

1.06 MEASUREMENT AND PAYMENT

- A. No separate payment for the items "Protection of Utilities" will be made. The costs of same shall be included in the Base Bid.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Scope
 - 1. Provide all labor, materials, tools, equipment, and incidentals as shown, specified and required to cooperate with the Coordinating Special Inspector and individual special inspectors employed by Owner, and to perform required testing and inspections. Owner shall engage the services of testing agencies as needed to facilitate Special Inspections.
 - 2. Supplement A, Statement of Special Inspections, included with this Section, lists testing and inspection divisions. The Statement of Special Inspections has been prepared by the Structural Engineer of Record (SER) for the project.

1.02 DEFINITIONS

- A. Special Inspector: Professional engineer or architect, hired by Owner, registered in the same state as the Site, responsible for coordinating and verifying the inspection and testing required by the Statement of Special Inspections included in this Section and reporting to the Building Official.
- B. Building Official: Officer or other designated authority having jurisdiction charged with the administration and enforcement of the governing code, or a duly authorized representative.
- C. SER: The Structural Engineer of Record (SER) is the Registered Design Professional in Responsible Charge of the structural system. The SER is responsible for preparing the Statement of Special Inspections (SSI) for the structural elements subject to inspection and testing.
- D. Special Inspections: Testing and inspection required in the Statement of Special Inspections, prepared by the SER.

1.03 QUALITY ASSURANCE

- A. Owner will employ and pay for services of the Special Inspector, who will have a minimum of five years of experience in managing, monitoring, and inspecting building construction.
- B. Special Inspections shall be in accordance with applicable building code Laws and Regulations, and the Statement of Special Inspections, prepared by the SER.
- C. Inspectors shall be qualified in their assigned Special Inspection in accordance with the Statement of Special Inspections, prepared by the SER.

1.04 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Samples: Representative Samples of materials when required or requested by Owner / Special Inspector.
- B. Informational Submittals: Submit the following:
 - 1. Completed Supplement D, Fabricator's Certificate of Compliance, as attached to this Section, for fabrication of structural steel.
 - 2. Site Quality Control Submittals: Material test reports.
 - 3. Qualification Statements: Names and qualifications of each testing agency employed, and qualifications of testing agency's personnel that will perform testing as required in the Statement of Special Inspections, prepared by the SER.

1.05 CONTRACTOR'S RESPONSIBILITIES

- A. Provide safe access to Work to be tested and inspected.
- B. Protect test samples left at designated area on Site.
- C. Facilitate inspections and tests.
- D. Provide access to Suppliers' and Subcontractors' operations as required.

SECTION 01416 – SPECIAL INSPECTIONS

- E. Notify testing agencies, Special Inspector, and Owner sufficiently in advance of the Work for the testing agencies, Special Inspector, and Owner to coordinate their personnel at the Site. Do not cover Work to be inspected until Special Inspections have been completed and accepted.
- F. Special Inspections required in this Section do not supersede or make unnecessary inspections and tests required under other Specification Sections or standard inspections required by Laws and Regulations.
- G. Provide the completed Statement of Special Inspections to the local Building Official when obtaining the Building Permit.
 - 1. SPECIAL INSPECTOR's RESPONSIBILITIES
- H. Special Inspector will:
 - 1. Review testing agencies and testing personnel, relative to conformance to the Statement of Special Inspections, and in accordance with Laws and Regulations.
 - 2. Complete Supplement A, Statement of Special Inspections, of this Section to provide names of each inspector and testing agency for each Special Inspection required. Review completed Statement of Special Inspections, prepared by SER for general conformance with the current State Building Code.
 - 3. Coordinate activities of individual inspectors and testing agencies with Contractor.
 - 4. Provide interim reports of inspections and material testing to Building Official and Owner.
 - 5. To obtain certificate of use and occupancy from the Building Official, complete and provide to the Building Official, County, Supplement B, Final Report of Special Inspections, of this Section, documenting completion of Special Inspections and correction of discrepancies noted in the Special Inspections.

1.06 INSPECTOR RESPONSIBILITIES

- A. Perform specified inspections, sampling, and testing of materials and methods of construction; review and ascertain compliance with Laws and Regulations.
- B. Promptly notify Special Inspector, Owner, and Contractor of irregularities or deficiencies in the Work observed during Special Inspections. Corrective action, if required, will be determined by Owner.
- C. Promptly submit two copies each of reports of inspections and tests to Special Inspector, Owner, and Contractor including:
 - 1. Date issued.
 - 2. Project title and number.
 - 3. Name and signature of inspector.
 - 4. Date of inspection or sampling and test.
 - 5. Record of temperature and weather.
 - 6. Identification of product and Specification Section.
 - 7. Location in Project.
 - 8. Type of inspection or test.
 - 9. Location of inspection or test within project.
 - 10. Results of inspections and tests, and observations regarding compliance with Laws and Regulations, and standards.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 SUPPLEMENTS

- A. The supplements listed below, following the "end of section" designation, are part of this section:
 - 1. Supplement A – Statement of Special Inspections
 - 2. Supplement B – Final Report of Special Inspections
 - 3. Supplement C – (Not Used)
 - 4. Supplement D – Fabricator's Certificate of Compliance

END OF SECTION

SECTION 01416 – SPECIAL INSPECTIONS

Supplement A - Statement of Special Inspections

Project:

Location:

Owner:

Design Professional in Responsible Charge:

This *Statement of Special Inspections* is submitted as a condition for permit issuance in accordance with the Special Inspection and Structural Testing requirements of the Building Code. It includes a schedule of Special Inspection services applicable to the Project as well as the name of the Coordinating Special Inspector and the identity of other approved agencies to be retained for conducting these inspections and tests. This *Statement of Special Inspections* encompass the following disciplines:

- ☐ Structural ☐ Mechanical/Electrical
☐ Architectural ☐ Other: _____

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

Inspections listed are periodic unless indicated to be continuous or required by code to be continuous.

Interim reports shall be submitted to the Building Official and the Registered Design Professional in Responsible Charge.

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

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

Interim Report Frequency: Weekly

or ☐ per attached schedule.

Prepared by:

(type or print name)



SECTION 01416 – SPECIAL INSPECTIONS

Signature

Date



Owner's Authorization:

Building Official's Acceptance:

Signature

Date

Signature

Date

Schedule of Inspection and Testing Agencies

This Statement of Special Inspections / Quality Assurance Plan includes the following building systems:

- | | |
|--|--|
| <input type="checkbox"/> Soils and Foundations | <input type="checkbox"/> Spray Fire Resistant Material |
| <input type="checkbox"/> Cast-in-Place Concrete | <input type="checkbox"/> Wood Construction |
| <input type="checkbox"/> Precast Concrete | <input type="checkbox"/> Exterior Insulation and Finish System |
| <input type="checkbox"/> Masonry | <input type="checkbox"/> Mechanical & Electrical Systems |
| <input type="checkbox"/> Structural Steel | <input type="checkbox"/> Architectural Systems |
| <input type="checkbox"/> Cold-Formed Steel Framing | <input type="checkbox"/> Special Cases |

Special Inspection Agencies	Firm	Address, Telephone, e-mail
1. Special Inspector		
2. Inspector		
3. Inspector		
4. Testing Agency		
5. Testing Agency		
6. Other		

Note: The inspectors and testing agencies shall be engaged by Owner or Owner's Agent, and not by Contractor or Subcontractor whose Work is to be inspected or tested. Conflicts of interest must be disclosed to the Building Official prior to commencing Work.

Qualifications of Inspectors and Testing Technicians

The qualifications of all personnel performing Special Inspections are subject to the approval of the Building Official. The credentials of all inspectors and testing technicians shall be provided if requested.

Key for Minimum Qualifications of Inspection Agents:

When Engineer deems it appropriate that the individual performing a stipulated test or inspection have a specific certification or license as indicated below, such designation shall appear below the *Agency Number* on the Schedule.

PE/SE	Structural Engineer – a licensed SE or PE specializing in the design of building structures
PE/GE	Geotechnical Engineer – a licensed PE specializing in soil mechanics and foundations
EIT	Engineer-In-Training – a graduate engineer who has passed the Fundamentals of Engineering examination

American Concrete Institute (ACI) Certification

ACI-CFTT	Concrete Field Testing Technician – Grade 1
ACI-CCI	Concrete Construction Inspector
ACI-LTT	Laboratory Testing Technician – Grade 1&2
ACI-STT	Strength Testing Technician

American Welding Society (AWS) Certification

AWS-CWI	Certified Welding Inspector
AWS/AISC-SSI	Certified Structural Steel Inspector

American Society of Non-Destructive Testing (ASNT) Certification

ASNT	Non-Destructive Testing Technician – Level II or III.
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International Code Council (ICC) Certification

ICC-SMSI	Structural Masonry Special Inspector
ICC-SWSI	Structural Steel and Welding Special Inspector
ICC-SFSI	Spray-Applied Fireproofing Special Inspector
ICC-PCSI	Prestressed Concrete Special Inspector
ICC-RCSI	Reinforced Concrete Special Inspector

National Institute for Certification in Engineering Technologies (NICET)

NICET-CT	Concrete Technician – Levels I, II, III & IV
NICET-ST	Soils Technician - Levels I, II, III & IV
NICET-GET	Geotechnical Engineering Technician - Levels I, II, III & IV

Exterior Design Institute (EDI) Certification

EDI-EIFS	EIFS Third Party Inspector
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Other

Soils and Foundations

Page of

Item	Agency # (Qualif.)	Scope
1. Shallow Foundations		
2. Controlled Structural Fill		
3. Deep Foundations (Auger Cast Piles)		
4. Load Testing		
4. Other:		

SECTION 01416 – SPECIAL INSPECTIONS

Cast-in-Place Concrete

Page of

Item	Agency # (Qualif.)	Scope
1. Mix Design		
2. Material Certification		
3. Reinforcement Installation		
4. Post-Tensioning Operations		
5. Welding of Reinforcing		
6. Anchor Rods		
7. Concrete Placement		
8. Sampling and Testing of Concrete		
9. Curing and Protection		
10. Other:		

SECTION 01416 – SPECIAL INSPECTIONS

Precast Concrete

Page of

Item	Agency # (Qualif.)	Scope
1. Plant Certification / Quality Control Procedures <input type="checkbox"/> Fabricator Exempt		
2. Mix Design		
3. Material Certification		
4. Reinforcement Installation		
5. Prestress Operations		
6. Connections / Embedded Items		
7. Formwork Geometry		
8. Concrete Placement		
9. Sampling and Testing of Concrete		
10. Curing and Protection		
11. Erected Precast Elements		
12. Other:		

SECTION 01416 – SPECIAL INSPECTIONS

Masonry**Required Inspection Level:** ☐ 1 ☐ 2

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Item	Agency # (Qualif.)	Scope
1. Material Certification		
2. Mixing of Mortar and Grout		
3. Installation of Masonry		
4. Mortar Joints		
5. Reinforcement Installation		
6. Prestressed Masonry		
7. Grouting Operations		
7. Weather Protection		
9. Evaluation of Masonry Strength		
10. Anchors and Ties		
11. Other:		

SECTION 01416 – SPECIAL INSPECTIONS

Structural Steel

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Item	Agency # (Qualif.)	Scope
1. Fabricator Certification/ Quality Control Procedures		
2. Material Certification		
3. Open Web Steel Joists		
4. Bolting		
5. Welding		
6. Shear Connectors		
7. Structural Details		
8. Metal Deck		
9. Other:		

SECTION 01416 – SPECIAL INSPECTIONS

Cold-Formed Steel Framing

Page of

Item	Agency # (Qualif.)	Scope
1. Member Sizes		
2. Material Thickness		
3. Material Properties		
4. Mechanical Connections		
5. Welding		
6. Framing Details		
7. Trusses		
8. Permanent Truss Bracing		
9. Other:		

Spray-Applied Fire Resistant Material

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Item	Agency # (Qualif.)	Scope
1. Material Specifications		
2. Laboratory Tested Fire Resistance Design		
3. Schedule of Thickness		
4. Surface Preparation		
5. Application		
6. Curing and Ambient Condition		
7. Thickness		
8. Density		
9. Bond Strength		
10. Other:		

SECTION 01416 – SPECIAL INSPECTIONS

Wood Construction

Page of

Item	Agency # (Qualif.)	Scope
1. Fabricator Certification/ Quality Control Procedures <input type="checkbox"/> Fabricator Exempt		
2. Material Grading		
3. Connections		
4. Framing and Details		
5. Diaphragms and Shearwalls		
6. Prefabricated Wood Trusses		
7. Permanent Truss Bracing		
8. Other:		

SECTION 01416 – SPECIAL INSPECTIONS

Exterior Insulation & Finish Systems (EIFS)

Page of

Item	Agency # (Qualif.)	Scope
1. Material Submittals		
2. Condition of Substrate		
3. Application of Foam Plastic Board		
4. Application of Coatings		
5. Application of Mesh		
6. Ambient Condition and Curing		
7. Flashing and Joint Details		
8. Sealants/Caulks		
9. Other:		

SECTION 01416 – SPECIAL INSPECTIONS

Mechanical & Electrical Systems

Page of

Item	Agency # (Qualif.)	Scope
1. Smoke Control		
2. Mechanical, HVAC & Piping		
3. Electrical System		
4. Other:		

SECTION 01416 – SPECIAL INSPECTIONS

Architectural Systems

Page of

Item	Agency # (Qualif.)	Scope
1. Wall Panels & Veneers		
2. Suspended Ceilings		
3. Access Floors		
4. Other:		

SECTION 01416 – SPECIAL INSPECTIONS

Special Cases

Page of

Item	Agency # (Qualif.)	Scope

Supplement B - Final Report of Special Inspections

Project:

Location:

Owner:

Owner's Address:

Architect of Record:

Structural Engineer of Record:

To the best of my information, knowledge and belief, the Special Inspections required for this project, and itemized in the *Statement of Special Inspections* submitted for permit, have been performed and all discovered discrepancies have been reported and resolved other than the following:

Comments:

(Attach continuation sheets if required to complete the description of corrections.)

Interim reports submitted prior to this final report form a basis for and are to be considered an integral part of this final report.

Respectfully submitted,

Special Inspector

(Type or print name)

Signature

Date

Licensed Professional Seal

Agent's Final Report

Project:

Agent:

Special Inspector:

To the best of my information, knowledge and belief, the Special Inspections or testing required for this project, and designated for this Agent in the *Statement of Special Inspections* submitted for permit, have been performed and all discovered discrepancies have been reported and resolved other than the following:

Comments:

(Attach continuation sheets if required to complete the description of corrections.)

Interim reports submitted prior to this final report form a basis for and are to be considered an integral part of this final report.

Respectfully submitted,

Agent of the Special Inspector

(Type or print name)

Signature

Date

*Licensed Professional Seal or
Certification*

Supplement D - Fabricator's Certificate of Compliance

Each approved fabricator that is exempt from Special Inspection of shop fabrication and implementation procedures per section 1704.2 of the International Building Code must submit a *Fabricator's Certificate of Compliance* at the completion of fabrication.

Project:

Fabricator's Name:

Address:

Certification or Approval Agency:

Certification Number:

Date of Last Audit or Approval:

Description of structural members and assemblies that have been fabricated:

I hereby certify that items described above were fabricated in strict accordance with the Contract Documents.

Signature

Date

Title

Attach copies of fabricator's certification or building code evaluation service report and fabricator's quality control manual.

+ + NO TEXT ON THIS PAGE + +

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Specification format.

1.02 REFERENCES

- A. The Specifications are generally arranged according to the Construction Specifications Institute (CSI) format. Most of the technical requirements are specified in the technical specifications of the document, which are grouped into sixteen (16) major divisions. Most of the legal and administrative requirements are included in Division 1, General Conditions, Information for Bidders, and the Contract (agreement).
- B. Technical sections are arranged in numerical order; however section numbers may not be consecutive from section to section.
- C. Page numbering is subordinate to each section.
- D. Most sections are generally broken down into three (3) parts:
 - PART 1 - GENERAL
 - PART 2 - PRODUCTS
 - PART 3 - EXECUTION
- E. Not all these parts may be used and, in some cases, the title of some of the parts may be different than listed above. Paragraph numbers are subordinate to each part.
- F. The Contractor is advised that the format described here is flexible in nature.
 - 1. There is some overlapping of specified information between various portions of the Specifications.
 - 2. In all cases, the entire requirements of the Contract Documents for the project shall apply.
- G. Explanations:
 - 1. Many technical sections begin with a paragraph titled “SECTION INCLUDES”, “DESCRIPTION”, or similar wording.
 - a. In these paragraphs, a brief listing of the specified products may appear or a brief description of the work generally specified in that section is presented.
 - b. These descriptions or listings are not all inclusive, but merely are provided as an aid in locating subject matter.
 - c. In some cases special cost related items of work are called to the attention of the Contractor in these opening paragraphs.
 - 2. “RELATED SECTIONS” or “RELATED WORK” or similar wording paragraphs list or reference related work specified elsewhere in the Contract Documents. Such listing is not all inclusive, rather, they are merely an aid to the Contractor in locating some of the other Specification Sections wherein work is specified which has a particularly close interrelationship with the work specified in that section.
 - a. It shall be understood that all the Work, and all of the Specifications and other portions of the Contract Documents, are interrelated, and that the total of all requirements set forth in all of the Contract Documents shall be met.
 - b. Equipment suppliers and manufacturers shall be advised of the requirements for making submittals and delivering products, as specified in Division 1 sections, even if said sections are not referenced therein that section.
 - 3. “REGULATORY REQUIREMENTS” or “REFERENCES” or similar wording paragraphs describe standards, laws, guidelines, regulations, and standards related to workmanship and installation of the products specified which shall be followed by the Contractor in completing the work specified therein that section as if it was written there in that section. All such requirements and references shall be latest issue in effect at the time of the bid opening.
 - 4. When a “GUARANTEE” or “WARRANTY” paragraph appears in the section it is calling attention to a guarantee which extends beyond the period of the Contractor’s Guarantee

SECTION 01422 – SPECIFICATION FORMAT

called for in the administrative portion of the Contract Documents or it states special requirements specific to the equipment, systems or products specified in that section.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01455 – ENVIRONMENTAL QUALITY CONTROL

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Asbestos and lead-based paint certification.
- B. Moisture control.

1.02 MOISTURE CONTROL

- A. Maintain a strict policy and protocol to control water infiltration and moisture build-up during the course of the project. The plans and specifications are not intended to depict each and every condition or detail of construction. As the knowledgeable party in the field, the Contractor is in the best position to verify that all construction is completed in a manner which will provide a watertight structure. The Contractor has the sole responsibility for ensuring the watertight integrity of the structure. The Contractor's contractual obligations include, but are not limited, to the following:
- B. Water Infiltration: If the Contractor observes water infiltration (unintended) into a completed building or an ongoing construction site, immediately report the condition to the Owner and Architect/Engineer, and immediately take steps to investigate the source of the water infiltration, identify the responsible party (person who performed work that resulted in water infiltration) and devise a procedure to promptly eliminate water infiltration into the building.
- C. Handling of Water-Damaged Building Materials and Construction:
 - 1. Inspect all building materials delivered to the site for pre-existing water damage, as well as existing mold growth.
 - 2. If in-place construction becomes wet, notify the Owner and Architect/Engineer immediately. The Owner and Architect/Engineer will determine whether or not the work shall be removed and replaced, or if the type of material can be permitted to dry.
 - 3. Under no circumstances may new or additional construction be placed over, or otherwise enclose, wet building materials.
- D. Visible Mold/Mildew:
 - 1. If the Contractor observes any substance that appears to be mold or other fungal growth and/or an unidentified substance within a completed building or the ongoing construction site, immediately suspend construction operations in the area, and report the condition to the Owner and Architect/Engineer.
 - 2. No person shall be allowed back into the affected area without permission of the Owner.

1.03 SUBMITTALS

- A. Submit the "Asbestos and Lead-Based Paint Certification" upon completion of all work.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

++ NO TEXT ON THIS PAGE ++

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Scope: This section covers the Contractor's responsibilities with respect to spill prevention and control.
- B. References: Where conflicts arise between requirements of the above-listed regulatory requirements, the most restrictive of the requirements shall be followed.
 - 1. USEPA Remedial Action at Waste Disposal sites EPA/625/6-B5/006
 - 2. 40 CFR Part 300 national Oil and Hazardous Substances Pollution Contingency Plan
 - 3. 40 CFR Protection of Environment
 - 4. ASTM E119 Fire Resistance Directory

1.02 SUBMITTALS

- A. A Spill Prevention and Control Plan shall be provided to the Engineer.

1.03 GENERAL REQUIREMENTS

- A. Prepare and implement a Spill Prevention and Control Plan and maintain appropriate containment and/or diversionary structures, materials and equipment to prevent and control the maximum spillage of any specific item within the Scope of Work. All materials and equipment used in connection with this project shall be included. The plan shall include inspection and test procedures performed to ensure compliance.
- B. Laws and Regulations: The Contractor shall not pollute any area with any manmade or natural harmful materials. It is the sole responsibility of the Contractor to investigate and comply with all applicable Federal, State, County and municipal laws and regulations concerning the Spill Prevention and Control Plan.
- C. A Project Telephone Directory shall be incorporated into the plan.
- D. Written Discussions: In addition to the minimal prevention standards listed, the Plan shall include a complete discussion of conformance with the following applicable guidelines, other effective spill prevention and containment procedures, or if more stringent, with the State rules, regulations and guidelines.
 - 1. Facility Drainage
 - 2. Bulk Storage
 - 3. Facility Transfer operations, pumping, and conveying materials
 - 4. Truck loading/unloading rack
- E. Design and Specifications: Submit a Spill Prevention and Control Plan with the following designs and specifications:
 - 1. Appropriate containment and/or diversionary structures or equipment to prevent discharge of materials to the environment
 - 2. Dikes sufficiently impervious to contain spill materials
 - 3. Curbing
 - 4. Culverts, gutters, or other drainage systems
 - 5. Weirs, booms, or other barriers
 - 6. Sorbent materials
 - 7. Curbing drip pans
 - 8. Sumps and collection systems
- F. Inspections and Records: Inspections required by this Scope of Work shall be in accordance with written procedures developed for the facility of the Contractor. These written procedures and a record of the inspections, signed by the appropriate supervisor or inspector, shall be part of the Spill Control and Prevention Plan, and shall be maintained during the project and submitted to the Engineer for final closeout.
- G. Facility Lighting: Facility lighting shall be commensurate with the type and location of the facility. Consideration shall be given to the following:

SECTION 01495 – SPILL PREVENTION AND CONTROL

1. Discovery of spills, occurring during hours of darkness, both by operating personnel, if present, and by non-operating personnel (security personnel, the general public, local police, etc.)
2. Prevention of spills occurring through acts of vandalism.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 GENERAL

- A. If materials are released, submit a written description of the event, corrective action taken, and plans for preventing a recurrence, as well as a written commitment of manpower, equipment, and materials required to expedite control and removal of any harmful quantity of materials released.
- B. Notify the New York State Department of Environmental Conservation, Nassau County Department of Health, Nassau County Department of Public Works, and the Engineer within two hours of the release or spill.

3.02 TRAINING

- A. Personnel Training and Spill Prevention Procedures: The Contractor shall be responsible for properly instructing his personnel regarding applicable pollution control laws, rules, and regulations; and in the operation and maintenance of equipment to prevent the discharge of materials.
- B. Briefings: Schedule and conduct Spill Prevention Briefings for its operating personnel at intervals frequent enough to assure adequate understanding of the Spill Prevention and Control Plan for this project. Such briefings shall highlight and describe known spill events or failures, malfunctioning components, and recently developed precautionary measures.
- C. Mark Evacuation Routes on the project site.

3.03 TESTING

- A. Facility communication or alarm systems and spill control equipment must be tested and maintained by the Contractor as necessary to assure proper operation in time of emergency.

END OF SECTION

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

- A. Provide temporary facilities and controls in the manner designated hereinafter.
- B. Coordinate and install all temporary facilities and controls in accordance with the requirements of the local authorities or utility companies having jurisdiction and in accordance with all state, federal and local codes and regulations.
- C. At the completion of the Work, or when the temporary facilities and controls are no longer required, subject to the approval of the Owner, remove the temporary facilities and controls and restore the facilities to their original condition.
- D. Costs in connection with the temporary electric, lighting, heating and ventilation, and other miscellaneous temporary facilities and controls including but not limited to, installation, maintenance, relocation and removal shall be borne by the Contractor.

1.02 TEMPORARY SANITARY FACILITIES

- A. Provide and pay all costs for temporary toilet facilities in sufficient numbers, for the Contractor's and Subcontractors' personnel on this Project.
- B. Sanitary facilities shall be properly screened from public observation and shall be provided and maintained at suitable locations by the Contractor including Contractor's staging area, all as prescribed by state labor regulations and local ordinances. This system shall not be connected to the local sanitary sewer system and the contents of same shall be removed and disposed of in a satisfactory manner, as the occasion requires.
- C. Prohibit nuisances within, on, or about the Work.
- D. Owner sanitary facilities and locker rooms are prohibited from Contractors' and subcontractors' use.

1.03 TEMPORARY ELECTRICAL FACILITIES

- A. Furnish and install a temporary electrical facilities system which shall consist of temporary electric service points, a temporary general lighting system, a security lighting system, a safety lighting system, and service to the Contractor's field offices.
- B. Submit a drawing showing the proposed temporary electrical facilities system layout for approval by the Engineer prior to installation.
 - 1. Work Included: Temporary work shall include the following:
 - a. Furnish and pay for all labor, material and equipment for the installation of the temporary electrical facilities system. The installation shall comply with all applicable requirements of the National Electric Code and any other codes or bodies having jurisdiction.
 - b. Furnish and pay for all labor material and equipment for the maintenance of the temporary electrical facilities system.
 - c. Furnish and pay for labor, materials and equipment for removing all temporary facilities.
- C. Requirements:
 - 1. Temporary electrical facilities system shall be as herein specified and required for the contractor's use, and shall be provided no later than thirty days after the date of Notice to Proceed.
- D. Temporary Electric Service Points:
 - 1. Furnish, install and maintain a temporary power distribution point local to the work area.
 - 2. At the temporary power distribution point, furnish and install an overcurrent protection device. The overcurrent protection device shall be rated for 208 volts, three-phase and sized for Contractor's temporary electric requirements.
 - 3. Provide a temporary transformer, a 100 Amp circuit breaker and other equipment necessary and required to provide the temporary electric system with the specified capacity. Provide separate distribution circuit breakers or fused switches for

SECTION 01500 – TEMPORARY FACILITIES AND CONTROLS

disconnection and overcurrent protection of the temporary electrical facilities fed from the service point which shall include the Contractor's field offices and the security lighting system for the Staging Area.

4. Furnish and install circuit breakers or fused switches, transformers, wiring and conduit as required for the temporary power distribution point.
5. Distribution circuit breakers or fused switches shall be furnished and installed at each location for disconnection and overcurrent protection of the temporary electrical facilities, including the temporary general lighting system, the security lighting system and the safety lighting system. Circuit breakers shall be thermal magnetic type. Circuit breakers shall be equipped with lockable handles. Disconnect switches shall be fused type with current limiting fuses and be equipped with padlocking features.
6. At the completion of the project, the Contractor shall remove the temporary electric service point facilities to the condition they were prior to construction.
7. Aerially routed cables shall be messenger supported from solid wood poles or other recognized means. Messenger shall be high strength galvanized steel. Install aerial conductors at a minimum height of 14 feet above finished grade. When conductors cannot be routed at the proper height or where it will interfere with plant operations or construction activities, conductors shall be provided in rigid steel conduit and installed underground.
8. Poles shall have a class suitable for the installation in accordance with the National Electrical Safety Code and shall be thirty feet length minimum. Poles shall be guyed at angle or corner runs and when eccentrically loaded.

E. Temporary General Lighting System:

1. Provide and maintain a temporary lighting system. The system shall conform to the applicable Federal and State codes, shall meet the illumination requirements specified herein, and shall meet the approval of the Owner.
2. Temporary general lighting system shall provide 120-volt receptacles and lighting for access to and egress from the work and for safe and expeditious construction within designated enclosed areas of the structure or structures. Receptacles shall be installed in such a manner so as to reach any point in the work areas with an extension cord not to exceed 40 feet in length.
3. Temporary general lighting system shall consist of wiring, switches, necessary insulated supports, poles, fixtures, receptacles, 100-watt lamps, guards, cutouts and fuses as specified shown or required.
4. Furnish lamps, fuses, receptacles and cords for the temporary general lighting system and shall replace broken and burned out lamps and blown fuses for the system.
5. Temporary general lighting system shall be installed progressively in the structure as the areas are enclosed or as lighting becomes necessary because of partial enclosure.
6. Required Illumination for Work Lighting:
 - a. General: Five foot-candles.
 - b. Stairs: Ten foot-candles.
 - c. Construction Plant and Shops: Ten foot-candles.
 - d. For Detail and Finishing Work: Twenty foot-candles.
 - e. For Testing and Inspection: Thirty foot-candles.
 - f. At First-aid Stations: Thirty foot-candles.
 - g. Areas of Owners's Operations: One 300-watt lamp at intervals of 15 feet on centers.
7. Maintain the temporary general lighting system in safe working order.
8. Arrange and install the lamps in a manner so as to provide an even distribution of illumination as necessary and required over the work areas.
9. If necessary and required, install receptacles in such a manner as to reach any point in the work areas with an extension cord not to exceed 40 feet in length.
10. In case of overloading of circuits, the Owner will restrict the use of tools as required for the correct loading.
11. The temporary general lighting system shall be used for small power purposes only.

SECTION 01500 – TEMPORARY FACILITIES AND CONTROLS

12. Handtools, such as drills, hammers and grinders, may be connected to the temporary general lighting system provided that they are suitable for 120 volt, single phase, 60 hertz operation and do not have a power requirement exceeding 1,500 volt amperes. Only one unit may be connected to a single receptacle and shall not be connected to lighting outlets. Cords of tools shall not exceed 40 feet in length.
 13. Do not proceed with any portion of his work which in the opinion of the Engineer is not adequately illuminated.
 14. Keep the temporary general lighting system in service each working day, from Monday through Friday inclusive, by energizing the system at 7:00 A.M. and de energizing the system at 3:30 P.M.
 15. Any Contractor requiring the use of a temporary general lighting system other than during the times set forth in the preceding paragraph from Monday through Friday, or at any time on Saturdays, Sundays or Holidays, shall pay the costs of energizing or de energizing the system and for keeping the system in operation.
 16. Temporary general lighting system shall be removed in its entirety at the completion of the project.
- F. Security Lighting System:
1. Furnish, install and maintain a security lighting system to illuminate the Staging Area and the construction site outside the building.
 2. Security lighting system shall consist of floodlights equal to Crouse Hinds Cat. No. MVD 4HCW O PC DF AF VS AF 400 watt mercury vapor lamp, Cat. No. ML2590 photocell, Cat. No. ML5547 vandal shield and Cat. No. 105 N11 bracket for wood pole mounting. Floodlights shall be mounted approximately 30 feet above the ground.
 3. Each floodlight shall be complete with a constant wattage, high power factor ballast in a cast aluminum housing, a flat clear lens of heat and impact resistant glass, photo control, lamp and suitable mounting hardware.
 4. Photometric performance shall be equal to that of the above specified unit with a beam spread of approximately 150 degrees horizontal to 80 degrees vertical and with a beam efficiency of not less than 55 percent.
 5. Poles shall be 35 foot, class F wood and shall be securely set five feet in the ground.
 6. Wiring for the security lighting system may be installed overhead. The security lighting system shall be properly maintained and energized at all times with each floodlight controlled by a photocell installed on the floodlight. The photocells shall be adjusted so that all floodlights are energized at approximately the same time. Broken and burned out lamps shall be replaced.
 7. Security lighting system shall be installed and made operative within 30 days after the date of the Notice to Proceed.
 8. Security lighting system shall be removed in its entirety at the completion of the project.
- G. Safety Lighting:
1. Provide, install and maintain sufficient lighting fixtures to provide adequate light to ensure safe access to, egress from, and passage through the construction areas between the hours of 4:30 P.M. and 7:00 A.M. Monday through Friday and 24 hours per day for Saturdays, Sundays, and Holidays. The lighting system shall be operated by a time clock. Fixtures shall be 100 watt and shall be provided, as a minimum at every landing of every stairway and every 50 feet along passageways. The safety lighting system shall be installed progressively in structures as the designated areas are enclosed or as lighting becomes necessary because of partial enclosure. This lighting is not intended for construction purposes.
- H. Contractors' Field Offices:
1. Provide temporary electric service from the tie-in to the service point specified in Paragraph 1.3.D.3 to the Contractor's field office.
 2. The Contractor shall be responsible for providing his own telephone facilities as required.
 3. Electric service for connection to construction trailers is available from the electric utility. Install the electrical service as required to each Field Office.

SECTION 01500 – TEMPORARY FACILITIES AND CONTROLS

I. Additional Facilities:

1. Should any portion of any Contractor's work require light or power in addition to that supplied by the temporary general lighting system herein described, furnish, install and maintain such additional temporary lighting and power facilities at own expense. Additional temporary lighting shall be sufficient for safe access to and egress from such work, and for safe expeditious construction.
2. The installation of additional facilities shall comply with all applicable requirements of the National Electric Code and any other codes of enforcing bodies having jurisdiction, and shall be installed so as not to interfere with the work.
3. Upon completion of the Contract work, remove all temporary facilities.

1.04 TEMPORARY HEATING FACILITIES

- A. Provide temporary construction heating for cold weather protection of equipment and Work, and for workers comfort.
- B. Provide temporary building heat for heating the interior of all structures and building areas, which is necessary for the protection of all Work and equipment of the Contract for the comfort of workers, after the building or structure is temporarily enclosed. Hot water or steam from the Owners facilities will not be available for use as temporary heating. The following requirements shall apply:
 1. All temporary heating methods proposed by Contractor shall be submitted to the Owner for approval and must comply with all federal, state and county rules and regulations.
 2. Temporary construction heat for "cold weather protection" shall be provided. "Cold weather protection" shall be considered to include both temporary heat and protective covers or enclosures required during the construction period prior to the enclosure of new buildings or buildings and structures being remodeled. Provide "Cold weather protection" until all construction requirements under the Contracts are complied with, or until the enclosure of a new building or structure complies with the requirements for temporary building heating as hereinafter specified in Paragraph 1.4.E.
- C. Provide temporary heat for the temporary building heating system. The systems shall be gas or oil fired; steam, hot water or warm air type. Electric heating will not be permitted.
- D. No salamanders or other direct fired equipment will be allowed in areas of existing buildings, or in new construction areas where the use of such equipment will damage or deteriorate the construction or finishes or is harmful to employees working in the area.
- E. Temporary building heating systems shall be complete, including pumps, radiators, unit heaters, water and heating piping, insulation, controls, or any other equipment necessary, all furnished and installed by Contractor. Systems shall include boilers, fuel, and fuel storage facilities or any other equipment necessary, all furnished and installed and paid for by the Contractor, including fuel and electrical costs. Provide fuel oil tanks with adequate secondary containment and the fuel oil systems shall comply with Nassau County Fire Prevention Ordinance-Article III. Electrical service and cost relative to obtaining temporary heating beyond those provided under the temporary electrical facilities shall be the responsibility of the Contractor and provided for under temporary heating. This includes, but is not limited to, the cost of providing temporary light if it should be required.
- F. A building, structure or gallery shall be considered to be temporarily enclosed when the area is covered by a permanent structural slab or deck and all openings through the permanent slab or deck are covered to prevent the entrance of rain or snow. Intermediate floor structures or multi floor buildings or structures shall be considered to be temporarily enclosed subject to the same requirements. The building shall be considered to be temporarily enclosed when one of the permanent exterior wall elements, concrete, block, or the permanent exterior wall, or facing material, is installed and all openings through that element are covered or temporarily enclosed to prevent the entrance of rain, snow, or direct wind. Openings through structures, intermediate floors or exterior wall elements shall be considered to be enclosed when that opening is covered with minimum ten mil plastic or minimum twelve (12) ounce waterproof duck canvas

SECTION 01500 – TEMPORARY FACILITIES AND CONTROLS

tarps or with minimum three eighths inch thickness exterior grade plywood. Temporary covers or enclosures for openings shall be the responsibility of the Contractor.

- G. Temporary building heating shall be provided from the first day of October to the last day of the following April. The system shall be capable of maintaining a minimum of fifty-five degrees Fahrenheit (55°F) simultaneously in all areas of construction in buildings, structures or galleries, and a minimum of sixty-five degrees Fahrenheit (65°F) in toilet rooms. Temporary heating shall be provided on a twenty-four hours per day, seven days per week basis. Where it is determined by the County that higher temperatures are required in a particular area to protect installed equipment or new construction, it shall be so, provided under this Contract.
- H. Provide and pay for all electric wiring and electrical accessories required for the temporary heating system.
- I. Temporary heating equipment shall not be located so as to interfere with the new construction Work. Heating system equipment shall not cause undue noise or fumes and shall be enclosed by wire fencing, or other means to provide protection to personnel.

1.05 TEMPORARY VENTILATION FACILITIES

- A. Provide temporary construction ventilation for the protection of equipment, Work and worker comfort and safety at all times.
- B. Provide all temporary building ventilation for ventilating all structures and building areas, both above and below ground level, which is necessary for the protection of all Work and equipment of this Contract or for the comfort and safety of workers, after the building or structure is enclosed.
- C. Ventilating systems may be forced or gravity type and shall be complete with fans, motors, inlets, outlets, ductwork, heaters, controls or any other equipment necessary, all furnished and installed by the Contractor. The following additional requirements shall apply:
 - 1. All temporary ventilation methods proposed by the Contractor shall be submitted to the Owner for approval and must comply with all federal, state and county rules and regulations.
 - 2. Temporary ventilation shall be provided by the Contractor until the building or structure is enclosed.
 - 3. A building or structure shall be considered to be enclosed as hereinbefore specified in Paragraph 1.4, Temporary Heating Facilities.
 - 4. Ventilation air shall be heated to those temperatures specified for space or room temperatures as hereinbefore specified in Paragraph 1.4, Temporary Heating Facilities. Provide dehumidification to prevent mildew or moisture forming on equipment in areas being ventilated.
- D. Provide and pay for all equipment and labor to operate the temporary ventilation system after a building or structure is enclosed. Heating required for the ventilation system shall be provided by the temporary heating system specified in Paragraph 1.4.
- E. Provide and pay for all electric wiring and electrical accessories required for the temporary ventilation system.
- F. Temporary ventilation equipment shall not be located so as to interfere with the operation of the new construction Work. Protective devices shall be provided for the protection of the personnel.
- G. Temporary ventilation shall be supplied to all buildings or structures below grade at a minimum of three air changes per hour and the outside air shall be tempered to room temperature levels unless otherwise noted. Temporary ventilation shall be supplied to all new buildings or structures above grade only where required to protect equipment and Work being installed or for safety of employee.

1.06 PROTECTION OF WORK AND MATERIALS

- A. Protection Requirements:

SECTION 01500 – TEMPORARY FACILITIES AND CONTROLS

1. During the progress of the Work and up to the date of Final Payment, the Contractor shall be solely responsible for the care and protection of all Work and materials covered by the Contract. In order to prevent damage, injury or loss, actions shall include, but not be limited to, the following:
 - a. Store apparatus, materials, supplies, and equipment in an orderly, safe manner that will not unduly interfere with the progress of the Work or the work of any other contractor or utility service company.
 - b. Provide suitable storage facilities for all materials, which are subject to injury by exposure to weather, theft, breakage, or otherwise.
 - c. Place upon the Work or any part thereof only such loads as are consistent with the safety of that portion of the Work.
 - d. Clean up frequently all refuse, rubbish, scrap materials, and debris caused by his operations, to the end that at all times the Site of the Work shall present a safe, orderly and workmanlike appearance.
 - e. Provide barricades and guard rails around openings, for scaffolding, for temporary stairs and ramps, around excavations, elevated walkways and other dangerous areas as deemed necessary by Engineer.
 2. Protect the existing Work and material from damage by the workers and be responsible to repair any such damage at no additional cost to the Owner.
 3. Protect trees, shrubbery and other natural features or structures from being cut, trimmed or injured in his areas of Work. Trees adjacent to the Site of Work shall be protected and temporary supports provided for long branches. Stored materials and equipment shall be in cleared spaces, away from all trees and shrubs, and confined to areas as directed by the Engineer.
 - a. Temporary fences or barricades shall be installed to protect trees and plants in areas subject to traffic.
 - b. No fires will be permitted at the site of the Work.
 - c. Within the limits of the Work, water trees and plants that are to remain, in order to maintain their health during construction operations.
 - d. Cover all exposed roots with burlap that shall be kept continuously wet. Cover all exposed roots with earth as soon as possible. Protect root systems from mechanical damage and damage by erosion, flooding, run off or noxious materials in solution.
 - e. If branches or trunks are damaged, prune branches immediately and protect the cut or damaged areas with emulsified asphalt compounded specifically for horticultural use in a manner approved by Engineer.
 - f. All damaged trees and plants that die or suffer permanent injury shall be removed when ordered by the Engineer and replaced by a specimen of equal or better quality.
 - g. Coordinate Work in this Section with requirements of Sections 02200, Earthwork, and 02485, Grassing and Planting.
 4. Protect Work and materials in accordance with the requirements of the Agreement, Article VI, "Protection"; General Conditions, Articles GC 17, "Materials and Equipment, Approvals Substitutions and Deviations", GC 21, "Protection Requirements", and GC 24, "Barricades, Warning Signs and Lights".
- B. Maintenance of Egress:
1. During demolition and construction Work of this Project, maintain and keep free of debris, materials or equipment points of required egress in accordance with the requirements of the Nassau County Fire Commissioner and Fire Safety Regulations.
 2. In active facility areas, do not store or stockpile material. Debris or other material which may obstruct Owner personnel from operating or maintaining active equipment and piping shall be removed daily.
- C. Temporary Construction Fencing:
1. The Work areas of the Project Site shall be enclosed at all times by temporary fencing to ensure security.

SECTION 01500 – TEMPORARY FACILITIES AND CONTROLS

2. Temporary fencing shall not be less than six feet in height. Fabric shall be ten-gauge minimum, electrically welded wire, forming a rectangular mesh with opening two by four inches and three rows of double barb ten-gage wire on angle brackets measuring two feet vertically. Fabric shall be mounted on heavy duty steel tee spaced at intervals not exceeding ten feet.
 3. Furnish, erect, relocate and maintain all temporary fencing. Upon completion of the Project all temporary fencing shall be removed and disposed of.
 4. All Work in connection with the temporary fencing shall be done at no additional cost to the County.
- D. Protection of Existing Structures:
1. Underground Structures:
 - a. Underground structures are defined to include, but not be limited to, all sewer, water, gas, and other piping, and manholes, chambers, electrical and signal conduits, tunnels and other existing subsurface work located within or adjacent to the limits of the Work.
 - b. All underground structures known to the Engineer, except water, sewer, electric and telephone service are shown on the Drawings. This information is shown for the assistance of the Contractor in accordance with the best information available, but is not guaranteed to be correct or complete.
 - c. Explore ahead of trenching and excavation Work and uncover all obstructing underground structures sufficiently to determine their location, to prevent damage to them and to prevent interruption of the services which such structures provide. If the Contractor damages an underground structure, restore to original condition at own expense.
 - d. Necessary changes in the location of the Work may be made by the Engineer, to avoid unanticipated underground structures.
 - e. If permanent relocation of an underground structure or other subsurface facility is required and is not otherwise provided for in the Contract Documents, the Engineer will direct the Contractor in writing to perform the Work, which shall be paid for under the provisions of the Agreement.
 2. Surface Structures: Surface structures are defined as all existing buildings, structures and other facilities above the ground surface. Included with such structures are their foundations or any extension below the surface. Surface structures include, but are not limited to, buildings, tanks, walls, bridges, roads, dams, channels, open drainage, piping, piles, wires, posts, signs, markers, curbs, walks and all other facilities that are visible above the ground surface.
 3. Protection of Underground and Surface Structures:
 - a. Sustain in their places and protect from direct or indirect injury all underground and surface structures located within or adjacent to the limits of the Work. Such sustaining and supporting shall be done in a careful manner and as required by the County. Before proceeding with the Work of sustaining and supporting such structure, the Contractor shall satisfy the Engineer that the methods and procedures to be used have been approved by the Owner.
 - b. The Contractor shall assume all risks attending the presence or proximity of all underground and surface structures within or adjacent to the limits to the Work. The Contractor shall be responsible for all damage and expense for direct or indirect injury caused by his Work to any structure. Repair immediately all damage caused by the Work to the satisfaction of the Owner of the damaged structure.
 4. All other existing surface facilities, including but not limited to guard rails, posts, guard cables, signs, poles, markers, and curbs, which are temporarily removed to facilitate installation of the Work shall be replaced and restored to their original condition at Contractor's expense.
- E. Protection of Floors and Roofs:
1. Protect floors, roofs and stairs from overloads, dirt and damage during entire construction period. In areas subject to foot traffic, secure heavy paper, sheet goods, or other

SECTION 01500 – TEMPORARY FACILITIES AND CONTROLS

- materials in place. For storage of products, lay tight wood sheathing in place. Cover walls and floors of elevator cars and surfaces of elevator car doors used by construction personnel.
2. Proper protective covering shall be used when moving heavy equipment, when handling materials or other loads, when painting, when handling mortar and grout and when cleaning walls and ceilings.
 3. Use metal pans to collect all oil and cuttings from pipe, conduit, or rod threading machines and under all metal cutting machines.
 4. Concrete floors less than 28 days old shall not be loaded without written permission of the Engineer. No floor, roof or slab shall be loaded in excess of the design loading shown on the Drawings.
 5. Roof slabs shall not be loaded without written permission of the Engineer. Prohibit use of finished roofing surfaces for traffic of any kind, and for storage of any products. When activity must take place in order to carry out the Work, obtain recommendations of installer for protection of surface. Install recommended protection and remove on completion of that activity. Restrict use of adjacent unprotected areas.
 6. Restrict access to roofs and keep clear of existing roofs except as required by the new Work.
 7. If access to roofs is required, roofing, parapets, openings and all other construction on or adjacent to roof shall be protected with suitable plywood or other approved means.
- F. Protection of Installed Products and Landscaping:
1. Provide protection of installed products to prevent damage from subsequent operations. Remove protection facilities when no longer needed, prior to completion of Work.
 2. Control traffic to prevent damage to equipment, materials and surfaces.
 3. Provide covering to protect equipment and materials from damage.
 - a. Cover projections, wall corners, and jambs, sills and soffits of openings, in areas used for traffic and for passage of products in subsequent Work.
 4. Prohibit traffic of any kind across planted lawn and landscaped areas.
- G. Protection from Flood: Do not allow any areas turned over for commencement of Work, to flood. Keep all existing and new facilities within Work area free of accumulations of water. Provide, install, and operate sufficient pumps for this purpose. Continuous monitoring for floods and protection of structures from damage and flotation shall be provided. Install any combination of suitable dikes, well points, pumps, and the like to protect the Work until it is accepted.
- H. Special Protection of Machinery and Equipment:
1. Take all protective measures necessary to the satisfaction of the Owner to ensure that inclement weather or dust and debris from demolition does not enter any of the mechanical or electrical equipment rooms or enclosures. Enclosures shall be provided where necessary to prevent contamination of the air. All protective measures shall be furnished, installed, lighted, ventilated, maintained and removed at the Contractor's own cost.
 2. Interior dustproof covers shall be a heavy reinforced polyethylene film curtain, minimum thickness 6 mils, supported by wood framing. All seams and penetration shall be sealed with duct tape on two sides. Junctions with existing walls, floors and ceilings shall be made with a double fold secured with a backing strip anchored to the existing wall, floor and ceiling.
 3. The Contractor shall be responsible for all damage to existing structures, equipment, and facilities caused by his construction operations and must repair all such damage when and as ordered at no additional cost to the County. All work shall be done in accordance with the requirements of Section 01039, Demolition and Removal of Existing Structures and Equipment.
- I. Emergency Repair Crews: In case the Contractor's operations disrupt facility operations herein before described, at any time and at own cost, immediately make all repairs or replacements and do all work necessary to restore the facility to operation to the satisfaction of the Owner. Such work shall progress continuously to completion on a 24-hour/day, 7-workday/week basis.

SECTION 01500 – TEMPORARY FACILITIES AND CONTROLS

The Contractor shall provide the services of emergency repair crews, available on call 24 hours per day.

1.07 ACCESS ROADS, PARKING, STAGING, STORAGE AND WORK AREAS

- A. Contractor's Staging and Storage Area
 - 1. The Contractor shall find a location for and construct a Contractor's Staging Area. The Staging Area shall be leveled, graded and seeded after completion of the Contract.
 - 2. The Staging Area shall be drained so that no ponding of runoff water shall occur in the Staging Area or adjacent areas.
 - 3. Erect six-foot high galvanized chain link fencing and gates around the Staging Area as specified in Paragraph 1.6.C.
 - 4. Provide pavement and utilities in the Staging Area and maintain all sections of the Staging Area in a suitable manner, including the cutting of grass, weeding and preventing the accumulation of debris. Provide electrical utilities in the Staging Area.
 - 5. At the completion of the project, remove all debris not limited to gravel, grout, wood, etc., from the Staging Area off-site. Grade the Staging Area level and furnish a minimum of six (6) inches of topsoil, which will be unloaded, graded and hydro-seeded as directed by the Engineer.
- B. Access Roads:
 - 1. Provide access roads in accordance with the requirements of the General Conditions, Article GC 22, "Access Roads and Parking Areas", the Drawings and the applicable Technical Specifications.
 - 2. Take all necessary precautions to protect traffic, including but not limited to, complying with the requirements of the General Conditions, Articles GC 23, "Traffic Regulations" and GC 24, "Barricades, Warning Signs and Lights".
 - 3. Post speed limit signs to be adhered to at all times in the vicinity of the staging and work areas.
- C. Parking, Storage and Work Areas:
 - 1. No on-site parking is permitted.
 - 2. Construct and maintain suitable storage areas for his use within the staging area.
 - 3. Arrange Work and dispose of materials in such manner as to cause the least interference with the Work.
 - 4. No Contractor shall claim exclusive occupancy of areas within or adjacent to the limits of his Work under this Contract. The Owner and its employees and the Contractors for other contracts shall also have access to these areas.
 - 5. Modify storage areas to cause minimum damage to the landscape and to comply with the directions of the Owner. At the completion of the Work the surfaces of the land used for storage areas shall be restored by the Contractor to the satisfaction of the Owner and the Engineer.

1.08 CONTRACTOR'S FIELD OFFICE

- A. Furnish, equip and maintain a field office for his use at the Site during the period of construction. The Contractor shall provide his own telephone service and shall have readily accessible, at the field office, copies of the Contract Documents, latest approved Shop Drawings and all Project related correspondence, Change Orders, etc.
- B. Contractor's field office shall be located at the Glen Cove WWTP. Exact location to be coordinated with Owner and Owner's operator.
- C. Provide a Contractor's field office with the minimum facilities specified. Provide all required storage and work sheds.
 - 1. Field Office and Furnishings:
 - a. Acceptable appearance, weatherproof insulated building or trailer with lockable door.
 - b. Telephone service.
 - c. Six protective helmets for visitor's use.
 - d. Exterior identifying sign.

SECTION 01500 – TEMPORARY FACILITIES AND CONTROLS

- e. Company sign no larger than 4 feet by 8 feet.
- 2. Remove office and sheds upon Final Acceptance unless otherwise approved by the Engineer.

1.09 SECURITY

- A. Make whatever provisions deemed necessary to safely guard all Work, materials, equipment and property from loss, theft, damage and vandalism. The Contractor's duty to safely guard property shall include the Owners property and other private property from injury or loss in connection with the performance of the Contract.
- B. The Contractor shall make no claim against the County for damage resulting from trespassing.
- C. Repair all damage to the property of the Owner and others arising from failure to provide adequate security.
- D. If existing fencing or barriers are breached or removed for purposes of obstruction, provide and maintain temporary security fencing equal to the existing one, in a manner satisfactory to the Engineer and the Owner.
- E. Security measures taken by the Contractor shall be at least equal to those usually provided by the County to protect his existing facilities during normal operation.
- F. Maintain the security program throughout construction until the date of Substantial Completion and occupancy precludes need for Contractor's security program.
- G. The Contractor's employees shall be issued identification badges, which shall be displayed at all times, as per Section 01356, Safe and Healthful Working Conditions, Paragraph 1.5.F.

1.10 SUBMITTALS

- A. Contractor shall submit for temporary electrical facilities working drawings, shop drawings and material specifications for the approval of the Engineer and the utility in accordance with the requirements of the General Conditions, Article GC-14 – Contractor Submissions; and as specified under Division 1 of the Specifications.
- B. Working Drawings:
 - 1. One line diagram representing the power distribution for the temporary system.
 - 2. Location plan indicating the major distribution equipment.
 - 3. Manufacturer's catalog cuts for the products proposed for use.
 - 4. Panel loading, voltage drop, short circuit and lighting calculations.
 - 5. Security lighting layout with photometric and footcandle printout.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Furnishing of the Engineer's Field Office (Trailer).
- B. The Engineer's Field Office shall be furnished by the General Construction Contractor within the time period specified hereinafter.
- C. Furnish the following in accordance with the specifications contained herein as follows:
 - 1. Miscellaneous equipment and supplies
 - 2. Materials
 - 3. Services as may be specified herein.
- D. Temporary electric, internet, water and sewer shall be installed to the Engineer's trailer within two (2) days from the date that the trailer is on-site and is ready for power as notified by the Engineer.

1.02 SERVICE

- A. Applications for electrical service shall be completed by the Contractor.
- B. Provide 100-amp temporary power to the Engineer's trailer.
 - 1. Wire and electrify the trailer.
 - 2. Maintain the service throughout the project up to final completion.
 - 3. Remove the service prior to the last day of final completion.

1.03 CARE AND PLACEMENT

- A. Field office shall be place where directed by the Engineer in accordance with site utilization requirements.
- B. All field offices shall be installed to meet all standard of the Occupational Safety and Health Act of 1970 and subsequent revisions.
- C. In the event of damage to existing facilities, including but not limited to: tanks, driveways, walks, pavement, buildings, pipes, conduits, valves, and electrical facilities then immediately make all repairs and replacements to an equal condition prior to the event.

1.04 QUALITY PERFORMANCE

- A. Comply with and perform all work in accordance with the requirements of local authorities and utility companies having jurisdiction.

1.05 SUBMITTALS

- A. Submit the following:
 - 1. Floor plan of the proposed Engineer Field Office.
 - 2. Catalog cuts of miscellaneous equipment and supplies if they are different from that specified.

PART 2 – PRODUCTS

2.01 CONTRACTOR OFFICE

- A. Provide and maintain during the life of this contract a separate and suitable office near the site that shall be used as the Contractor's superintendent office.
- B. Provide adequate facilities for maintaining record documents, for holding small meetings and a telephone upon which calls may be received from Owner, Engineer and others. The telephone shall be equipped with a fax machine and an answering machine.
- C. Install, maintain, and repair if necessary, temporary electric and telephone to their own field office.

2.02 MATERIALS, EQUIPMENT AND SERVICES FURNISHED TO THE OWNER BY THE CONTRACTOR

- A. Furnish the following equipment and services. All items specified herein shall be new and remain the property of the Owner unless otherwise stated. The following shall be furnished:

SECTION 01512 – FIELD OFFICES

1. Computer:
 - a. Laptop computer systems, Dell or approved equal, with the following:
 - b. Processor: 10th gen Intel® Core™ i7-10850H Processor (2.7GHz, 12M cache)
 - c. Operating System: Windows 10 Professional English/French 64bit
 - d. Office Productivity Software: Microsoft® Office Professional 2019, English, French and Spanish
 - e. Dell Data Protection |Encryption Security SW: 1 Year ProSupport Plus with Next Business Day Onsite Service
 - f. Adobe Creativity and Productivity Software: Adobe® Acrobat® Professional 2020
 - g. Video Card: Nvidia GeForce MX250 Discrete Graphics with Thunderbolt for Intel 10th Gen Core i7-10850H Intel® Integrated HD Graphics 4400
 - h. Hard Drive: 500GB Solid State Hybrid Drive M.2 512GB PCIe NVMe Class 40 Solid State Drive
 - i. Latitude 15 5000 Series Chassis Options: Latitude 15 5000 5511 Series Bottom Door L10
 - j. Memory: 4GB (1x4GB) 1600MHz DDR3L Memory 16GB, 1x16GB, DDR4 Non-ECC
 - k. Internal Keyboard: Internal English Single Pointing Keyboard Dual Pointing US English Keyboard Backlit with 10 Key Numeric Keypad
 - l. Optical Drive: 8X DVD+/-RW
 - m. Wireless Driver: Intel® Dual Band Wireless-AC 7260 + BT 4.0 Driver Intel Wi-Fi 6 AX201 2x2 802.11ax 160MHz + Bluetooth 5.1
 - n. Wireless: Intel® Dual Band Wireless-AC 7260 802.11AC Wi-Fi + BT 4.0 LE Half Mini Card
 - o. Non-Microsoft Application Software: Additional Software for Windows 7 Downgrade
 - p. Power Supply: 65W A/C Adapter (3-pin)
 - q. Camera: Light Sensitive Webcam and Noise Cancelling Digital Array Mic
 - r. LCD Display: 15.6" FHD (1366x768) 1920 x 1080 Wide View Anti-Glare WLED backlit Non-Touch, RGB Cam & Mic, WLAN/WWAN Capable
 - s. Palmrest: No Fingerprint Reader (Single Pointing) Palmrest
 - t. FGA Module: Alpine15_R1_106/US/BTS
 - u. Provide for each laptop G-data total protection for duration of project."
2. One (1) printer, scanner and fax machine with 8½ x 11, 8½ x 14 and 11 x 17 double sided capability as manufactured by Canon, ImageClass MF7480 or equal.
3. One (1) point-and-shoot digital camera with zoom capabilities and two 4GB memory cards, manufactured by Canon, Powershot ELPH 180 or equal.
4. One (1) portable tablet computer with a minimum of 64 GB of storage, camera and Wi-Fi connectivity, iPad Mini as manufactured by Apple, or equal.
5. Two (2) 23-gallon plastic wastepaper basket.
6. One large set of triangles, an engineer's scale and an architect's scale.
7. New 50-person industrial first aid station, OSHA approved, by Acme United or equal, order no. ACM-1403 (Huntington Business Products) or equal.
8. Thermometer, with indoor and outdoor sensing bulbs, and high, low instantaneous reading, with magnetic reset function by Radio Shack or equal.
9. Infrared thermometer, Extech Model #42509.
10. Two U.L. and F.M. approved fire extinguishers with a minimum rating of 4A-60B:C.
11. Two (2) 30 inch x 60 inch desks with 4 side drawers and a locking center drawer.
12. Two (2) new swivel task chairs for use with desk equal to order no. SUP-12223643 by Superior Chair (Huntington Business Products).
13. One (1) new rolling stand with top, Model No. 76MR/76TP from Plan Hold, catalog #27, or equal.
14. One (1) 30-inch x 72-inch folding table.
15. Four (4) metal folding chairs.
16. One (1) adjustable, heavy-duty three-hole punch, by Master, order no. MAT-1340PB (Huntington Business Products or equal).

SECTION 01512 – FIELD OFFICES

17. One (1) 40 sheet capacity heavy-duty two-hole punch, by Master, order no. MAT-327B or equal.
 18. One (1) 2-foot x 4-foot cork bulletin board with wall mounting hardware.
 19. One (1) 2-foot x 4-foot white board with wall mounting hardware and dry erase marker set
 20. One (1) 3-foot x 3.5-foot high metal book shelf
 21. One (1) four (4) drawer, legal size, fireproof filing cabinets with lock and keys, Global Business Furniture Catalog No. F4053, or equal. Provide with legal size hangers and with 60 legal size-hanging folders all the same color.
 22. Bottled water service with water cooler and hot water dispenser.
 23. 6 cubic foot refrigerator with separate freezer section.
 24. Boot brush at each trailer staircases.
 25. Mud mat at each trailer doorway.
 26. Three (3) legal size clipboards.
 27. Five (5) coat hooks or coat rack.
 28. Three (3) Surge protection power strips, five receptacles minimum each.
 29. Chair mat for each desk area.
 30. One (1) 12-inch diameter battery operated wall clock.
 31. Two (2) battery back-up units for desk top computer system: CyberPower Intelligent LCD Battery Backup, 825VA/450 Watts
 32. Five (5) extension cords, minimum three plug each, three prong type
 33. One (1) 10/100 Ethernet router with at least 4 Smith Ports.
- B. Provide janitorial services two (2) times each week. Thoroughly clean and dust entire office and leave in a condition satisfactory to Owner. Remove and dispose of trash. Provide this service through final completion.
- C. All items to be provided by Contractor under this paragraph shall remain the property of the Owner unless otherwise stated.
- D. All items shall be delivered prior to the first application for payment, but no later than the day the Engineer's Trailer is delivered.
- E. Engineer's Field Trailer:
1. Office – Furnish, equip, and maintain a field office at the site for the exclusive use of Owner/Engineer.
 - a. The field office shall be of substantial weatherproof construction, with a usable floor space of not less than 10 feet x 40 feet box size, with bathroom.
 - b. Office may be in an approved, near new condition, independent trailer, complete with insulated skirt and with sufficient non-skid metal landings and stairs at each door.
 - c. Submit a scaled floor plan of the trailer.
 2. Duration - Provide office by no later than 30 calendar days from the date of the Notice to Proceed and maintained during the duration of the Contract, up to the date of the Final Certificate.
 3. Location – Glen Cove WWTP. Relocate during the progress of the work, without additional cost to Owner, as may be required by the Owner/Engineer.
 4. Utilities - Provide the following in sufficient size, quantity, and capacity, as approved by the Owner/Engineer.
 - a. Windows for natural light and ventilation, with locks, screens, and shades or curtains.
 - b. LED lighting acceptable to the Owner/Engineer.
 - c. Door with hasp and padlock and five keys for Owner/Engineer's use. Provide two (2) commercial grade foot mats at each door.
 - d. Air conditioning unit and heater in each room, sized to maintain an indoor temperature of 60 degrees F with an outdoor temperature range of 10 deg. F to 90 degrees F.
 - e. 110 volts, 100-amp electric service with sufficient receptacles spaced around the room.

SECTION 01512 – FIELD OFFICES

2.03 TELEPHONE SERVICE

- A. Provide on-site telephone line and service, and answering machine in Engineers field trailer.

2.04 INTERNET SERVICE

- A. Provide high-speed internet access to computer to be used by Owner and Engineer.

2.05 WATER SERVICE

- A. Provide a water service with backflow prevention and freeze protection in accordance with water utility and health department requirements to serve plumbing fixtures in trailer.

2.06 WASTEWATER DISPOSAL

- A. Provide a sewer connection or wastewater holding tank with freeze protection below trailer if trailer provided with bathroom.
- B. If wastewater holding tank utilized, provide pump out service to maintain holding tank.

2.07 REMOVALS

- A. Remove all items provided under this Section except as otherwise specified.

PART 3 – EXECUTION

3.01 REMOVAL OF UTILITIES, FACILITIES AND CONTROLS

- A. Remove temporary above grade or buried utilities, equipment, facilities and materials.
- B. Remove underground installations to a minimum depth of 2 feet or as specified elsewhere.
- C. Regrade area to existing slope and elevation and restore the surface to its existing condition or to the condition shown on the Contract Drawings.
- D. Inventory all equipment that has been turned back to the Contractor prior to agreeing to final payment.

END OF SECTION

SECTION 01516 – TEMPORARY FIRE PROTECTION

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Scope:
 - 1. Provide temporary fire protection at the work sites throughout the Project, until the Owner takes occupancy. Remove temporary fire protection when the Owner takes occupancy.
 - 2. Comply with Section 901.7 and 1404.5 of the Fire Code of New York State (2010).
 - 3. Pay all costs associated with temporary fire protection, including installation, maintenance, and removal.
 - 4. Conform to provisions of this Section and Laws and Regulations.
- B. Reference Standards and Regulatory Requirements:
 - 1. Comply with applicable provisions of:
 - a. NFPA Standard No. 10, Portable Fire Extinguish-ers.
 - b. NFPA Standard No. 241, Safeguarding Building Construction and Demolition Operations.
 - c. Fire Code of New York State, Section 901.7.
 - d. Fire Code of New York State, Section 1404.5
 - 2. Temporary fire protection shall conform to Laws and Regulations.

1.02 REQUIRED TEMPORARY FIREFIGHTING EQUIPMENT

- A. Provide portable fire extinguishers, rated not less than 2A or 5B in accordance with NFPA Standard No. 10 for each temporary building and for every 3,000 square feet of floor area under construction.
- B. Provide portable fire extinguishers 50 feet maximum from all points in protected area.

1.03 FIRE PREVENTION AND SAFETY MEASURES

- A. Prohibit smoking in hazardous areas and inside of the Owner's buildings. Provide visible, suitable warning signs in areas that are continuously or intermittently hazardous.
- B. Storage of Flammable and Combustible Products:
 - 1. Use metal safety containers for storing and handling flammable and combustible liquids and materials.
 - 2. Do not store flammable or combustible liquids and materials in or near stairways or exits.
- C. Maintain clear exits from all points at the Site.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01516 – TEMPORARY FIRE PROTECTION

++ NO TEXT ON THIS PAGE ++

SECTION 01517 – TEMPORARY SANITARY WASTEWATER CONVEYANCE SYSTEM

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Temporary system of pumps, pipes and appurtenances to convey sanitary wastewater to allow the work to be performed.
- B. Standby equipment for the temporary sanitary wastewater conveyance system to assure continuous operation.

1.02 SYSTEM DESCRIPTION

- A. Each temporary pump shall be capable of conveying the design operating flow rate as coordinated with the Owner. The flow varies throughout the day. The lowest flow typically occurs between the hours of 1:00 a.m. and 6:00 a.m. Flow will be higher during precipitation. The Contractor shall be responsible for determining pump duty point and total dynamic head (TDH) based on final suction and discharge piping layout.
- B. Provide pump control elements such as floats to prevent surcharging of wastewater into the piping system and overflow from structures.
- C. Pumps handling raw and partially treated wastewater shall be capable of passing a sphere of at least 3-inches in diameter. Pump suction and discharge openings shall be at least 4-inches in diameter.
- D. Maintain sanitary conditions to allow work to be performed. Protect equipment, suction piping and discharge piping main from inclement weather, freezing conditions and traffic.
- E. Prevent leakage and spillage of wastewater.
- F. Provide walkways over obstructions on sidewalks to maintain pedestrian traffic.
- G. Provide ramps or below grade piping to maintain vehicular traffic.
- H. Provide alarm system to indicate increase above normal operating liquid level in tank.
- I. Electrical system and components in sewers and raw wastewater wet wells shall comply with the National Electric Code requirements for Class I, Group D, Division 1 locations.
- J. Provide spare suction and discharge piping at the project site.
- K. For temporary sanitary wastewater conveyance systems located in roadways, provide signs and traffic controls in accordance with the State Manual of Uniform Traffic Control Devices.
- L. Obtain confined space entry permit from Owner.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Provide a written plan of the proposed temporary sanitary wastewater conveyance system to the Engineer at least three weeks prior to the need for the system. The written plan shall include number size and type of pumps, material, diameter and proposed route of piping and/or hoses, control system, back-up and spare equipment, method to protect system components from damage, and estimated duration of bypass operation.
- C. Include the following for each site requiring bypass pumping:
 - 1. Staging areas for pumps and ancillary equipment.
 - 2. Flow stoppage system, including pipe and channel plugging method and types of plugs.
 - 3. Number, size, material, location and method of installation of all piping and valves.
 - 4. Sections showing suction and discharge pipe depth and embedment, if applicable.
 - 5. Pump and pipe anchoring details.
 - 6. Suction tube installation, bracing and support in the sewer.
 - 7. Discharge pipe thrust and restraint block sizes and locations.
 - 8. Temporary pipe supports and anchoring required.
 - 9. Plan indicating proposed location of bypass pumping line locations including provisions for access to bypass pumping locations. Drawings shall include standard scale and dimensions to existing referenced site features.

SECTION 01517 – TEMPORARY SANITARY WASTEWATER CONVEYANCE SYSTEM

10. Downstream discharge plan.
11. Method of protecting discharge manholes or structures from erosion and damage.
12. Bypass pump dimensions, capacity, pump performance curves, quantity of pumps and power requirements.
13. Calculations for selection of bypass pumping pipe size including static lift, friction losses and flow velocity.
14. Pump curves showing pump operating range plotted against the system head curve.
15. Pump diesel engine sizing, dimensions, emissions data and location plan.
16. Standby power generator size and location.
17. Engine and pump noise enclosure details.
18. Engine fuel consumption curves.
19. Fuel storage tank details.
20. Qualifications of site pump operators.
21. Complete information on instruments, including calibration certificates.
22. Complete operating procedures, including mode of operation, sequence of starting and stopping the pumps and coordination with Owner's staff.
23. Submit a list of twenty-four (24) hour emergency telephone numbers, which shall include the Project Manager, foreman and a responsible representative from the pump supplier

PART 2 – PRODUCTS

2.01 PRODUCTS

- A. Provide close coupled centrifugal pump with vacuum priming compressor mounted to a diesel engine or electric motor on skid base or two-wheeled highway trailer, or submersible pump.
- B. Provide solids handling ball type check valve with flexible rubber seat and quick release access feature with centrifugal pumps.
- C. Provide compact unit mounted on skid base or two-wheeled highway trailer.
- D. Provide fuel storage capacity to operate continuously for twenty-four (24) hours without refueling. Provide auxiliary fuel containers to supplement integral fuel tanks as required. Deliver fuel only during normal daytime working hours. Provide spill containment around fuel storage tanks and at tank fill.
- E. Engines shall be equipped with critical silencers and be housed to minimize noise to comply with the applicable noise code regulations.
- F. Provide suction hose from source to pump.
- G. Discharge Piping: Construct using rigid pipe with positive, restrained joints to withstand at least twice the maximum system pressure or 50 psi, whichever is greater. All piping and fittings shall be steel with Victaulic couplings or flanged joints, or fused high-density polyethylene pipe as manufactured by Performance Pipe or equal. Do not use aluminum irrigation type piping or glued PVC pipe. Discharge hose shall only be allowed in short sections and by specific written permission from the Engineer.
- H. Furnish start and stop mercury free float switches to automatically control the operation of the pumps in response to level changes. In the event that a high level is imminent, the control system shall immediately activate the standby pumping system
- I. Road Crossings: Fabricated of galvanized steel and engineered to provide minimal head-loss when used on pumping projects. Road crossing shall be manufactured to remain in compliance with federal bridge laws of 20,000 lbs. single axle. Entrance and exit ramps shall be sloped. Piping connections shall be flanged. Vehicle width clearance 12 feet. Tie downs at each corner out of path of vehicle travel. Manufacturer: Rain for Rent.
- J. Provide temporary lighting at the location of the temporary pumping system.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Furnish all labor, materials, equipment and appliances necessary to maintain both vehicular and pedestrian traffic, to protect the public from all damage to person and property and to minimize inconveniences to the facilities adjacent to the work areas for the duration of the use of the temporary sanitary wastewater conveyance system in accordance with the Contract and the appropriate State, County or local agency.
- B. Install, operate and maintain bypass pumping system in accordance with manufacturer's instructions.
- C. Install plugs or other devices to prevent flow into out of service facilities.
- D. Test temporary conveyance system for a minimum of two hours of continuous run time to the satisfaction of the Engineer prior to usage.
- E. System shall require low level of maintenance, typically confined to checking engine oil levels and seal cavity oil levels. Supply all necessary lubrication, fuel and supplies necessary to maintain the entire installation.
- F. Provide personnel to continuously operate the bypass system to assure continuous wastewater conveyance for entire time use of the system is required.
- G. Conduct work to minimize duration of bypass pumping system operation.
- H. Provide road crossing to keep pedestrian and road traffic moving during temporary conveyance system operation. Secure road crossing to roadway. Provide traffic delineators to direct vehicles through road crossing.
- I. Restore roadway where anchors utilized at corners of road crossings.

3.02 FIELD QUALITY CONTROL

- A. Subject the pump discharge piping for all systems to a pressure test of 45-psi or two times operating pressure, whichever is greater, for four (4) hours using clean water prior to actual operation. No loss of pressure or visible leakage will be permitted. Provide blind flanges to allow capping of both ends of the piping during testing. Give Engineer a minimum of twenty-four (24) hours notice prior to commencing testing.
- B. Inspect bypass pumping system every two (2) hours to ensure that the system is functioning properly.
- C. During bypass pumping, do not allow sewer flow to be leaked, dumped, spilled, or discharged in or onto any area outside of the existing sewer system.
- D. In the event of overflow, immediately stop the discharge and take action to clean and stabilize disturbed area at own expense and promptly notify Owner and NYSDEC.

END OF SECTION

+ + NO TEXT ON THIS PAGE + +

PART 1 - GENERAL

1.01 SUMMARY

- A. Furnish all labor, materials, equipment and appliances necessary to maintain both vehicular and pedestrian traffic, to protect the public from all damage to person and property, and to minimize inconveniences to the residences and businesses adjacent to the Contract area for the duration of the Contract in accordance with the specifications, the appropriate State, County or local agency, and in accordance with the Manual of Uniform Traffic Control Devices (MUTCD).

1.02 SYSTEM DESCRIPTION

- A. Maintain traffic over a reasonably smooth travelway which shall be so marked by signs, delineations and/or other methods so that a person who has no knowledge of conditions can safely, and with a minimum of discomfort and inconvenience, ride, drive or walk over all or any portion of the roadway under construction. This shall include the maintenance of temporary pavement in accordance with the appropriate temporary pavement specifications.
- B. Maintenance and protection of traffic over roadways during construction is considered as important and necessary an item of work as is the actual construction itself. Conduct operations in a manner to ensure the safety of motorists, pedestrians and employees.
- C. Protect the user from damage to person and property by reason of any construction operation (i.e., painting, paving, blasting, tree work, demolition, etc.) by such protective screens, devices or methods as are approved by the appropriate governing agency.
- D. The Contractor shall be responsible for the maintenance within the limits of the Contract of the entire pavement, drainage facilities and other highway elements, both old and new, beginning on the date construction commences and ending on the date the Contract is officially accepted.
- E. Schedule work to minimize the amount of the old travelway that is destroyed or substantially damaged at any one time.
- F. Throughout the course of the work, the health and welfare of the people shall be provided for. At least one (1) week in advance of proposed work, ascertain the specific needs of individuals whose homes or places of business may be inaccessible for periods of time while required work is in progress. In all such cases, make all arrangements with health, safety and protective agencies to ensure that any and all emergency or incidental needs of seriously hampered people will be cared for. Roads shall not be closed to traffic completely during the work.

1.03 SUBMITTALS

- A. Prepare and submit a plan that outlines a schedule of operations for the maintenance, protection and detouring of traffic, showing in complete detail the methods, sequences, procedures and proposed facilities.
- B. Submit a detailed maintenance and protection of traffic scheme to the appropriate local agency and secure written approval from that agency prior to beginning work. Submit a copy of the approved plan.
- C. For work on State highways, prepare and submit for approval a detailed maintenance and protection of traffic plan to the New York State Department of Transportation (NYSDOT). All detour schemes and maintenance details shall conform to the requirements of the latest edition of the MUTCD and Section 619 of the New York State Standard Specifications dated September 2021, and latest addenda. Submit a copy of the approved plan.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Materials used shall comply with the requirements for the various items or materials as established in the specifications or the Contract plans.
- B. Temporary signs, delineators, barricades, lighting and other warning and guiding devices shall be as approved by the appropriate State, county and local agency, and shall remain the property of the Contractor.

SECTION 01555 – TRAFFIC CONTROL

- C. Cones shall be standard 28-inch height. The minimum diameter at the base shall be 12-inches. Cone color: orange.
- D. Thirty to fifty-gallon drums or containers set on end may be used as delineators, provided they are painted orange and white. Other markers or delineators may be circular or rectangular in shape, and shall be constructed of reflective sheeting having a minimum area of 20 square inches or reflective buttons having a minimum diameter of three (3) inches.
- E. All materials, equipment and workmanship for electrical installations shall comply with the Standard Code Requirements. Electrical work shall be performed by licensed electricians. Obtain, supply and pay for all required electrical energy, and make all necessary arrangements with the utility company for service points. Obtain and pay for electrical services, permits and certificates.
- F. Warning signs used in conjunction with work zone activities shall have an orange background with black legend.

PART 3 - EXECUTION

3.01 PROTECTION

- A. General - provide a travelway suitable for maintaining a minimum of one lane of traffic in each direction. Keep travelway well-drained and reasonably smooth and hard at all times, and free of potholes, bumps, irregularities and depressions that hold or retain water.
- B. Erect barricades, detour signs, warning lights and other facilities approved by the State or appropriate agency at the beginning, end and for the entire length of any detours to adequately warn the traveling public that the road is closed and indicate the direction and route of the detour. Conduct operations to ensure a minimum of delay to traffic.
- C. Furnish, erect, and maintain proper reflectorized signs, indicating to motorists the status of the highway under construction.
- D. Keep signs clean, mounted at the indicated height and placed so as to be effective both day and night. Sign supports shall display the sign panel in a vertical position. Use signs, warnings, delineators, and barricades to adequately inform the motorist of any unusual or unsafe condition and to safely and clearly guide him through the Contract area. Place and light such signs, barricades, warnings, or devices to give timely warning and permit the motorist to take the necessary action to traverse the area safely. Barricades and signs shall be lighted when and as required.
- E. Delineate areas where there is a drop-off near the edge of the travel lanes and areas on which it is unsafe to travel. Where the drop-off is less than six inches and where soft or unsafe areas occur, an approved delineator shall be placed along the edge of the travelway at intervals of not more than 200 feet. Where the drop-off is greater than 18 inches, a continuous delineation consisting of a white board or band shall be used in addition to individual delineators.
- F. Keep delineators always clean.
- G. All reflective delineators or markers shall be yellow or amber in color, except those at entrances to commercial establishments, where a green reflective marker shall be placed on each side of the designated safe entrance to the establishment. The entire entrance area between adjacent green markers shall be kept safe and smooth for convenient ingress and egress. Delineators shall be substantially mounted so that the bottom of the reflective unit is four feet above the elevation of the travelway. Any area judged to be particularly hazardous shall be marked by the use of signal flashers with a large reflectorized orange lens in addition to the reflective markers.
- H. All signs, markers and other facilities shall indicate actual conditions existing and shall be moved, removed, or changed immediately as conditions require. Details and types of signs, temporary barricades, timber curb and other devices are shown on Standard Structure Sheets, Manual of Uniform Traffic Control Devices, of the New York State Traffic Commission. These are minimum requirements, and the Contractor shall have an adequate quantity of each available for use as required. If conditions warrant additional signs may be required. In that

SECTION 01555 – TRAFFIC CONTROL

event, they shall be consistent with the arrangements, material requirements and details of those shown on the Standard Structure Sheets.

- I. Lighted barricades shall be fully equipped with complete electrical facilities including fixtures, lamps, conduits, switches, cut-outs, boxes, cable and all other required equipment, appurtenances and connections to the service points designated by the utility company as necessary to install and light the barricades. The Contractor shall set and adjust time switches and other equipment as required to put the lighting system in satisfactory operation.
- J. Whenever it is necessary to maintain traffic, employ a sufficient number of competent flaggers during the time traffic is to be maintained. Provide a sufficient number of competent flaggers in areas where traffic is congested, particularly where construction equipment is operating.
- K. If the Contractor fails to maintain and protect traffic adequately and safely for a period of 24 hours, the Owner may correct the adverse conditions by the use of such means that he may deem necessary and augmented by such other equipment and personnel as it may be necessary to hire from outside sources, and the entire cost of this work by such forces, materials and equipment shall be deducted from any monies due the Contractor on this Contract.

3.02 MAINTENANCE

- A. Furnish materials, labor and equipment at any time, day or night, to immediately repair, remedy and prevent washouts, formation of holes, ruts and depressions, sunken trenches and the destruction or sinking of temporary pavements. This applies when the work is underway and when the work is temporarily suspended for any period of time. Special attention shall be given to maintenance of a satisfactory travelway over weekends, holidays and during the winter season.
- B. Any damage to any portion of the work occasioned by lack of adequate maintenance shall be repaired by the Contractor at his own expense.

3.03 ACCESS

- A. Construct and maintain at all times, where required, temporary bridges or bridging across pipe trenches, excavations, obstructions and newly laid pavements to provide adequate ingress and egress for pedestrian and vehicular traffic to and from private driveways, business and commercial establishments or for main street intersections and heavily traveled crossings.
- B. After the installation of all pipes and necessary appurtenances thereto, immediately backfill all trenches; compact same with the surface of the fill graded off; and install temporary pavement to permit the resumption of traffic without delay. The surfaces of all trenches shall be maintained continually by the Contractor to carry traffic smoothly, safely and without interruptions or slowdowns until the permanent pavement has been restored.

3.04 EXISTING SIGNS

- A. All existing highway signs and supports within the Contract limits are to remain under the control and jurisdiction of the Engineer, and shall be properly maintained for the duration of the Contract by the Contractor.
- B. When shown on the plans or ordered, remove existing signs; store, protect and keep them clean; and replace them in the Contract area designated by the Engineer. Signs not to be replaced shall be cleaned and delivered to the State as directed by the Engineer.
- C. Signs or markers lost or damaged because of negligence on the part of the Contractor shall be replaced at the Contractor's expense.

END OF SECTION

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SECTION 01560 – ENVIRONMENTAL CONTROLS

PART 1 – GENERAL

1.01 GENERAL

- A. Provide and maintain methods, equipment, and temporary construction, as necessary to provide controls over environmental conditions at the construction site and adjacent areas. Remove physical evidence of temporary facilities at completion of Work.

1.02 NOISE CONTROL

- A. Contractor's vehicles and equipment shall be such as to minimize noise to the greatest degree practicable. Noise levels shall conform to the latest OSHA standards and shall comply with local ordinance. In no case will noise levels be permitted which interfere with the Work of the Owner or others.

1.03 DUST CONTROL

- A. Control objectionable dust caused by operation of vehicles and equipment, clearing or for any reason whatever, in accordance with the General Conditions Article GC-25, "Dust Control and Spillage."

1.04 PEST AND RODENT CONTROL

- A. Provide rodent and pest control as necessary to prevent infestation of construction or storage area.
 - 1. Employ methods and use materials, which will not adversely affect conditions at the Site or on adjoining properties.
- B. Provide seals in accordance with the General Conditions, Article GC-26, "Vermin Control."

1.05 WATER CONTROL

- A. Provide methods to control surface water and water from excavations and structures to prevent damage to the Work, the Site, or adjoining properties.
 - 1. Control fill, grading and ditching to direct water away from excavations, pits, tunnels and other construction areas; and to direct drainage to proper runoff courses so as to prevent any erosion, damage or nuisance.
- B. Provide, operate and maintain equipment and facilities of adequate size to control surface water.
- C. Dispose of drainage water in a manner to prevent flooding, erosion, or other damage to any portion of the Site or to adjoining areas and in conformance with all environmental requirements.
- D. All work shall conform to the Storm Water Pollution Control Plan.

1.06 POLLUTION CONTROL

- A. Provide methods, means and facilities required to prevent contamination of soil, water or atmosphere by the discharge of noxious substances from construction operations.
- B. Provide equipment and personnel, perform emergency measures required to contain any spillages, and to remove contaminated soils or liquids.
 - 1. Excavate and dispose of any contaminated earth off-site, and replace with suitable compacted fill and topsoil.
- C. Take special measures to prevent harmful substances from entering public waters.
 - 1. Prevent disposal of wastes, effluents, chemicals, or other such substances adjacent to streams, or in sanitary or storm sewers.
- D. Provide systems for control of atmospheric pollutants.
 - 1. Prevent toxic concentrations of chemicals.
 - 2. Prevent harmful dispersal of pollutants into the atmosphere.
- E. Equipment used during construction shall conform to all current federal, state and local laws and regulations.

1.07 EROSION CONTROL

- A. Plan and execute construction work and earthwork by methods to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation.
 - 1. Hold the areas of bare soil exposed at one time to a minimum.
 - 2. Provide temporary control measures such as berms, dikes and drains.
- B. Construct fills and waste areas by selective placement to eliminate surface silts or clays which will erode.
- C. Periodically inspect earthwork to detect any evidence of the start of erosion, apply corrective measures as required to control erosion.

1.08 HAZARDOUS MATERIALS CONTROL

- A. Refer to Section 01355, Hazardous Materials Control.

1.09 DIESEL EMISSION CONTROLS

- A. Diesel On-Road Vehicles: All diesel non-road vehicles on site for more than 10 total days shall have either:
 - 1. Engines that meet U.S. Environmental Protection Agency (EPA) 2007 on-road emissions standards, or
 - 2. Emission control technology verified by EPA or the California Air Resources Board (CARB) to reduce PM emissions by a minimum of 85%.
- B. Diesel Generators: All diesel generators on site for more than 10 total days shall be equipped with emission control technology verified by EPA or CARB to reduce PM emissions by a minimum of 85%.
- C. Diesel Non-Road Construction Equipment
 - 1. All non-road diesel engines on site shall be Tier 2 or higher. Tier 0 and Tier 1 engines³ are not allowed on site. Machines with engines which have been repowered by Tier 2 engines, or engines upgraded from Tier 0 or 1 to Tier 2 using original equipment manufacturers approved conversion kit and certified by the original equipment manufacturer to Tier 2 standard performance are acceptable.
 - 2. All diesel non-road construction equipment on site for more than 10 total days shall have either (1) engines meeting EPA Tier 4 non-road emission standards or (2) emission control technology verified by EPA or CARB for use with non-road engines to reduce PM emissions by a minimum of 85% for engines 50 HP and greater and by a minimum of 20% for engines less than 50 HP.
- D. Upon confirming that the diesel vehicle, construction equipment, or generator has either an engine meeting Tier 4 non road emissions standards or emission control technology, as specified above, installed and functioning, the developer will issue a compliance sticker. All diesel vehicles, construction equipment, and generators on site shall display the compliance sticker in a visible, external location as designated by the developer.
- E. Emission control technology shall be operated, maintained, and serviced as recommended by the emission control technology manufacturer.
- F. All diesel vehicles, construction equipment, and generators on site shall be fueled with ultra-low sulfur diesel fuel (ULSD) or a biodiesel blend approved by the original engine manufacturer with sulfur content of 15 ppm or less.
- G. During periods of inactivity, idling of diesel on-road vehicles and non-road equipment shall be minimized and shall not exceed the time allowed under state and local laws. In the absence of state or local idling regulations, idling shall not exceed three minutes in any sixty-minute period.
- H. Exemptions, if any, from state or local idling laws are specified by those laws, which shall be enforced on site. In locations without prevailing state or local idling regulations, idling for more than three minutes over a sixty-minute period is permitted only under the following circumstances:

SECTION 01560 – ENVIRONMENTAL CONTROLS

1. When an on-road diesel vehicle or non-road construction equipment is forced to remain motionless because of traffic conditions or mechanical difficulties over which the operator has no control;
 2. To bring the on-road diesel vehicle, non-road construction equipment, or generator to the manufacturer's recommended operating temperature;
 3. When there are regulations requiring temperature control for driver or passenger comfort and there are no auxiliary power sources available to provide temperature control;
 4. When it is necessary to operate auxiliary equipment that is located in or on the diesel vehicle or construction equipment, to accomplish the intended use of the vehicle or equipment (for example, cranes and cement mixers);
 5. When the on-road diesel vehicle, non-road construction equipment, or generator is being repaired, if idling is necessary for such repair; and/or
 6. When the on-road diesel vehicle, non-road construction equipment, or generator is queued for inspection, if idling is necessary for such inspection.
- I. Exemptions in this section apply only to emission control technology requirements and do not in any way exempt the contractor from meeting the requirement that all engines onsite must be Tier 2 or higher as specified in 1.8 C 1.
1. On-road diesel vehicles, non-road construction equipment, and generators on site for 10 working days or less over the life of the project need not install emission control technology. This equipment shall be included on the equipment list submitted by the Contractor and approved by the developer.
 2. If the Contractor can prove to the developer's satisfaction that for a particular class of on-road diesel vehicle, non-road construction equipment, or generator, (1) no alternative equipment with a Tier 4 engine is available, (2) it is not technically feasible to meet the control level specified above with a verified device, or (3) installing the control device would create a safety hazard or impaired visibility for the operator, then the contractor may, with the developer's written approval, drop down to a lower level of control.
 3. The Owner's representative may create an exemption when there is a compelling emergency need to use diesel vehicles or engines that do not meet the contract conditions for emission controls. An example would be the need for rescue vehicles or other equipment to prevent or remedy harm to human beings or nearby property. Meeting contract deadlines, failure to rent equipment in a timely manner, planned unavailability, or lack of advance planning are not considered compelling emergencies.
 4. The Owner may provide an exemption lasting no more than 30 days to a Contractor, if the Contractor can prove with valid documentation and to the developer's satisfaction that the appropriate emission control equipment has been ordered in a timely manner after the bid was awarded, but has yet to be installed due to delays attributable to the equipment manufacturer and beyond the control of the contractor. The Contractor shall install the retrofit as soon as practicable once it has been delivered, and shall submit proof thereof when installation is complete. Provided, however, that such exemption shall not be available to a contractor who already owns an equivalent piece of equipment that meets the engine requirements for the project, as the contractor may use that piece of equipment.
- J. Construction shall not proceed until the Contractor submits a certified list of all diesel vehicles, construction equipment, and generators to be used on site. The list shall include the following:
1. Contractor and subcontractor name and address, plus contact person responsible for the vehicles or equipment.
 2. Equipment type, equipment manufacturer, equipment serial number, engine manufacturer, engine model year, engine certification (Tier rating), horsepower, engine serial number, and expected fuel usage and hours of operation.
 3. For the emission control technology installed: technology type, serial number, make, model, manufacturer, EPA/CARB verification number/level, and installation date and hour-meter reading on installation date.
 4. The Certification Statement signed and printed on the Contractor's letterhead. A model certification statement is presented at the end of this Section.

SECTION 01560 – ENVIRONMENTAL CONTROLS

- K. If the Contractor subsequently needs to bring on site equipment not on the list, submit written notification within 24 hours that attests the equipment complies with all contract conditions and provide information asked for in 1.8 J.
- L. All diesel equipment shall comply with all pertinent local, state, and federal regulations relative to exhaust emission controls and safety.
- M. Establish generator sites and truck-staging zones for vehicles waiting to load or unload material on site. Such zones shall be located where diesel emissions have the least impact on abutters, the general public, and especially sensitive receptors such as hospitals, schools, daycare facilities, elderly housing, and convalescent facilities.
- N. Submit to the Owner's Representative a monthly report that, for each on-road diesel vehicle, non-road construction equipment, or generator onsite, includes:
 - 1. Hour-meter readings on arrival on-site, the first and last day of every month, and on off-site date
 - 2. Any problems with the equipment or emission controls.
 - 3. Certified copies of fuel deliveries for the time period that identify:
 - a. a. Source of supply
 - b. b. Quantity of fuel
 - c. c. Quality of fuel, including sulfur content (percent by weight).
- O. All on-road diesel vehicles, non-road construction equipment, and generators shall be compliant with these provisions whenever they are present on the project site. The Contractor's compliance with this notice shall not be grounds for a claim on the project.
- P. If any on-road diesel vehicle, non-road construction equipment, or generator is found to be in non-compliance with the contract terms, the equipment will be immediately removed from the job site.
- Q. Once the Contractor has brought previously non-compliant machinery into compliance, the developer's representative shall promptly issue the Contractor a written acknowledgment of compliance.
- R. All costs associated with the acquisition and installation of diesel emission control technology are considered incidental to the cost of the project. No additional compensation will be provided.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01582 – PROJECT SIGN

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Fabrication and installation of a project identification sign for projects receiving funding through the New York Clean Water State Revolving Fund Program (CWSRF).

1.02 REFERENCES

- A. Lumber Standard: American Softwood Lumber Standard; U.S. Department of Commerce Product Standard PS1.
- B. Softwood Plywood Standard: Construction and Industrial; U.S. Department of Commerce Product Standard PS1.

1.03 SUBMITTALS

- A. Submit under provision of Section 01300.
- B. Submit proof sheet of sign.
- C. Color samples: match specified colors.

1.04 QUALITY ASSURANCE

- A. Painter's Qualifications: Sign shall be prepared by a professional sign painter.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Framing and Posts: Standard Grade Douglas Fir, Hem-Fir, White Pine or Southern Pine: S4S; preservative treated.
- B. Sign Panel: 3/4-inch APA rated, A-B grade exterior plywood rabbeted into a 2" x 4" nominal frame or other suitable materials and construction capable of withstanding typical weather conditions common to the project site.
- C. Sign: Aluminum blank sign board with vinyl sheeting. Panel material shall be either Aluminum Alloy 6061-T6, 5154-H38 or 5052-H38.
- D. Type: Caslon 540 with the exception of the logotype.
- E. Select finishes to withstand weathering, fading and chipping for duration of sign placement.
- F. Fasteners: Type 316 stainless steel.

2.02 FABRICATION

- A. Sign and structure shall be designed, supported and braced to remain in the proper positioning and alignment to withstand 115 mile per hour wind velocity.
- B. Prepare surface of aluminum sign board before application of vinyl sheeting. The board shall not be handled between the cleaning operation and application of sheeting except by device or clean canvas gloves.
- C. Cover aluminum blanks with vinyl sheeting to achieve background color.
- D. Apply sheeting to the aluminum panel by the vacuum application process or mechanical process in accordance with the recommendations of the sheeting manufacturer.
- E. Silk screen copy and logo on this surface.
- F. For projects with more than one funding source the information specified for CWSRF projects may be combined with other project signage requirements onto one sign, as allowed and approved by the funding agencies. The size and spacing of the lettering on the sign may change to accommodate the addition of other funding agencies.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Sign shall be fabricated and in place within 21 days following the Notice to Proceed. Maintain sign through completion of construction and the Owner's acceptance of the work.

SECTION 01582 – PROJECT SIGN

- B. Set posts plumb, 4 feet minimum into the ground.
- C. Embed posts in concrete and compact. Posts shall be painted white.
- D. Fasten sign in a level position securely to posts with heavy-duty Type 316 stainless steel fasteners. Provide at least three (3) equally spaced lag bolts into each post.
- E. Provide bracing between posts.
- F. Install bottom of the sign panel a minimum of five feet above existing grade.

3.02 PROTECTION

- A. Maintain the sign clean, plumb and level throughout the duration of the contract.
- B. Repair deterioration and damage.
- C. Remove sign after the Owner's acceptance of the work. Sign shall remain property of the Contractor. Fill post holes when sign is removed.

END OF SECTION

PART 1 – GENERAL

1.01 GENERAL

- A. Make all arrangements for transportation, delivery and handling of equipment and materials required for prosecution and completion of the Work.
- B. Shipments of materials to the Contractor or Subcontractors shall be delivered to the Site only during regular working hours. Shipments shall be addressed and consigned to the proper party-giving name of the Project, street number and city. Shipments shall not be delivered to the Owner except where otherwise directed.
- C. If necessary to move stored materials and equipment during construction, move or cause to be moved materials and equipment without any additional compensation.

1.02 DELIVERY

- A. Arrange deliveries of products in accordance with construction schedules and in ample time to facilitate inspection prior to installation.
- B. Coordinate deliveries to avoid conflict with Work and conditions at site and to accommodate the following:
 - 1. Work of other contractors, or the Owner.
 - 2. Limitations of storage space.
 - 3. Availability of equipment and personnel for handling products.
 - 4. Owner's use of premises.
- C. Do not have products delivered to the Project Site until related Shop Drawings have been approved by the Engineer.
- D. Do not have products delivered to the Site until required storage facilities have been provided.
- E. Have products delivered to the Site in manufacturer's original, unopened, labeled containers. Keep the Engineer informed of delivery of all equipment to be incorporated in the Work.
- F. Partial deliveries of component parts of equipment shall be clearly marked to identify the equipment, to permit easy accumulation of parts and to facilitate assembly.
- G. Immediately on delivery, inspect shipment to assure:
 - 1. Product complies with requirements of the Contract Documents and reviewed submittals.
 - 2. Quantities are correct.
 - 3. Containers and packages are intact, labels are legible.
 - 4. Products are properly protected and undamaged.

1.03 PRODUCT HANDLING

- A. Provide equipment and personnel necessary to handle products by methods to prevent soiling or damage to products or packaging.
- B. Provide additional protection during handling as necessary to prevent scraping, marring or otherwise damaging products or surrounding surfaces.
- C. Handle products by methods to prevent bending or overstressing.
- D. Lift heavy components only at designated lifting points.
- E. Materials and equipment shall at all times be handled in a safe manner and as recommended by manufacturer or supplier so that no damage will occur to them. Do not drop, roll or skid products off delivery vehicles. Hand carry or use suitable materials handling equipment.

1.04 REMOVING, HAULING, AND INSTALLING EQUIPMENT AND MATERIALS

- A. Inspect all items including all boxes, crates and packages containing equipment and materials for damage that may have occurred during shipment prior to its removal from the truck or other conveyance. Any damage shall immediately be reported to the Engineer. The Contractor shall then carefully remove the equipment and materials from the truck or trucks on which it is shipped. The equipment and materials shall then be transported to the place of installation at the job Site. The Contractor shall be liable for loss or damage that the equipment and materials

SECTION 01610 – TRANSPORTATION AND HANDLING OF MATERIALS AND EQUIPMENT

may receive while being unloaded, transported, stored or installed. Employ competent mechanics experienced in the installation of the types of equipment and materials to be furnished, and ensure that all equipment and materials are installed in accordance with the recommendations of the manufacturer. Furnish bolts, nuts and other fastenings, and comply with the applicable requirements as specified. Equipment that arrives at the job site during normal working hours shall be unloaded as soon as practicable.

1.05 COORDINATE STORAGE AND INSTALLATION

- A. Coordinate storage and installation of new equipment with construction schedule for existing and new structures.

1.06 CONTRACTOR'S USE OF OWNER LIFTING EQUIPMENT

- A. The Contractor shall not be permitted to use any existing lifting equipment at Owner facilities unless the following procedure is followed:
 - 1. Employ the services of a qualified representative of the lifting equipment manufacturer to inspect all equipment. The manufacturer shall certify that said equipment is in safe operating condition and meets the rated load capacities. The Owner makes no claim that any existing lifting equipment is in operable condition or meets the requirements of the Contractor. All costs for inspections, certifications and repairs shall be the responsibility of the Contractor.
 - 2. Upon submittal of the required certifications and receipt of written authorization from the Owner, the Contractor shall assume full responsibility for the operation, maintenance and regular inspection of the lifting equipment for the duration of his work.
 - 3. Upon completion of his work, employ the services of a qualified representative of the lifting equipment manufacturer to re-inspect the equipment. The manufacturer shall recertify that said equipment is in safe operating conditions. All costs for inspections, certifications and repairs shall be the responsibility of the Contractor.
 - 4. Upon submittal of the required certifications and acceptance by the Owner, the Owner will resume responsibility for the equipment.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01615 – BASIC PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This Section includes the general requirements for products that are to be furnished, installed, or otherwise incorporated into the project.

1.02 QUALITY ASSURANCE - APPLIES TO ALL PRODUCTS

- A. In addition to the Contractor's warranties and guarantees on materials and equipment required under the General Conditions of the Contract and the Technical Specifications contained hereinafter, the Contractor shall also be responsible for all materials, equipment, and products that have or is planned to be incorporated into the work.
 - 1. The Contractor shall be responsible for the finished work and that it accurately and completely complies with these Contract Documents.
 - 2. The Contractor shall be responsible for work performed by subcontractors, equipment suppliers, and material vendors.
 - 3. The Contractor shall be satisfied as to the product's performance before it is ordered for installation. At the Contractor's option, he/she shall have tested each product to determine compliance with these specifications.
- B. The Architect may check all or any portion of the work and the Contractor shall afford all necessary assistance to the Architect in carrying out such checks.
 - 1. Such checking by the Architect shall not relieve the Contractor of any responsibilities for the accuracy or completeness of the work.
 - 2. Such checking is a courtesy service being provided by the Owner and does not relieve the Contractor of his/her responsibilities under this Construction Contract.
- C. If witnessed shop tests or inspections are required at the point of manufacture, the Contractor shall keep the Architect advised as to the progress of the work to allow inspection at the proper time and place. Provide at least two (2) weeks advance notice before scheduled shop tests.
- D. Should a dispute arise as to the quality of workmanship, equipment or material performance, then the final decision regarding acceptability with these Contract Documents shall be that of the Owner.
- E. At the request of the Architect, the Contractor shall promptly provide the services of a competent representative of the manufacturer at the project site, fully equipped and prepared to answer questions, perform tests, make adjustments and to prove compliance with the Contract Documents free of all additional charges. Proof of compliance shall be the responsibility of the Contractor, and such special visits to the project site by the manufacturer shall not be eligible under any cash allowances or stipulated man-hours necessary to startup the system and/or train the Owner as may be specified in the Technical Specifications.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Equipment shall have been in successful regular operation under comparable conditions for a period of at least five (5) years.
 - 1. This time requirement does not apply when the manufacturer posts an Owner/Architect acceptable Performance Bond or Letter of Credit for the duration of the time period that will guarantee replacement of the equipment in the event of failure.
 - 2. The bond shall be in a form that is acceptable to the Owner's legal council.
- B. The Owner reserves the right to reject any material or equipment manufacturer who, although he appears to be qualified and meets the technical requirements, does not provide satisfactory evidence indicating adequate and prompt post-installation repair and maintenance service, as required to suit the operational requirements of the Owner.
- C. Whenever it is required that the Contractor furnish materials or manufactured articles or shall do work for which no detailed specifications are set forth, the materials or manufactured articles shall be of the best grade in quality and workmanship obtainable on the market from firms of

SECTION 01615 – BASIC PRODUCT REQUIREMENTS

established good reputation, or, if not ordinarily carried in stock, shall conform to the usual standards for first-class materials or articles of the kind required.

- D. Perform work in full conformity and harmony with the intent to secure the best standard of construction and equipment of the work as a whole or in part.
- E. Items of any one type of material or equipment shall be the product of a single manufacturer.
 - 1. For ease of the Owner in maintaining and obtaining service for equipment and for obtaining spare parts from as few places as possible, to the maximum extent possible, use equipment of a single manufacturer.
 - 2. The Architect reserves the right to reject any equipment from various manufacturers if suitable equipment can be secured from fewer manufacturers and to require that source of materials be unified to the maximum extent possible.
- F. Substitute equipment shall not be fabricated nor installed until after written decision to accept request is received from the Architect.

2.02 CONTROL PANELS, MCC'S AND SWITCHBOARDS

- A. All control panels, motor control centers, and switchboards shall be fabricated with pilot lights, selector switches, PLC, graphics display panels, elapsed time meters and other components that shall match.
 - 1. This does not require that all components be one manufacturer, but does require that the like components be of the same manufacturer.
 - 2. The Contractor shall coordinate the shop drawing submittals to indicate that all components have been selected on this basis.
 - 3. This requires the Contractor to advise each control panel supplier that product options are limited in this regard.
- B. Replacement of unlike products delivered to the job site shall be the responsibility of the Contractor.
- C. All costs associated with the replacement shall be borne by the Contractor.

2.03 NAMEPLATES

- A. Each unit of equipment shall have the manufacturer's name or trademark on a stainless steel nameplate securely affixed in a conspicuous place.
- B. The manufacturer's name or trademark may be cast integrally with stamp, or otherwise permanently marked upon the item of equipment.
- C. Such other information as the manufacturer may consider necessary for complete identification shall be shown on the nameplate.

2.04 FABRICATIONS

- A. Insofar as possible, shop prefabricate all items complete and ready for installation.
- B. Accurately fabricate all items to the details shown on the Drawings and on the shop drawings found in compliance with the Contract Documents.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Prior to work under any Section, carefully inspect the existing work and verify that it is complete to the point where the work under that Section may properly commence.
- B. Avoid the need to remove and replace work and to avoid unnecessary cutting and patching.
- C. Inspect all surfaces to be sure that they have been properly prepared before applying new work to such surfaces.
- D. Verify that all work can be installed in strict accordance with the drawings and the approved shop drawings. Immediately report discrepancies to Architect.
- E. Do not proceed with the work under any Section until these conditions are obtained.

SECTION 01615 – BASIC PRODUCT REQUIREMENTS

3.02 INSTALLATION

- A. Furnish and install materials and equipment in accordance with the instructions of the applicable manufacturer, fabricator or processors, except as otherwise provided in the Contract Documents.
- B. All work shall be done in a workmanlike manner and set to proper lines and grades. The work shall be square, plumb and/or level as the case may be.
- C. Where performance criteria are specified, do all work necessary to attain the required end results.

3.03 FIELD QUALITY CONTROL

- A. Neither observations by Architect nor inspections, tests or approvals by other persons shall relieve the Contractor from his obligations to perform the work in accordance with the requirements of the Contract Documents.
- B. If the Contract Documents, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any work to specifically be inspected, tested or approved by some public body, the Contractor shall assume full responsibility therefore, pay all costs in connection therewith, and furnish the Architect with the required certificates of inspection, testing or approval.
- C. The Owner reserves the right to independently perform laboratory tests on random samples of material or performance tests on equipment delivered to the site.
 - 1. These tests, if made, will be conducted in accordance with the appropriate referenced standards or specification requirements.
 - 2. The entire shipment represented by a given sample, samples or piece of equipment may be rejected on the basis of the failure of samples or pieces of equipment to meet specified test requirements.
 - 3. All rejected materials or equipment shall be removed from the site, whether stored or installed in the work, and the required replacements shall be made, all at no additional cost to Owner.

3.04 ADJUST AND CLEAN

- A. Upon the completion of installations, and as a condition of its acceptance, visually inspect all work, adjust all components for proper alignment and touch-up abrasions and scratches to make them completely invisible.
- B. Thoroughly examine all materials and equipment with protective or decorative finishes for defects and damage prior to being covered.
 - 1. In the case of buried items of work, restore protective surface covers so as to conform to the Contract Documents prior to being backfilled, buried or embedded, as the case may be.
 - 2. In the case of exposed items of work, for which a decorative finish is required, all scratches, discoloration's, unmatched colors, disfigurements and damages shall be repaired and touched-up so as to provide a neat, clean finish, and be uniform in color.

3.05 UNCOVERING WORK

- A. Unless otherwise specified or directed by Architect, no work shall be covered until it has been observed, tested, photographed, measured, and authorized to be covered by Architect.
- B. Tie distances to above ground physical structures as reference points to all underground utilities, conduits, pits, manholes, valves, and pipelines shall be obtained by the Contractor prior to covering the work. Immediately comply with the Architect's direction to uncover the work if tie distances were not obtained.
- C. If any work has been covered with Architect's consent and Architect considers it necessary or advisable that covered work be observed or tested, the Contractor, at Architect's request, shall uncover, expose or otherwise make available for observation, or testing as Architect may require, that portion of the work in question, furnishing all necessary labor, material and equipment.

SECTION 01615 – BASIC PRODUCT REQUIREMENTS

1. If it is found that such work is defective, the Contractor shall bear all the expenses of such uncovering, exposure, observation, and testing of satisfactory reconstruction, including compensation for additional engineering services and an appropriate deductive change order shall be issued.
2. If, however, such work is not found to be defective, the Contractor shall be allowed an increase in the contract price or an extension of the contract time, or both, directly attributable to such uncovering, exposure, observation, testing and reconstruction if he makes a claim therefore as provided in the General Conditions.

3.06 DEFECTIVE WORK

- A. The repair, removal, replacement and correction of defective work is a part of this Contract and shall be promptly performed in accordance with the requirements set forth in the General Conditions or other portions of the Contract Documents. All costs in connection with the correction of defective work shall be borne by the Contractor.
- B. Products that fail to maintain the performance or other salient requirements of the Contract Documents, shows undue wear, or other deleterious effects during the maintenance period, shall be considered defective.

END OF SECTION

PART 1 – GENERAL

1.01 GENERAL

- A. Initially start up and place all equipment installed during work into successful operation according to manufacturers' written instructions and as instructed by manufacturers' field representatives. Provide all material, labor, tools, equipment, and expendables required.
- B. General Activities Include:
 - 1. Cleaning.
 - 2. Removing temporary protective coatings.
 - 3. Flushing and replacing greases and lubricants, where required by manufacturer.
 - 4. Lubrication.
 - 5. Check shaft and coupling alignments and reset where needed.
 - 6. Check and set motor, pump and other equipment rotation, safety interlocks, and belt tensions.
 - 7. Check and correct if necessary leveling plates, grout, bearing plates, anchor bolts, fasteners, and alignment of piping which may put stress on pumping equipment connected to it.
 - 8. All adjustments required.
- C. Provide initial filling of lubricants and all other required operating fluids.
- D. Provide filters, chemicals, and other expendables required for initial start-up of equipment unless otherwise specified.

1.02 MINIMUM START UP PROCEDURES

- A. Bearings and Shafting:
 - 1. Inspect for cleanliness, clean and remove foreign materials.
 - 2. Verify alignment.
 - 3. Replace defective bearings, and those which run rough or noisy.
 - 4. Lubricate as necessary, in accordance with manufacturer's recommendations.
- B. Drives:
 - 1. Adjust tension in V belt drives and adjust varipitch sheaves and drives for proper equipment speed.
 - 2. Adjust drives for alignment of sheaves and V belts.
 - 3. Clean and remove foreign materials before starting operation.
- C. Motors:
 - 1. Check each motor for comparison to amperage nameplate value.
 - 2. Correct conditions which produce excessive current flow, and which exist due to equipment malfunction.
 - 3. Check each motor for proper rotation.
- D. Pumps:
 - 1. Check glands and seals for cleanliness and adjustment before running pump.
 - 2. Inspect shaft sleeves for scoring.
 - 3. Inspect mechanical faces, chambers, and seal rings, and replace if defective.
 - 4. Verify that piping system is free of dirt and scale before circulating liquid through the pump.
- E. Valves:
 - 1. Inspect both hand and automatic control valves, clean bonnets and stems.
 - 2. Tighten packing glands to assure no leakage but permit valve stems to operate without galling.
 - 3. Replace packing in valves to retain maximum adjustment after system is judged complete.
 - 4. Replace packing on any valve which continues to leak.
 - 5. Remove and repair bonnets which leak.

SECTION 01650 – STARTING OF SYSTEMS

6. Coat packing gland threads and valve stems with a surface preparation of "Moly Cote" or "Fel Pro", after cleaning.
- F. Verify that control valve seats are free from foreign material and are properly positioned for intended service.
- G. Tighten all pipe joints after system has been tested. Replace gaskets which show any sign of leakage after tightening.
- H. Inspect all joints for leakage.
 1. Promptly remake each joint which appears to be faulty, do not wait for rust to form.
 2. Clean threads on both parts, apply compound and remake joints.
- I. After system has been tested, clean strainers, dirt pockets, orifices, valve seats and headers in fluid system, to assure freedom from foreign materials.
- J. Open steam traps and air vents where used, remove operating elements. Clean thoroughly, replace internal parts and put back into operation.
- K. Remove rust, scale and foreign materials from equipment and renew defaced surfaces.
- L. Set and calibrate equipment.
- M. Inspect fan wheels for clearance and balance. Provide factory authorized personnel for adjustment when needed.
- N. Check each electrical control circuit to assure that operation complies with Specifications and requirements to provide desired performance.
- O. Inspect each pressure gage and thermometer for calibration. Replace items which are defaced, broken, or which read incorrectly.
- P. Repair damaged insulation.
- Q. Vent gasses trapped in any part of systems. Verify that liquids are drained from all parts of gas or air systems.

1.03 INITIAL PLANT START UP

- A. Prior to start-up of the facilities, prepare and pre-test all equipment to check its ability for sustained operation, including inspections and adjustments by manufacturer's service representatives, as specified in Section 01660 and this Section. Training by vendors shall have begun and all O&M manual submittals shall be completed prior to start-up.
- B. After the facilities are sufficiently complete to permit start up, furnish competent personnel to start up the facilities. The Contractor will be responsible for start-up of all facilities constructed under this Contract. During the initial start-up period check and provide for satisfactory mechanical operation of the facilities. Prior to start up, prepare a schedule detailing the proposed start up and his plans for manpower and auxiliary facilities to be provided. The start-up schedule is subject to approval of the Engineer. Start-up of the facilities by the Contractor shall include the operation and maintenance of all mechanical facilities such as pumps, and like equipment, and the ventilating, air conditioning, heating, and electrical systems. The start-up period shall be a minimum of 5 consecutive 24-hour days of satisfactory operation of the facility or the number of days called for in the Technical Specifications. Start-up of either the heating or air conditioning systems is dependent upon the time of year that the plant start up is initiated. The Contractor will be required to return at the beginning of the next heating or air conditioning season (whichever is applicable) to start the appropriate system.
- C. When the start-up period is completed, the Owner will assume responsibility for operation of the new facilities, provided that all major items of the Work are operating satisfactorily and operation and maintenance training has been completed satisfactorily. If any or all of the new facilities are not operating satisfactorily at the end of the start-up period, continue to operate those facilities that are incomplete or not operating satisfactorily until they are complete and acceptable to the Owner.

SECTION 01650 – STARTING OF SYSTEMS

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

+ + NO TEXT ON THIS PAGE + +

PART 1 – GENERAL

1.01 GENERAL

- A. All materials and equipment will be tested and inspected to insure full and complete compliance with the Specifications as determined by the Owner. All testing shall be in accordance with the American Society for Testing Materials and other Specifications as specified herein. Responsibility for performing testing shall be in accordance with the Detailed Specifications.
- B. The Owner will perform the tests tabulated in the General Conditions, Article GC 19, "Inspection and Testing".
- C. Perform all other testing laboratory services and furnish all test reports in accordance with the requirements of the General Conditions, Article GC 19, "Inspection and Testing".
- D. Perform all leak testing of concrete structures as described herein.

1.02 FIELD TESTING OF EQUIPMENT

- A. General:
 - 1. Field testing of equipment shall conform to the requirements of the General Conditions, Article GC 19, "Inspection and Testing", the Technical Specifications and as hereinafter specified.
- B. Preliminary Field Tests, Yellow Tag:
 - 1. As soon as conditions permit, after the equipment has been secured in its permanent position, check the equipment for alignment, direction of rotation and absence of defects.
 - 2. Purpose of tests is to determine if equipment:
 - a. Is properly installed.
 - b. Complies with operating cycles.
 - c. Is operational and free from overheating, overloading, vibration or other operating problems.
 - 3. Flush all bearings, gear housings, etc., in accordance with the manufacturer's recommendations, to remove any foreign matter accumulated during shipment, storage or erection. Lubricants shall be added as required by the manufacturer's instructions.
 - 4. Furnish all labor, materials, instruments, fuel, incidentals, and expendables required, unless otherwise provided.
 - 5. Make all changes, adjustments and replacements required to place equipment in service and test it.
 - 6. The Engineer and the Owner shall be given sufficient prior notice to witness tests.
 - 7. When the Contractor has demonstrated to the Engineer that the equipment is ready for operation, a yellow tag will be issued. The tag will be signed by the Engineer or his designated representative and attached to the equipment. The tag shall not be removed.
 - 8. Preliminary field tests, yellow tag, must be completed before equipment is subjected to final field tests, blue tag.
- C. Final Field Tests, Blue Tag:
 - 1. Upon completion of the installation, and at a time approved by the Engineer, equipment will be tested by operating it as a unit with all related piping, ductwork, electrical controls and mechanical operations.
 - 2. To the maximum extent possible, perform final field tests of equipment prior to initial start-up and operation of the Project. Where this is not practicable, final field tests shall be performed during initial start-up and operation of the Project.
 - 3. Purpose of the tests is to demonstrate that equipment is:
 - a. Properly installed.
 - b. Completely ready for operation by the Owner personnel.
 - c. In compliance with design conditions, material specifications and all other requirements of the Contract Documents.
 - 4. Submit the test procedure for approval by the Engineer. The procedure shall specify the duration and the parameters of the test.

SECTION 01660 – QUALITY CONTROL

5. Notify the Engineer at least 24 hours prior to beginning of tests. Keep notes and data on tests and submit copy to the Engineer. The Engineer and the Owner's operating personnel shall witness all tests.
6. The equipment will be placed in continuous operation as prescribed or required and witnessed by the Engineer or his designated representative.
7. Each pump shall be tested at maximum rated speed for the number of points specified in the Technical Specifications, but no less than four points, on the pump curve for capacity, head and electric power input. The rated motor nameplate current and power shall not be exceeded at any point within the specified range. Vibrometer readings shall be taken when directed by the Engineer and the results recorded.
8. Pumps with drive motors rated at less than five horsepower shall only be tested for excess current or power when overheating or other malfunction becomes evident in general testing.
9. Until final field tests are acceptable to the Engineer, make all necessary changes, readjustments and replacements at no additional cost to the Owner.
10. Defects which cannot be corrected by installation adjustments will be sufficient grounds for rejection of any equipment.
11. Upon acceptance of the field tests a blue tag will be issued. The tag will be signed by the Engineer and attached to the unit. The tag shall not be removed and no further construction Work will be performed on the unit, except as required during start-up operations and directed by the Engineer.
12. All costs in connection with such tests including all materials, equipment, instruments, labor, etc. shall be borne by the Contractor.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

PART 1 – GENERAL

1.01 GENERAL

- A. The intent of this Section is to have the Contractor perform his Work in such a manner that continuous, uninterrupted conveyance of sewage flow is maintained operational throughout the construction period.
- B. Except for the scheduled shutdowns and facility bypass specified in this Section, the existing sewage pump stations will be maintained in continuous operation by the Owner during the entire construction period. Work shall be so scheduled and conducted such that it will not create potential hazards to Owner personnel, reduce the conveyance capacity or other nuisance. In performing the Work shown and specified, plan and schedule Work to meet both constraints outlined in this Section and facility operating requirements.
- C. The work covered in the following paragraphs may not be all inclusive of all work which may affect facility operations. All operations which involve the demolitions, isolation or tie in to existing facility equipment and/or systems shall be submitted for approval.
- D. Temporary bypass pumping will be required during this project for the construction of new facilities and connection of new to existing force mains.
- E. Contractor has the option of providing additional temporary facilities that can eliminate a constraint, provided it is done without additional cost to the Owner, and provided that all requirements of these Specifications are fulfilled.
- F. Be aware that existing valves, dampers, sluice gates, and other shutoff devices may not be tight closing and that supplemental pumping and/or other means may have to be provided by the Contractor to isolate the system as intended.
- G. This Section of the Specifications contains several references to equipment, piping, material and appurtenances to be removed or reinstalled. The Contractor shall also refer to the Drawings and other applicable Sections for definition of the equipment, piping, material and appurtenances to be removed and turned over to the Owner and stored on site, or to become the property of the Contractor and removed from the site.
- H. Related Sections:
 - 1. Section 01031, Additions, Modifications and Alterations to Existing
 - 2. Section 01500, Temporary Facilities and Controls.
 - 3. Section 01517, Temporary Sanitary Wastewater Conveyance Systems.
 - 3. Section 02050, Demolition, Removals and Modifications.

1.02 GENERAL CONSTRAINTS

- A. The following constraints shall be applied to all equipment and appurtenant utility systems on the Facility site.
 - 1. Personnel Access: Owner must have access to all areas that remain in operation throughout the construction period.
 - 2. Potable Water System: Existing potable water systems shall be kept in operation at all times.
 - 3. Plumbing Facilities: Sanitary facilities in the existing structures, or temporary sanitary facilities, shall be operational at all times for Owner personnel. All other building plumbing systems such as roof and floor drains, pumping, etc. shall be maintained for all structures.
 - 4. Storm Drainage: Storm drainage on the site shall be operational at all times.
 - 5. Building Heating and Ventilating: In the Contractor's work areas and areas affected by the Contractor's operations, building heating and ventilating shall be both provided and maintained. Temperatures to be maintained as specified in Section 01500, Temporary Facilities and Controls.
 - 6. Power, Light and Communication Systems: Electric power, lighting service and communication systems shall be maintained in uninterrupted operation in all areas.

SECTION 01711 – MAINTENANCE OF FACILITY OPERATIONS

7. Draining Process Pipes and Conduits:
 - a. Unless otherwise specified, the contents of pipes and conduits undergoing modifications shall be transferred to the Facility drain sewer system using hoses, piping, or pumps (if hydraulic conditions so require them) by the Contractor whose Work requires the draining.
 - b. If a drain is not available on the pipe to be drained, then a wet tap shall be made by the Contractor using an approved tapping saddle and valve. No uncontrolled spillage of a pipe's contents shall be allowed.
 - c. Immediately wash down all spillage to the floor drains, sumps and sump pump discharge piping flushed out by the Contractor to prevent clogging and septic odors.
8. Dead End Valves or Pipe: Provide blind flanges on all valves or pipe that dead-end a line on a temporary or permanent basis as specified in Section 02050, Demolition, Removals and Modifications.

1.03 OVERTIME

- A. Overtime Work by the Contractor necessary to conform to the requirements of this Section and related Sections shall be performed by the Contractor and the Contractor shall make no claims for extra compensation as a result thereof.

1.04 MAINTENANCE OF FACILITY OPERATIONS (MOPO) AND SEQUENCE OF CONSTRUCTION

- A. In order to maintain a continuous facility operation during construction, a suggested MOPO plan description for each of the four pump stations is included in this Section. The MOPO is the responsibility of the Contractor and the Contractor may utilize the plans described herein or different means and methods for the MOPO plans.
- B. The Contractor shall submit a detailed MOPO plan for each pump station for approval. The plans shall include a sequence of work items, material and equipment to be used for the MOPO, and a time schedule for the work items associated with the MOPO plans. If temporary bypass pumping is used, submit the details of the pumps and piping and the operating characteristics of the pumps.
- C. The Contractor shall note that all necessary shutdowns may not be included in the MOPO descriptions herein. As the need for additional shutdowns becomes evident, the Contractor shall notify the Engineer, who with assistance and approval of the Owner, will arrange for necessary shutdowns.
- D. Regardless of the MOPO method used, the contractor shall have at least one pump truck on standby for contingency use during critical parts of the work (such as establishing or removing a bypass system). Make advance arrangements with NCDPW to allow the pumping truck to discharge to a nearby sewage treatment plant in an emergency. Perform time-sensitive work at times when sanitary flows are likely to be lower than average, such as late at night.
- E. Provide temporary standby generator during the period when the existing electric service wiring is replaced and as needed for temporary bypass pumping.
- F. The pump station shut down should be coordinated and receive prior approval from the owner and owner's representative prior to shut down.
- G. Contractor is advised that work in multiple pump stations may need to be performed simultaneously in order to complete the entire scope of the Contract within the allotted time.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION - DETAILED MOPO DESCRIPTIONS

3.01 KNOTT DRIVE EJECTOR STATION

- A. Bypass pumping will be required at the Knott Drive Ejector Station project site to perform the specified work, including, but not necessarily limited to, installation of new wet well, valve

SECTION 01711 – MAINTENANCE OF FACILITY OPERATIONS

chamber, flow metering manhole, force main piping and valves, and all other components shown on the drawings and specified herein.

- B. The following is a suggested MOPO plan sequence of consideration by the contractor:
 - 1. With the existing pumping station still in operation, install wet well, valve chamber, meter pit, and all piping up to existing force main tie in.
 - 2. At a period of low flows, cut in wye connection and install valves on existing force main.
 - 3. Using the new valves installed at the force main connection, isolate the existing pump station and test the function of the new pumping station components with fresh water.
 - 4. Once the pumping station has been inspected and approved by NCDPW and the engineer, make the final connection to the existing upstream manhole.
 - 5. Once the new pumping system is in operation. Demolish the existing structures which are called out to be removed.
 - 6. All existing pump station structures indicated to be abandoned should be cut 3' below grade and then backfilled.

3.02 MORGAN PARK PUMP STATION

- A. Bypass pumping will be required at the Morgan Park Pumping Station project site to perform the specified work, including, but not necessarily limited to, installation of new grinder manhole, wet well, valve chamber, flow metering manhole, doghouse and directional manholes, force main piping and valves, and all other components shown on the drawings and specified herein.
- B. The following is a suggested MOPO plan sequence of consideration by the contractor:
 - 1. With the existing pumping station still in operation, construct the doghouse manhole, alignment manholes, grinder manhole, wet well, valve chamber, meter pit, and all piping up to existing force main tie in.
 - 2. At a period of low flows, cut in wye connection and install valves on existing force main.
 - 3. Using the new valves installed at the force main connection, isolate the existing pump station and test the function of the new pumping station components with fresh water.
 - 4. Once the pumping station has been inspected and approved by NCDPW and the engineer, make the final connection within the doghouse manhole.
 - 5. Once the new pumping system is in operation. Demolish the existing structures which are called out to be removed.
 - 6. All existing pump station structures indicated to be abandoned should be cut 3' below grade and then backfilled.

3.03 VIOLA DRIVE PUMP STATION

- A. Bypass pumping will be required at the Viola Drive Pumping Station project site to perform the specified work, including, but not necessarily limited to, installation of new grinder manhole, wet well, valve chamber, flow metering manhole, force main piping and valves, and all other components shown on the drawings and specified herein.
- B. The following is a suggested MOPO plan sequence of consideration by the contractor:
 - 1. With the existing pumping station still in operation, construct the grinder manhole, wet well, valve chamber, meter pit, and all piping up to existing force main tie in.
 - 2. At a period of low flows, cut in wye connection and install valves on existing force main.
 - 3. Using the new valves installed at the force main connection, isolate the existing pump station and test the function of the new pumping station components with fresh water.
 - 4. Once the pumping station has been inspected and approved by NCDPW and the engineer, make the final connection within the doghouse manhole.
 - 5. Once the new pumping system is in operation. Demolish the existing structures which are called out to be removed.
 - 6. All existing pump station structures indicated to be abandoned should be cut 3' below grade and then backfilled.

3.04 ROSLYN VILLAGE PUMP STATION

- A. Bypass pumping will be required at the Roslyn Village Pumping Station project site to perform the specified work, including, but not necessarily limited to, installation of new temporary

SECTION 01711 – MAINTENANCE OF FACILITY OPERATIONS

bypass vault, sewage pumps, valves, piping and adapters, and all other components shown on the drawings and specified herein.

- B. The following is a suggested MOPO plan sequence of consideration by the contractor. These methods refer to component numbers shown in flow schematic diagram on sheet DD140.00 of the Contract Drawings.
1. Locate and test existing buried valve #12 on the force main in Skillman Street to ensure operation for steps 2 thru 6.
 2. Prepare the area around the new bypass connection vault. Excavate to expose the force main, have all materials for the bypass connection on site. All work in steps 3 thru 6 must be completed within a 5 hour timeframe to prevent sewage overflow.
 3. At a period of low flow, pump the wet well down to maximize storage capacity during shut down. Close valve #12 on force main. Open check valves #5, #6, & #7 on pumps to drain force main between valve #12 and wet well. Close valves #11 and #13.
 4. Cut force main and make wye connection installing valves #23 and #24 in bypass chamber. During cut-in, pump to the emergency overflow chamber if necessary.
 5. Once connection is complete pressure test new components.
 6. Return pump station to normal operation by opening valves #11, #12, #23. Drain emergency storage chamber if used during cut-in.
 7. Take delivery of trailer-mounted temporary bypass pumps. Install suction piping into wet well through doors on NE corner of building. Connect discharge line to new wye connection, and transfer system over to temporary bypass closing the suction valves #1, #3, & #4 in the dry pit and the new valve #23 in the bypass connection vault.
 8. Replace all existing pipe, valves, fittings, pumps, equipment, etc between the shutoff valves.
 9. Isolate and drain north wet well, replace suction valves #1 and #2 during period of low flow.
 10. Isolate and drain south wet well, replace suction valves #3 and #4 during period of low flow. Note: valves #2 and #3 on pump #2 need to be shut during replacement of valves #1 and #4 to prevent active wet well from draining through common connection in pump #2. Work must be completed quickly during period of low flow since only one pump will be available.
 11. Return the system to normal pumping mode with new equipment. Remove temporary piping, electrical, etc.

END OF SECTION

SECTION 01740 – CLEANING

PART 1 – GENERAL

1.01 GENERAL

- A. Execute cleaning, during progress of the Work, at completion of the Work, and as required by the General Conditions, Article GC-33, "Cleaning".
- B. Requirements of Regulatory Agencies:
 - 1. In addition to the requirements herein, maintain the cleanliness of the Work and surrounding premises within the Work limits so as to comply with federal, state, and local fire and safety laws, ordinances, codes and regulations.
 - 2. Comply with all federal, state and local anti-pollution laws, ordinances, codes and regulations when disposing of waste materials, debris and rubbish.
- C. Scheduling of Cleaning and Disposal Operations:
 - 1. So that dust, wash water or other contaminants generated during such operations do not damage or mar painted or finished surfaces.
 - 2. To prevent accumulation of dust, dirt, debris, rubbish and waste materials on or within the Work or on the premises surrounding the Work.
- D. Waste Disposal:
 - 1. Dispose of all waste materials, surplus materials, debris and rubbish off the Site.
 - 2. Do not burn or bury rubbish and waste materials on the Site.
 - 3. Do not dispose of volatile or hazardous wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains or on the ground.
 - 4. Do not discharge wastes into storm drains, streams or waterways.
- E. Cleaning Materials:
 - 1. Use only cleaning materials recommended by manufacturer of surface to be cleaned.
 - 2. Use each type of cleaning material on only those surfaces recommended by the cleaning material manufacturer.
 - 3. Use only materials which will not create hazards to health or property.
- F. During Construction:
 - 1. Keep the Work and surrounding premises within work limits free of accumulations of dirt, dust, waste materials, debris and rubbish, in accordance with the General Conditions, Article GC-33, "Cleaning."
 - 2. Keep dust generating areas wetted down.
 - 3. Provide suitable containers for storage of waste materials, debris and rubbish until time of disposal.
 - 4. Dispose of waste, debris and rubbish off Site at legal disposal areas.
- G. When Project is Completed:
 - 1. Clean and maintain the Site in accordance with Division 1, Section 01760, Project Closeout.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01740 – CLEANING

+ + NO TEXT ON THIS PAGE + +

PART 1 - GENERAL

1.01 - SUMMARY

- A. Testing of piping.
- B. Testing of tanks vented to atmosphere.
- C. Pipe leakage testing shall comply with the conditions noted in the Schedule.

1.02 - DEFINITIONS

- A. Leakage (or exfiltration) - The quantity of water to be supplied into the newly laid pipe, any valved section thereof, manhole, or other appurtenance, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.
- B. Infiltration - The quantity of water that enters into any pipe, manhole, or other appurtenance when the static groundwater elevation is at the maximum elevation above the pipe or appurtenance as specified hereinafter.

1.03 - QUALITY ASSURANCE

- A. Prior to Substantial Completion, pressure pipes and non-pressure pipes shall meet specific leakage requirements. These leakage requirements shall be satisfied by the basic materials alone. Where joint fillers and the like have been specified, primarily to protect jointing materials, and secondarily to provide a factor of safety, they shall not be applied until after leakage tests have been completed and have been accepted by Engineer.
- B. Engineer will witness all tests. Tests not witnessed will be considered as not having been performed.
- C. Do not close or cover up work until it has been observed for proper and satisfactory construction and installation in compliance with the Contract Documents. Should incomplete or unacceptable work be covered, the Contractor shall, at his/her own expense, uncover all work so that it may be properly observed. After such observations, repair and replace the work that was found defective, unsatisfactory, and not in accordance with the Contract Documents. After such repair and replacement, bring all work to completeness and status as it was before it was closed and covered, all at the Contractor's own expense. Submit for review and approval proposed corrective action to correct failed systems.
- D. Successful completion of required tests shall be in no way interpreted as relieving the Contractor of responsibility for defects that become apparent subsequent to the time of testing. It shall be the sole right of the Engineer/Architect to determine whether defects exist. Retest all portions of the work deemed necessary by the Engineer/Architect prior to Substantial Completion.

1.04 - SUBMITTALS

- A. Submit under provisions of Section 01330.
- B. Provide details and specifications on testing apparatus.
- C. Provide certified test results on forms approved by the Engineer/Architect.

1.05 - SEQUENCING AND SCHEDULING

- A. Notify Engineer/Architect and governing agencies, if necessary, at least 48 hours in advance of a scheduled test so that the test may be witnessed.
- B. Test underground pipe prior to backfilling.
- C. At Engineer/Architect's discretion, additional sections of pipelines may be required to be tested as soon as pipe is laid and prior to backfilling when working conditions or the standard of workmanship have been altered.

PART 2 - PRODUCTS

2.01 - TESTING APPARATUS

- A. Provide labor, plugs, measuring equipment, and other apparatus, complete, to perform testing.
- B. Provide clean water, air, nitrogen, and other materials as required to accomplish testing.
- C. Provide plugs and caps capable of withstanding test pressures.
- D. Provide temporary flanges, plugs, bulkheads, thrust blocks, weighing, bracing and other items necessary to prevent joints from separating, and to prevent injuries or damage.

PART 3 - EXECUTION

3.01 - PREPARATION

- A. Plug open ends, adequately block bends, tees, ends, and other fittings, and do whatever is necessary to brace piping system so that it will safely withstand the pressures developed under the tests and so that no damage or injury shall occur to the pipeline, people or property.
- B. Before tests are conducted, isolate, or remove any regulator, gauge, trap, or other apparatus or equipment that may be damaged by test pressures.

3.02 - GENERAL

- A. Trapped Air: Trapped air may cause a false indication of the rate of leakage. Points of concern include ends of lines, stubs, house connections and high points in pipelines. No credit will be made for this condition and no adjustment will be made to the allowable leakage. When trapped air is suspected of causing a test failure, do whatever is necessary to evacuate the air and repeat tests until the actual leakage is equal to or less than allowable rate of leakage.
- B. Water Absorption: No credit will be given for absorption of water in pipe and manhole walls. If necessary, fill pipes and manholes with water well in advance of testing and allow them to soak in order to eliminate or minimize the effects of absorption.

3.03 - TESTS FOR NON-PRESSURE PIPING

- A. General:
 - 1. Leakage shall be determined by exfiltration testing. The Engineer/Architect reserves the right to also require infiltration testing.

2. Air testing is not permitted.
3. Leakage testing shall include the main non-pressure pipe, house connections, and appurtenances on the section of pipeline being tested.
4. Limit pipeline test sections to runs between adjacent structures. Manholes may be tested simultaneously with pipes.
5. Adequately plug ends of house connections, stubs, and openings from which water may escape.
6. Use clean water for exfiltration tests.
7. Determine groundwater levels by installing piezometers, test holes or test pits at intervals not to exceed 1,000 feet.

B. Pipe Exfiltration Test:

1. The minimum water level required for testing is 4 feet above the crown of the upstream (highest) end of the pipe being tested or 2 feet above the maximum groundwater level along the test section, whichever is greater.
2. Install a watertight plug in the downstream end of the manhole pipe.
3. Fill upstream manhole with water and conduct test for six (6) hours.
4. Upon satisfactorily completing the test, remove the downstream plug in the presence of Engineer/Architect. Do not touch nor remove anything until approved by Engineer/Architect.
5. Maximum allowable exfiltration is one hundred (100) gallons per inch diameter per mile per day.

C. Pipe Infiltration Test:

1. The minimum head of groundwater required for infiltration testing is 2 feet above the crown of the pipe at the upstream end but must in all cases reach its normal level.
2. Infiltration may be measured with an approved graduated container capable of intercepting all inflow, by a pipeline V-notch weir, or by other approved methods. When using instream type measuring devices, do not measure flows until steady state conditions are established.
3. Maximum allowable infiltration is one hundred (100) gallons per inch diameter per day per mile of pipe.
4. Where groundwater level is at least 2 feet above the highest manhole joint, manholes may be included in the test. No visible leakage will be permitted in manholes.

3.04 - TESTS FOR PRESSURE PIPES

- A. Leakage testing shall include the main exiting pipe, service connections, and other appurtenances on the section of pipeline being tested.

- B. Test pipes prior to applying insulation and before they are concealed or furred-in.
- C. Provide all necessary gauges. Gauges shall be standard pressure type with a minimum 6 inch diameter dial and a pressure range not in excess of 150% of the maximum required test pressure.
- D. Provide and maintain at the site a gauge stand with an approved laboratory calibrated test gauge. Periodically check test gauge used for testing against the test gauge, and whenever requested by Engineer.
- E. Where it is necessary for testing, tap pipes and insert approved plugs after testing is completed.
- F. Provide a hand or motor driven compressor to maintain the required test pressure constant throughout the duration of the test. If a water pump is used, pump water from a container with a known volume of water. If an air or inert gas pump is used, leakage shall be determined and calculated by the cycling of the pump.
- G. Provide test gauges at each end of the line being tested.
- H. Conduct leakage test in accordance with the requirements contained in the Schedule.

3.05 - ALLOWABLE LEAKAGE

- A. The maximum allowable leakage for the various piping systems is presented in the schedule.
- B. It is the intent of this Contract to secure piping systems without leakage.
 - 1. Each section of pipe and within each structure shall not exceed the allowable leakage.
 - 2. It is also the intent to secure a piping system free from visible drips, streams and leaks. Therefore, even if a portion of the system meets the requirements for allowable leakage, visible leaks are not permitted and shall be repaired.
- C. Leakage tests will be considered satisfactorily passed when the rate of leakage is equal to or less than the stipulated allowances, there is no evidence of visible leaks, and there is no evidence of other system defects.

3.06 – TEST FOR TANKS VENTED TO ATMOSPHERE

- A. Prior to testing liquid holding tanks open to the atmosphere, backfill to finished grade. Piping and equipment within the tank that might affect the watertightness of the tank shall be completely installed and operable.
- B. Isolate each individual tank for testing.
 - 1. Fill with clean, potable water to the maximum operating level.
 - 2. After a suitable stabilization period, the maximum operating level shall be reestablished and a twenty-four (24) hour leakage test shall be performed.
 - 3. During the test, no water shall be added to or taken from the tank. The drop in the water level shall be recorded at the end of the period.

4. The allowable loss is no more than 1/4-inch per eight hours and no running leaks shall be visible.
 5. Leaks shall be repaired by methods and materials approved by the Engineer prior to the start of the corrective action.
 6. Leakage shall be corrected prior to the performance of equipment testing.
 7. During the testing of each individual tank, as outlined in this paragraph, all immediately adjacent tanks shall be empty of water.
- C. After each individual tank has passed the leakage test, all tanks within each complex shall be filled with water to the normal operation level to check complex structural integrity and the hydraulics of operation.

3.07 - RETESTING

- A. Pipes, tanks and manholes not passing the tests shall have all defects corrected with methods approved by the Engineer/Architect to the inspection and satisfaction of Engineer/Architect, and shall be retested and re-corrected as often as is necessary until the test requirements have been met.
- B. It is the intent of this Contract to obtain work meeting test requirements on their own and solely through the use of the normal integral sealing components.
1. Joint leaks shall not be stopped using concrete, caulking, mortar, or other patching materials.
 2. Leaking pipe joints shall be re-jointed and leaking manhole joints shall have joints reset, or replaced if necessary.
- C. Methods other than rejoining, resetting or replacing joint seals shall require the written approval of Engineer/Architect.

3.08 - SCHEDULE

LEAKAGE TESTING REQUIREMENTS

SERVICE	FLUID	PRESSURE	DURATION (Hrs.)	ALLOWABLE LEAKAGE (Note 1)		
				UNDERGROUND		EXPOSED
				Infil.	Exfil.	
Non-Pressure Piping	Water	4ft.	6	100	100	None
Pressure Piping	Water	(Note 2)	(Note 2)	0	0	0

SCHEDULE NOTES:

01755 – PROCESS PIPE AND TANK TESTING

1. Maximum allowable leakage in gallons/day/inch diameter per mile of pipe, or gallons/day/inch diameter/mile for manholes. Where a percentage is shown, the loss shall not exceed the percentage of the starting test pressure.
2. Maintain 100 psi or two times operating pressure, whichever is greater, for 2 hours.

END OF SECTION 01755

PART 1 – GENERAL

1.01 FINAL CLEANING

- A. At the completion of the Work, remove temporary structures, construction signs, tools, scaffolding, materials, supplies and equipment which he or any of his Subcontractors may have used in the performance of the Work.
- B. Broom clean paved surfaces and rake clean other surfaces of grounds.
- C. Thoroughly clean all materials, equipment and structures; all marred surfaces shall be touched up to match adjacent surfaces; replace dirty filters and burned-out lights as required. Clean and polish all interior and exterior glass surfaces so as to leave glass surfaces in a clean and new appearing condition.
- D. Remove spatter, grease, stains, fingerprints, dirt, dust, labels, tags, packing materials, rubbish, and other foreign items or substances from interior and exterior surfaces, equipment, signs and lettering.
- E. Remove paint, clean and restore all equipment and material name-plates, labels and other identification markings.
- F. Maintain cleaning until Project, or portion thereof, is occupied by the Owner.

1.02 INSPECTIONS

- A. At the time of substantial completion an inspection shall be held in accordance with the requirements of the Agreement, Article XXXVI, "Substantial Completion Payment". At this time the Contractor shall also provide all necessary documentation as required by the above referenced Article.
- B. At the time of completion of all the Work a final inspection shall be held in accordance with the requirements of the Agreement, Article XXXVII, "Final Payment". Provide all necessary documentation as required by the above referenced Article and comply with all the requirements of the General Conditions, Article GC-38, "Project Closeout".
- C. Follow-up Inspection:
 - 1. At the time of the completion of the guarantee period as specified in the Agreement, Article XX, "Maintenance and Guarantee," the Engineer will make arrangements with the Owner and the Contractor for a follow-up inspection and will send a written notice to said parties to inform them of the date and time of the inspection.
 - 2. After the inspection, the Engineer will inform the Contractor of any corrections required.
 - 3. When the corrections have been satisfactorily completed, the Engineer will forward a certificate for the release of Bonds.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

++ NO TEXT ON THIS PAGE ++

PART 1 – GENERAL

1.01 GENERAL

- A. Maintain and provide the Engineer with Project record documents as specified below except where otherwise specified or modified in the Specifications or in the General Conditions, Article GC-5, "Drawings and Specifications" and Article GC-36, "Record Drawings."

1.02 MAINTENANCE OF DOCUMENTS

- A. Maintain in the Contractor's field office in clean, dry, legible condition, complete sets of the following: Contract Drawings, Specifications, Addenda, approved Shop Drawings, Samples, photographs, Change Orders, other Modifications of Contract, test records, survey data, Field Orders, and all other documents pertinent to Contractor's Work.
- B. Provide files and racks for proper storage and easy access. File in accordance with the filing format of the Construction Specification Institute (CSI) unless otherwise approved by the Engineer.
 - 1. Make documents available at all times for inspection by the Engineer and the County representative.
 - 2. Record documents shall not be used for any other purpose and shall not be removed from the office without the Engineer's approval.

1.03 RECORDING UPDATED INFORMATION

- A. General:
 - 1. Label each document "PROJECT RECORD" in 2-inch high printed letters.
 - 2. Keep record documents current, and updated at least monthly.
 - 3. Do not permanently conceal any Work until required information has been recorded.
- B. Contract Drawings: Legibly mark to record actual construction including:
 - 1. Depths of various elements of foundation in relation to datum.
 - 2. Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvements.
 - 3. Location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure.
 - 4. Field changes of dimensions and details.
 - 5. Changes made by Change Order or Field Order.
 - 6. Details, not on original Contract Drawings.
 - 7. Record drawings shall be the same size as the Contract Drawings.
- C. Specifications and Addenda: Legibly mark up each Section to record:
 - 1. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
 - 2. Changes made by Change Order or Field Order.
 - 3. Other matters, not originally specified.
- D. Shop Drawings: Maintain as record documents and legibly annotate Drawings to record changes made after review.

1.04 FINAL SUBMISSION OF RECORD DOCUMENTS

- A. Record Drawings:
 - 1. At the completion of the Work, Contractor shall furnish to the Engineer record drawings one (1) reproducible (Mylar) media set and on a USB flash drive one (1) electronic bound AutoCAD drawing set in Release 2012 or later and one (1) compiled PDF set showing the actual in-place installation of these items installed under this Contract. The AutoCAD drawings shall conform to Owner requirements and specific contract CAD Plans. Drawings shall show the Work in plan and sections as required for clarity with reference dimensions and elevations for complete Record Drawings. Documentation shall be furnished not later than 30 days after completion of the Work and prior to Final Payment. Engineer will make available to the Contractor electronic media (USB flash drive) in a zipped format of the CAD Contract Drawings for the sole purpose of the Contractor

SECTION 01780 – PROJECT RECORD DOCUMENTS

- preparing record drawings. Prior to forwarding the media, the Contractor will be required to execute an indemnification and hold harmless agreement with the Engineer.
2. At the completion of the Work, furnish to the Engineer reproducible mylar tracings showing the actual in-place installation of these items installed under this Contract. Drawings shall show the Work in plan and sections as required for clarity with reference dimensions and elevations for complete Record Drawings. Tracings shall be furnished not later than 30 days after completion of the Work and prior to Final Payment.
 3. The Contract Drawings may be used as a starting point in developing these Drawings. Subcontractor and manufacturer's drawings may be included in this drawing package. The drawing package shall be fully integrated and include the necessary cross-references between Drawings. The drawing package shall include interconnection and termination details to the equipment furnished under this Contract.
 4. All Drawings must be submitted for approval of the Engineer. This shall include the following composite drawings for the system being furnished:
 - a. Schematic (Elementary) Diagrams: This shall include but not be limited to complete schematics including items furnished by others for the following:
 - 1) Motor control circuits for starters furnished under this Contract.
 - 2) Controls.
 - b. Wiring (connection) diagrams: Include for all pre-wired equipment furnished under this Contract.
 - c. Interconnection diagrams: Include all interconnections to be furnished under this Contract.
 - d. Conduit and cable schedules: Include all conduit and cable furnished under this Contract.
 - e. Dimension of outline drawings: Include all equipment furnished under this Contract.
 - f. Power and lighting layout drawings: Include all conduits and wiring furnished under this Contract.
- B. Submittal:
1. At completion of Project, deliver record documents to the Engineer.
 2. Accompany submittal with transmittal letter containing:
 - a. Date.
 - b. Project title and number.
 - c. Contractor's name and address.
 - d. Title and number of each record document.
 - e. Certification that each document as submitted is complete and accurate.
 - f. Signature of the Contractor, or his authorized representative.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

PART 1 – GENERAL

1.01 GENERAL

- A. Provide operation and maintenance data in the form of instructional manuals for use by the Owner's personnel for:
 - 1. All equipment and systems.
 - 2. All instruments and control devices.
 - 3. All electrical gear and devices.

1.02 LUBRICATION SURVEY

- A. Provide a lubrication survey, made by a lubricant supply firm, subject to the approval of the Engineer, and paid for by the Contractor.
- B. Lubrication survey shall list all equipment, the equipment manufacturer's lubrication recommendations, and an interchangeable lubricants tabulation standardizing and consolidating lubricants whenever possible. Include lubricant type, quantities and frequencies for each piece of equipment.
- C. Supply all lubricants, applicators and labor for lubricating the equipment, in accordance with manufacturer's recommendations, for field-testing and prior to final acceptance. Provide a supply of required lubricants sufficient for start-up and one year of operation.
- D. Submit twelve copies of the approved lubrication survey prior to final acceptance.

1.03 SPARE PARTS AND SPECIAL TOOLS

- A. Spare Parts:
 - 1. As soon as practicable after approval of the list of equipment, furnish spare parts data for each different item of equipment listed. The data shall include a complete list of parts and supplies, with current unit prices and source or sources of supply. This information shall also be included in the Operations and Maintenance Manuals.
 - 2. Furnish a list of parts, and supplies that are either normally furnished at no extra cost with the purchase of the equipment, or specified to be furnished as part of the Contract and a list of additional items recommended by the manufacturer to assure efficient operation for the particular installation for a period of one year or the guarantee period, whichever is greater.
 - 3. All parts shall be securely boxed and tagged, and clearly marked on the box and individually for identification as to the name of manufacturer or supplier, applicable equipment, part number, description and location in the equipment. All parts shall be protected and packaged for a shelf life of at least ten years.
 - 4. The following procedure shall be followed for furnishing spare parts to the Owner:
 - a. Prepare a formal letter of transmittal listing the name or description of the part, part number, model number, manufacturer (or supplier), and system component name and the Section where it was specified to be provided.
 - b. Submit two (2) counterparts of the parts transmittal letter.
 - c. Turn each part over individually to the Owner/Engineer.
 - d. The Owner/Engineer will initial next to the part description on each counterpart of the transmittal letter.
 - e. The initials represent that the part was satisfactorily received.
 - f. One transmittal counterpart will be returned to the Contractor.
- B. Special Tools:
 - 1. Furnish at no additional cost to the Owner with each piece of equipment as a minimum, two complete sets, or the number of sets called for in the Technical Specifications, of suitably marked special tools and appliances which may be needed to adjust, operate, maintain, or repair the equipment.
 - 2. Submit, for approval by the Engineer, a complete list of the special tools and appliances to be furnished. Such tools and appliances shall be furnished in approved painted steel cases properly labeled and equipped with good grade cylinder locks and duplicate keys.

1.04 OPERATION AND MAINTENANCE MANUALS

A. Final Operations and Maintenance Manuals:

1. As a prerequisite to obtaining payments for equipment furnished under this Contract in excess of fifty percent of the Contract amount, prepare, submit and obtain the Engineer's approval of an operation and maintenance manual for each item of equipment supplied under this Contract. Each item of equipment shall be identified with the equipment identification number given in the Contract Documents or as furnished by the Engineer. Each manual shall be prepared specially for this installation and shall include all approved Shop Drawings, all pertinent and legible instructions, technical bulletins and other printed matter required to provide fully accurate and comprehensive information for the safe and proper operation, maintenance and repair of the equipment item. It shall include, but not be limited to the following:
 - a. Catalogs, diagrams, schematics, drawings, instruction bulletins and manuals marked by underlining, checking, the use of arrows or the obliteration or removal of extraneous data, so as to pertain only to the specific equipment item for which the manual is supplied. Original reprints of manufacturers' catalog information and maintenance data shall be furnished; photocopies or facsimile (FAX) copies will not be acceptable.
 - b. Complete electrical schematics and wiring diagrams. Complete wiring between terminal points must be shown. Computerized diagrams are not acceptable.
 - c. Drawings, diagrams and illustrations shall be original quality and clearly legible. Facsimile copies are not acceptable. Reduced drawings shall not be reduced to less than one-half of the original size. All lines, dimensions, lettering and text must be clearly legible.
 - d. Reference to features and elements of equipment, such as operational limits of time, speed, pressure, temperature, etc., shall be clear, complete and compatible with authoritative published engineering reference documents. Torque ratings shall be given for all bolted connections. All functional components, electrical systems, equipment, etc., shall be shown on diagrams and discussed in the text so as to identify their proper system relationship. Operation, service, trouble-shooting, checkout and in-line and bench repair procedures, identifying specific system characteristics of the equipment, shall be provided. Detailed start-up and shutdown procedures shall be included as a separate section for each piece of equipment or system.
 - e. Recommended procedures and frequencies for preventive maintenance such as inspection, adjustment, lubrication, calibration and cleaning shall be provided including pre-startup checklists for each piece of equipment and long-term shutdown maintenance.
 - f. Equipment parts shall be identified by manufacturer's part number and located with relation to other components of the equipment utilizing "exploded" type drawings for clarity. Complete parts lists shall be included, which indicate the part number, the part description, applicable serial and model numbers, current unit prices and the name, address and telephone number of the nearest equipment manufacturer's representative and nearest service and spare parts warehouse. Complete instructions for the ordering of all replaceable parts shall be noted in this section of the Manual. Recommendations as to spare parts and spares inventory levels shall be made. Lead time and shelf life values and preservation, packaging and labeling methods shall be recommended.
 - g. All copyrighted material used in the manual or in any operation required in the performance of the Contract will be preceded by the Contractor obtaining the copyright holder's written permission to use such material. The Contractor shall hold the Owner and the Engineer free of any legal responsibility for its use.
2. Each operation and maintenance manual shall be bound in a durable, permanent, stiff cover binder of one (more if required) volume with a complete index of the manual's contents arranged by subject matter and in order of presentation in each volume.

SECTION 01782 – OPERATION AND MAINTENANCE DATA

Applicable equipment item numbers, as shown in the Contract Documents, shall be prominently included at their appropriate location in the index. The title of the manual shall be securely affixed to the binder in two places: the front cover and the binder back edge. The title shall identify the Project by number and name, state the volume is an O&M manual, generally classify the equipment and state the manufacturer's name, equipment model number and equipment identification number.

- a. Covers shall permit easy removal of pages and shall be of the three-post, metal-hinged, self-expanding type and shall not be overfilled. Covers shall be oil, moisture and wear resistant and approximately 9 by 12 inches in size.
 - b. Page size shall be 8-1/2 by 11 inches; paper shall be 60 pound and holes reinforced with plastic cloth or metal.
 - c. Drawings, diagrams and illustrations shall be attached foldouts up to 11 by 17 inches in size; larger sizes shall be inserted in 3 hole punched clear plastic envelopes marked as to contents.
3. Contractor's submittal to the Engineer for approval shall consist of three complete sets of each operation and maintenance manual and two copies of an itemized listing providing cross-reference identification between the Specification Sections of the Contract Documents, the approved Shop Drawings, and the operations and maintenance manual submittal. One copy of the manual and itemized listing will be returned to the Contractor stamped either "Approved" or "Disapproved", the latter when the Manual submittal is considered inadequate, inaccurate or lacking essential information. Discrepancies will be noted on the return itemized listing of a "Disapproved" submittal. Rectify all unapproved submittals by replacing submitted portions or adding additional data, as required, to the manual. The manual's index of contents and the itemized, cross-referenced listing shall be revised to reflect all revisions or additions made. Then two copies of the entire package shall be resubmitted to the Engineer for approval.
 4. Upon approval of the operation and maintenance manuals, submit ten printed copies of the manual and the itemized listing to the County and a searchable .pdf on a USB flash drive.

1.05 MAINTENANCE AND LUBRICATION SCHEDULES

- A. For all items of equipment furnished, provide a list including the equipment name, and address and telephone number of the manufacturer's representative and service company so that service and/or spare parts can be readily obtained. In addition, a maintenance and lubrication schedule for each piece of equipment shall be submitted with the Shop Drawings. Submission shall be in fifteen copies. The schedules shall be in the form indicated below.

SAMPLE MAINTENANCE SCHEDULE

ITEM	ACTION	FREQUENCY	REMARKS
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SAMPLE LUBRICATION SCHEDULE:

ITEM	MANUFACTURER'S RECOMMENDATIONS	TYPE LUBRICANT	QUANTITY PER TANK	FREQUENCY
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1.06 EQUIPMENT START-UP SERVICES

- A. Equipment start-up period, shall begin after satisfactory completion and acceptance of the field tests described in Section 01660 and shall end before the certified date of substantial completion for the part of the Work for which the equipment is included. If the equipment is not covered by a certificate of substantial completion for a part of the Work, the period shall begin upon substantial completion of the Project.

SECTION 01782 – OPERATION AND MAINTENANCE DATA

- B. During the equipment start-up period furnish, at no additional cost to the Owner, the services of factory-trained representatives of the equipment manufacturers for the equipment designated in the Specifications to:
 - 1. Assist in the start-up and operations of the equipment.
 - 2. Conduct training of plant personnel in the proper operation and maintenance of the equipment.
- C. The Owner shall provide the necessary facility personnel for training in the operation and maintenance of the equipment during their regularly assigned work shifts.
- D. Pay for all chemicals consumed up to the date of "certified substantial completion", and in addition shall provide the quantities of fuel and chemicals specified in Section 01660, Quality Control.
- E. The Contractor shall be available to promptly repair all Work during the start-up period so as to cause minimum disruption to the total plant operation.
- F. Upon completion of a minimum of ten consecutive twenty-four hour days of satisfactory operation, or the number of days called for in the Technical Specifications, the Owner will assume operation and operating cost of the equipment. If the equipment malfunctions during this start-up period, the start-up period will be repeated until satisfactory operation is achieved.
- G. In the event a system, equipment or component proves defective or is unable to meet specified performance criteria, replace the defective item, and the minimum two years guarantee period, or the guarantee period called for in the Technical Specifications for the item, shall start after satisfactory replacement and testing of the item.

1.07 TRAINING

- A. General:
 - 1. Provide the services of manufacturers' factory trained specialists to instruct the Owners operation and maintenance personnel in recommended operation and corrective and preventive maintenance procedures for equipment as specified in the respective equipment Section and outlined in the attached schedule at the end of this Section. Training shall be scheduled prior to start-up of the equipment.
 - 2. The qualifications of the specialists shall be subject to approval by the Owner's representative.
 - 3. Coordinate these services at times acceptable to the Owner, with a minimum of 14 days prior notice, after an approval of the Lesson Plan.
 - 4. Manufacturer shall provide a combination of classroom, equipment site, and machine shop training. All training shall be conducted at the work site unless otherwise specified.
 - 5. Provide the minimum training for each piece of equipment as specified in the attached schedule.
 - 6. The Owner reserves the right to videotape any and all manufacturer training sessions.
- B. Submittals:
 - 1. Submit for approval manufacturer's proposed Lesson Plans for the instruction prior to scheduling training. Lesson plans shall include operations, mechanical maintenance, and electrical and instrumentation maintenance as outlined in the attached schedule at the end of this section.
 - 2. Submit for approval credentials of the manufacturers' designated instructors with the Lesson Plan Submittals. Credentials shall include a brief resume and specific details of the instructor's experience with operation and maintenance of and training on the equipment specified.
- C. Instruction Lesson Plans:
 - 1. Proposed Lesson Plans shall include the elements presented in the Training Instruction Lesson Plans in Paragraph 1.7 C.4. and any other information necessary for proper operation and maintenance of the equipment. Specific components and procedures shall be identified in the proposed Lesson Plan.

SECTION 01782 – OPERATION AND MAINTENANCE DATA

2. Lesson Plans shall detail specific instruction topics. Training aids to be utilized including handouts, in the instruction shall be referenced and attached to the proposed Lesson Plan. "Hands-On" demonstrations planned for the instruction shall be described in the Lesson Plans.
3. Indicate the estimated duration of each segment of the training Lesson Plans and the training audience the instruction is to address.
4. Training Instruction Lesson Plans: Guide for Equipment Maintenance:
 - a. Maintenance Training:
 - 1) System Overview.
 - (a) Describe the function and performance objectives of the equipment or system.
 - (b) Describe the main features of the equipment or system.
 - (c) Identify all support system and related auxiliary equipment.
 - (d) Preventive Maintenance (PM):
 - (1) Define the recommended PM program and schedules for each system and equipment item.
 - (2) Describe PM procedures.
 - (3) Describe inspection and test procedures and use of test equipment, if applicable.
 - (4) Describe routine inspection procedures required to:
 - (5) Perform an inspection of equipment while it is operating.
 - (6) Identify symptoms of potential problems to anticipate breakdowns.
 - (7) Describe equipment housekeeping procedures.
 - (e) Equipment Troubleshooting:
 - (1) Define recommended systematic troubleshooting procedures.
 - (2) Provide component-specific troubleshooting check-lists.
 - (3) Describe applicable equipment testing and diagnostic procedures to facilitate troubleshooting.
 - (f) Equipment Corrective Maintenance:
 - (1) Describe recommended equipment preparation requirements.
 - (2) Identify and describe the use of any special tools required for maintenance of the equipment.
 - (3) Describe component removal/installation and disassembly/assembly procedures.
 - (4) Perform at least two "hands-on" demonstrations of common corrective maintenance repairs.
 - (5) Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.
 - (6) Define recommended torquing, mounting, calibration and/or alignment procedures and settings, as appropriate.
 - (7) Describe recommended procedures to check/test equipment following a corrective repair.
 - b. Operations Training:
 - 1) System Overview:
 - (a) Describe the function and performance objective of the equipment or system.
 - (b) Describe the main features of the equipment or system.
 - (c) Identify all support systems and related auxiliary equipment.
 - (d) Operation:
 - (1) Describe operating principles and practices.
 - (2) Describe routine operating, start-up and shutdown procedures.
 - (3) Describe alarm conditions and response to alarms. Identify safety features and control interlocks.

SECTION 01782 – OPERATION AND MAINTENANCE DATA

(4) Describe routine monitoring and record keeping procedures.

- D. Responsibilities: Manufacturer's Instructors shall be fully prepared for the training sessions. Training delivery shall be communicative, clear and proceed according to the approved lesson plan material covered shall be appropriate for the personnel in attendance. If training delivery is found by the Owner or Engineer to be not to Standards or requirements, the training shall be postponed and rescheduled at a cost to be borne by the Contractor.
- E. Training Schedule and Operation & Maintenance Manuals: In order to provide the Owner with adequate time requirements for manufacturer's training, minimum training times for various pieces of equipment and systems are listed on the attached schedule.

Training Schedule Specification Section	Description of Equipment	Minimum Training Time
11316	Variable Speed Pumps	4-hours
11317	Constant Speed Pumps	4-hours
11330	Sewage Grinder	4-hours
13420	Magnetic Type Flow Meters	2-hours
13420	Paperless Chart Recorders	2-hours
13420	Pressure Liquid Level Sensors	2-hours
13420	Liquid Level Float Switches	2-hours
15100	Valves	2-hours for each type of valve
15546	Electric Unit Heaters	2-hours
15832	Exhaust Fans	2-hours
16620	Stand-by Generator	1-day each site

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section specifies the Contractor's responsibilities in the commissioning process. Commissioning requires the participation of the Contractor to ensure that all systems are operating in a manner consistent with the Contract Documents.
- B. The commissioning process integrates the traditionally separate functions of system documentation, equipment startup, performance testing and training. Commissioning during the construction phase is intended to achieve the following specific objectives in accordance with the Contract Documents:
 - 1. Verify and document that applicable equipment and systems are installed according to the manufacturer's recommendations, contract requirements, and industry standards, and that they receive adequate operational checkout by installing contractors.
 - 2. Verify and document proper performance of equipment and systems.
 - 3. Verify and document that O&M documentation is complete.
 - 4. Verify and document that Owner personnel are properly trained.
- C. The systems and equipment to be commissioned are listed in this Section. The Contractor's general commissioning requirements and coordination are detailed in this Section. Specific requirements for commissioning of each system or piece of equipment are detailed in the specification Section for the individual systems or pieces of equipment. A detailed description of the overall commissioning process is included in the Schedule.
- D. The commissioning process does not reduce the responsibility of the Contractor to provide finished and fully functional systems and equipment.

1.02 SYSTEMS TO BE COMMISSIONED

- A. The following systems will be commissioned in this project. Specific requirements for the commissioning of each system are included in the related specification Section.
 - 1. Ventilation Systems
 - 2. Unit Heaters
 - 3. Gate Valves
 - 4. Check Valves
 - 5. Pumps
 - 6. Lighting Fixtures
 - 7. Pump Motor Starters
 - 8. Engine-Generator System
 - 9. Transfer Switch
 - 10. Fuel tanks and tank alarm system
- B. Example Commissioning Documents: Equipment and system specific Pre-Functional Checklists and Functional Test procedures will be developed by the Commissioning Authority based on approved submittals, and then will be provided to the Contractors.

1.03 DEFINITIONS

- A. Acceptance Phase: Phase of construction after startup and initial checkout when functional performance tests, O&M documentation review and training occurs.
- B. Approval: Acceptance that a piece of equipment or system has been properly installed and is functioning in the tested modes in accordance with the Contract Documents.
- C. Commissioning Plan: An overall plan that provides the structure, schedule and coordination planning for the commissioning process.
- D. Commissioning Team: The members of the commissioning team consist of the Owner's representative (s), the Contractor, the architect/engineer.

SECTION 01812 – COMMISSIONING SUMMARY

- E. Deferred Functional Tests: Functional tests that are performed after substantial completion, due to partial occupancy, seasonal requirements, design or other site conditions that prevent the test from being performed prior to substantial completion.
- F. Deficiency: A condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents.
- G. Factory Testing: Testing of equipment on-site or at the factory by factory personnel.
- H. Functional Performance Test (FT): Test of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems (rather than just components) under full operation. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The Contractor develops the functional test procedures in sequential written form. The Owner's representative coordinates, oversees and documents the actual testing. The Contractor performs the functional tests. FTs are performed after prefunctional checklists and startup is complete.
- I. Phased Commissioning: Commissioning that is completed in phases (by floors, for example) due to the size of the structure or other scheduling issues, in order to minimize the total construction time. Commissioning shall be provided for each phase according to the schedule for that phase. Some repetition and/or remobilization may be required.
- J. Prefunctional Checklist (PC): A list of items to inspect and component tests to conduct to verify proper installation of equipment prior to initiating functional testing.
- K. Startup: The initial starting or activating of dynamic equipment, including executing prefunctional checklists.

1.04 COORDINATION

- A. All members of the commissioning team shall work together to fulfill their contractual responsibilities and meet the objectives of the Contract Documents.
- B. Integrate all commissioning activities into the approved progress schedule. All parties will address scheduling problems and make necessary notifications and changes in a timely manner in order to expedite the commissioning process and maintain the approved progress schedule.

1.05 COMMISSIONING PROCESS

- A. Commissioning Plan. The commissioning plan provides guidance in the execution of the commissioning process. Following the initial commissioning scoping meeting the Owner's representative will update the plan which is then considered the "final" plan, although it may be revised as the project progresses.
- B. Commissioning Process. The following narrative provides a brief overview of the typical commissioning tasks during construction and the general order in which they occur. A more detailed description of the commissioning process can be found in the Appendix.
 - 1. Commissioning during construction begins with a scoping meeting conducted by the Owner's representative where the commissioning process is reviewed with the Commissioning Team.
 - 2. Additional meetings will be required throughout construction, scheduled by the Owner's Representative, to plan, scope, coordinate, and schedule future activities and to resolve problems. When possible, commissioning meetings will be scheduled immediately following construction meetings.
 - 3. Equipment documentation is submitted to the Engineer during the submittal process, including detailed start-up procedures.
 - 4. The Owner's representative works with the Contractor to develop startup activity lists and startup documentation. The Owner's representative provides pre-functional checklists to be completed by the Contractor during the startup process.

SECTION 01812 – COMMISSIONING SUMMARY

5. In general, the checkout and performance verification proceeds from simple to complex; from component level to equipment to systems and intersystem levels. In each case prefunctional checklists are completed, submitted, and approved before functional testing begins.
6. The Contractor executes and documents the prefunctional checklists, and provides notification to the Owner's Representative. The Contractor performs startup and initial checkout. The Owner's representative documents that the checklists and startup were completed according to the approved plans.
7. The equipment manufacturer develops specific equipment and system functional performance test procedures. The Contractor reviews the procedures and submits suggestions or comments. Procedures are finalized by the Owner's representative.
8. The procedures are executed by the Contractor.
9. Items of non-compliance in material, workmanship, or setup are corrected and retested at the Contractor's expense. The Contractor is responsible for providing all resources, manpower, and materials necessary to rectify deficiencies as per requirements of the approved schedule.
10. The O&M documentation prepared by the Contractor is reviewed for completeness by the Owner's representative.
11. Commissioning is completed before Substantial Completion.
12. The Owner's representative reviews, pre-approves and coordinates the training provided by the Contractor and verifies that it was completed.
13. Deferred testing is conducted, as specified or required.

1.06 CONTRACTOR'S RESPONSIBILITIES

- A. The Contractor's commissioning responsibilities are as follows (all references apply to commissioned systems and equipment only):
 1. Construction and Acceptance Phase:
 - a. Attend the commissioning scoping meeting and other necessary meetings scheduled by the Owner's Representative to facilitate the commissioning process.
 - b. Facilitate the coordination of the commissioning work by the Owner's representative, and with the Owner's representative ensure that commissioning activities are being scheduled into the approved progress schedule.
 - c. Provide detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, factory test reports, and full warranty information, including all responsibilities of the Director to keep the warranty in force. The installation, start-up and checkout materials that are actually shipped with the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Owner's representative. The Owner's representative may request further documentation necessary for the commissioning process.
 - d. In each purchase order or subcontract written, include requirements for submittal data, O&M data, commissioning tasks and training.
 - e. Ensure that all subcontractors execute their commissioning responsibilities according to the Contract Documents and approved progress schedule.
 - f. Assist in the process of writing detailed test procedures by clarifying the operation and control of commissioned equipment.
 - g. Review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.
 - h. Develop a full start-up and testing plan using manufacturer's start-up procedures and the prefunctional checklists from the Owner's representative for all commissioned equipment. Submit to the Owner's representative for review and approval prior to startup.
 - i. During the startup and initial checkout process, execute all portions of the prefunctional checklists for all commissioned systems and equipment. Verify that

SECTION 01812 – COMMISSIONING SUMMARY

system installations include all ports, gages, thermometers, access doors, valves, etc., required for specified functional performance testing.

- j. Provide all special tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment.
- k. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the Owner's representative.
- l. Address incomplete Work before functional performance testing.
- m. Provide skilled technicians to execute startup of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
- n. Provide skilled technicians to perform functional performance testing under the direction of the Owner's representative for specified equipment. Provide Manufacturer's Representative as required and as specified in the Specification. Assist the Owner's representative in interpreting the monitoring data, as necessary.
- o. Correct deficiencies (differences between specified and observed performance) as directed by the Owner's Representative.
- p. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions. Provide a copy of the O&M manuals and submittals of commissioned equipment to the Owner's representative for review and approval.
- q. Provide training as specified.
- r. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

2. Warranty Period

- a. Execute seasonal or deferred functional performance testing in accordance with the specifications
- b. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

PART 2 - PRODUCTS

2.01 TEST EQUIPMENT

- A. All standard testing equipment required to perform startup and initial checkout and required functional performance testing shall be provided by the Contractor.
- B. Specified special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment shall be provided by the Contractor, and turned over to the Owner at the completion of the Work.
- C. Datalogging equipment and software required to test equipment shall be provided by the Contractor, but shall not become the property of the Owner.
- D. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. All equipment shall be calibrated according to the manufacturer's recommended intervals. Calibration tags shall be affixed or certificates readily available.

PART 3 - EXECUTION

3.01 MEETINGS

- A. Scoping Meeting. Prior to the commencement of construction, the Owner's representative will schedule, plan and conduct a commissioning scoping meeting with the Commissioning Team.
- B. Miscellaneous Meetings. Other meetings will be planned and conducted by the Owner's representative as construction progresses. These meetings will cover coordination, deficiency resolution and planning issues with the Contractor, appropriate sub-contractors and suppliers and the Engineer.

3.02 START-UP, PREFUNCTIONAL CHECKLISTS, AND INITIAL CHECKOUT

- A. Prefunctional checklists and initial checkout shall ensure that the equipment and systems are hooked up and operational. Each piece of equipment receives full prefunctional checkout. No sampling strategies are used. The prefunctional testing for a given system must be successfully completed prior to formal functional performance testing of systems or equipment.
- B. Start-up and Initial Checkout Plan. The Engineer shall assist the commissioning team members responsible for startup of any equipment in reviewing detailed start-up plans for all equipment. The primary role of the Engineer in this process is to ensure that there is written documentation that each of the manufacturer's recommended procedures have been completed.
- C. Execution of Prefunctional Checklists and Startup.
 - 1. Four weeks prior to startup, the Contractor shall schedule startup and checkout with the Owner's Representative.
 - 2. The Contractor shall execute startup and provide the Engineer with a signed and dated copy of the completed start-up and prefunctional tests and checklists.

3.03 FUNCTIONAL PERFORMANCE TESTING

- A. Development of Test Procedures. Using the requirements in the specifications, develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Prior to testing, provide a copy of the test procedures to the Engineer who shall review the tests for feasibility, safety, equipment and warranty protection.
- B. Functional performance testing shall document that each system is operating in accordance with the Contract Documents. During the testing process, areas of deficient performance shall be identified. Deficiencies shall be corrected by the Contractor and functional testing shall be re-scheduled. The Contractor shall be responsible for all costs associated with re-testing for functional performance.
- C. Each system shall be operated through all modes of operation. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested.
- D. Test Methods. Each function and test shall be performed under conditions that simulate actual conditions as closely as possible. The Contractor shall execute the test and shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At the completion of the test, the Contractor shall return all building equipment and systems affected by these temporary modifications to their pre-test condition.

3.04 OPERATION AND MAINTENANCE MANUALS

- A. Standard O&M Manuals. The specific content and format requirements for the standard O&M manuals are detailed in Section 01782.
- B. Compile and prepare commissioning documentation for all equipment and systems and include this information in the O&M manuals.

3.05 TRAINING

- A. Coordinate, schedule, and document that all required training has been completed successfully.
- B. The Contractor shall have the following training responsibilities:
 - 1. Provide a training plan two weeks before the planned training.
 - 2. Provide comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of equipment.
 - 3. Training shall normally start with classroom sessions followed by hands-on training on each piece of equipment.
 - 4. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.

SECTION 01812 – COMMISSIONING SUMMARY

5. Training shall include:
 - a. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.
 - b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, and any emergency procedures.
 - c. Discussion of relevant health and safety issues and concerns.
 - d. Discussion of warranties and guarantees.
 - e. Common troubleshooting problems and solutions.
 - f. Explanatory information included in the O&M manuals and the location of all plans and manuals in the facility.
 - g. Discussion of any peculiarities of equipment installation or operation.

3.06 DEFERRED TESTING

- A. Unforeseen Deferred Tests. If any check or test cannot be completed due to project conditions, required occupancy condition or other deficiency, execution of checklists and functional testing may be delayed upon approval of the Owner's Representative. These tests will be conducted in the same manner as the seasonal tests as soon as possible.
- B. Seasonal Testing. Seasonal testing (tests delayed until weather conditions are closer to the system's design conditions) shall be completed as part of this Contract. Make any final adjustments to the O&M manuals and as-builts resulting from information gained during testing.

3.07 SCHEDULE

- A. Conduct a test of the facility with transfer from normal power to standby power and transfer from standby power to normal power. The duration of the test under standby power shall be 2 hours.
- B. Test the function of all loads on emergency power.
- C. Verify building ventilation fan turns off when generator is running.
- D. Verify intake and exhaust louvers open and close based on generator operation.
- E. Verify intake and exhaust louvers open and close based on ventilator operation.
- F. Turn off lead pump in each wet well to demonstrate operation of lag pump.
- G. Turn off lead and lag pumps in each wet well to demonstrate operation of high water and high-high water level alarms at pump panel and to alarm system.
- H. Manually pump down wet well level to demonstrate operation of low-level alarm at pump panel and to alarm system.
- I. Demonstrate operation of spare wastewater pump.
- J. Conduct 5-day test to demonstrate operation of entire pump station.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope:
1. Provide all labor, materials, equipment and incidentals as shown, specified, and required to complete the Work of demolition, removal, and disposal. Included are all modifications to existing facilities as shown and required to complete the Work.
 2. Included, but not limited to, are the demolition, removal, and disposal of existing structures, removal and disposal portions of any existing equipment including piping not required for the operation of the plant as indicated on the Drawings and as specified hereinafter.
 3. Furnish all labor, materials and equipment to demolish portions of structures and to remove anchors, supports, piping, equipment and accessories designated to be removed on the Drawings.
 4. The removal of all equipment, piping, and all other materials from the demolition of structures shall, when released by the Engineer, be done by the Contractor for the materials removed by him and shall become Contractor's property, unless otherwise noted. The debris shall be disposed of off-site in a manner not contrary to the Contract requirements.
- B. Related Sections:
1. Section 02200, Earthwork.

1.02 SUBMITTALS

- A. Schedule: Submit for approval the following:
1. Submit a detailed description of methods and equipment and sequence for demolition and removal for the Engineer's review.

1.03 PROTECTION

- A. General:
1. Demolition and removal Work shall be performed by competent workmen experienced in the various types of demolition and removal Work required, and shall be carried through to completion with due regard to the safety of the Owner's employees, workmen on the Site and the public. The Work shall be performed with as little nuisance as possible.
 2. The Work shall comply with the applicable provisions and recommendation of ANSI A10.2, Safety Code for Building Construction, and all governing codes and as hereinafter specified.
 3. Make such investigations, explorations and probes necessary to ascertain any required protective measures before proceeding with demolition and removal.
 4. Provide interior and exterior shoring, bracing and support to prevent movement, settlement, or collapse of existing structures or facilities. The Owner assumes no responsibility for the actual condition of the structures or facilities adjacent to the Work or the structures or facilities designated for removal or modification.
 5. Do not bring explosives on site. No explosives will be permitted for this Project.
- B. Execution:
1. Provide, erect and maintain catch platforms, lights, barriers, weather protection, warning signs and other items as required for proper protection of the public, occupants of the building, workmen engaged in demolition operations, and adjacent construction.
 2. Provide and maintain weather protection at exterior openings so as to fully protect the interior premises against damage from the elements until such openings are closed by new construction.
 3. Provide and maintain temporary protection of the existing structure designated to remain where demolition, removal and new Work is being done, connections made, materials handled or equipment moved.
 4. Take necessary precautions to prevent dust from rising by wetting demolished masonry, concrete, plaster and similar debris. Unaltered portions of the existing buildings affected

SECTION 02050 – DEMOLITION, REMOVALS, AND MODIFICATIONS

- by the operations under this Section shall be protected by dustproof partitions and other adequate means.
5. Provide adequate fire protection in accordance with local Fire Department requirements.
 6. Do not close or obstruct walkways, passageways, or stairways and do not store or place materials in passageways, stairs or other means of egress. Conduct operations with minimum traffic interference.
 7. The Contractor shall be responsible for any damage to the existing structure or contents by reason of the insufficiency of protection provided.
 8. Carry out operations to avoid interference with operations and work in the existing facilities and the work under other contracts.
 9. The Contractor shall be solely responsible for making all necessary arrangements and for performing all necessary work involving the discontinuance or interruption of all utilities or services.
- C. Any equipment, piping and appurtenances removed without proper authorization, which are necessary for the operation of the existing plant or of the plant expansion, shall immediately be replaced to the satisfaction of the Engineer at no cost to the Owner.
- D. Notification:
- E. At least 48 hours prior to commencement of demolition or removal, notify the Engineer in writing of his proposed schedule therefor. The Owner shall inspect the existing equipment and (review with the Contractor) those items that are to remain the property of the Owner. No removals shall be started without the permission of the Engineer.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 GENERAL

- A. The Work required shall be done with care, and shall include all required shoring, bracing, etc. The Contractor shall be responsible for any damage which may be caused by demolition and removal Work to any part or parts of existing structures or items designated for reuse or to remain. Perform patching, restoration and new Work in accordance with applicable technical sections of the Specifications and in accordance with the details shown on the Drawings.
- B. Surfaces of walls, or other areas which are exposed by any of the removals specified herein, and which will remain as architecturally finished surfaces, which have holes, scars, chipped or other damaged surfaces revealed by the removal shall be repaired by the Contractor with the same or matching materials as the existing surface or as may be otherwise approved by the Engineer.
- C. Pollution Controls: Use water sprinkling, temporary enclosures, and other suitable methods to limit the amount of dust and dirt rising and scattering in the air to the lowest practical level. Comply with governing regulations pertaining to environmental protection.
1. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.
 2. Clean adjacent structures, facilities, and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to conditions existing prior to the start of the Work.
- D. Remove supports, pedestals and anchors with the equipment and piping unless otherwise specified or required. The concrete bases, anchor bolts and other supports shall be removed to approximately one inch below the surrounding finished area and the recesses shall be patched to match the adjacent areas. The superstructure wall and roof openings shall be closed, and damaged surfaces shall be patched to match the adjacent areas, as specified under applicable sections of the Specifications, as shown on the Drawings, or as directed by the Engineer. Wall sleeves and castings shall be plugged or blanked off, all openings in concrete shall be closed in a manner meeting the requirements of the appropriate sections of the Specifications, as shown on the Drawings and as directed and approved by the Engineer.
- E. Deposition of Materials and Equipment:

SECTION 02050 – DEMOLITION, REMOVALS, AND MODIFICATIONS

1. Dispose of all demolition materials, equipment, debris, and all other items not marked by the Owner to remain as property of the Owner, off the site and in conformance with all existing applicable laws and regulations.
- F. Wherever piping is to be removed for disposition, the piping shall be drained by the Contractor and adjacent pipe and headers that are to remain in service shall be blanked off or plugged and then anchored in an approved manner.
- G. Where alterations occur, or new and old Work join in, cut, remove, patch, repair or refinish the adjacent surfaces to the extent required by the construction conditions, so as to leave the altered Work in as good a condition as existed prior to the start of the Work. The materials and workmanship employed in the alterations, unless otherwise shown on the Drawings or specified, shall comply with that of the various respective trades, which normally perform the particular items of work.
- H. Remove temporary work, such as enclosures, signs, guards, and the like when such temporary work is no longer required or when directed at the completion of the Work.

3.02 STRUCTURAL REMOVALS

- A. Remove concrete and structures to the lines and grades shown unless otherwise directed by the Engineer. Where no limits are shown, the limits shall be 4 inches outside the item to be installed.
- B. Determine the thickness of existing concrete to be removed and the extent to which it is reinforced. No additional compensation will be made because of variations from the thickness shown or for variations in the amount of reinforcement.
- C. All concrete, concrete block, reinforcement, structural or miscellaneous metals, plaster, wire mesh and other items contained in or upon the structure shall be removed and taken from the site, unless otherwise approved by the Engineer. Demolished items shall not be used in backfill.
- D. After removal of parts or all of slabs and like work which tie into new Work or existing work, the point of junction shall be neatly repaired so as to leave only finished edges and finished surfaces exposed.
- E. Where new anchoring materials including bolts, nuts, hangers, welds and reinforcing steel are required to be attached to new Work to the existing work, they shall be included under this Section, except where specified elsewhere.

3.03 PAVEMENT, CURB AND SIDEWALK REMOVALS

- A. Remove existing pavement, including bases and surface courses, stabilized sub-bases, curbs, and gutters as required to construct new facilities or as shown. Before removing, saw a straight joint at least 1-1/2-inches deep between sidewalk and pavement designated for removal and that left in place. Remove curbs and gutters to the nearest construction joint beyond the end of demolition symbol shown on the Drawings.
- B. Determine the thickness of existing pavement, base, sub-base, curb, gutter, driveway pavement, and sidewalk to be removed, and the extent to which they are reinforced. No additional compensation will be made because of variations from the assumed thickness or from the thickness shown or for variations in the amount of reinforcement.
- C. Provide for satisfactory transition between replaced pavement and sidewalks and the portions remaining in place.

3.04 MECHANICAL REMOVALS

- A. Equipment removals shall consist of dismantling and removing of existing piping, equipment, and other appurtenances as specified, shown, or required for the completion of the Work. It shall include cutting, capping, draining, and plugging as required, except that the cutting of existing piping for the purpose of making connections thereto will be included under Division 15.

SECTION 02050 – DEMOLITION, REMOVALS, AND MODIFICATIONS

- B. When underground piping is to be altered or removed, properly cap the remaining piping. Abandoned underground piping may be left in place unless it interferes with new Work or is shown or specified to be removed.
- C. Any demolition or changes to potable water piping and other plumbing and heating system work shall be made in conformance with all applicable codes. Portions of the potable water system that may have been altered or opened shall be pressure tested and disinfected in accordance with Division 15 and local codes. Other plumbing piping and heating piping shall be pressure tested only.
- D. Provide all caps, plugs, blind flanges, shut-off valves and other work and materials required to remove from service existing piping and necessary to keep existing piping in service where shown or required.

3.05 MISCELLANEOUS REMOVALS

- A. Remove miscellaneous concrete walls, slabs, pipe supports, and curbs where shown on the Drawings or where necessary for the construction of new structures or modification of existing structures.

3.06 MODIFICATIONS AND CLOSURES

- A. Modifications shall conform to all applicable Specifications, the Drawings, and the directions and approvals of the Engineer.
- B. Where alterations require cutting or drilling into existing floors and walls the holes shall be repaired in an approved manner. Repair such openings with the same or matching materials as the existing floor, wall, or roof or as otherwise approved by the Engineer. All repairs shall be smoothly finished unless otherwise approved by the Engineer.
- C. Where parts of existing structures are to remain in service, demolish the portions to be removed, repair damage, and leave the structure in proper condition for the intended use. Remove concrete and masonry to the lines designated by drilling, chipping, and other suitable methods. Leave the resulting surfaces true and even, with sharp straight corners that will result in neat joints with new construction or be satisfactory for the purpose intended. Where existing reinforcing rods are to extend into new construction, remove the concrete so that the reinforcing is clean and undamaged. Cut off other reinforcing flush with the surface.
- D. New Work shall be keyed into the existing in an acceptable manner. New reinforcing steel shall be welded to the existing reinforcing. Welding shall conform to AWS D12.1, Reinforcing Steel Welding Code. In general, the same or matching materials as the existing adjacent surface shall be used. The finished closure shall be a smooth, tight, sealed, permanent closure with all exposed surfaces smooth finished and acceptable to the Engineer.

3.07 TITLE TO EQUIPMENT AND MATERIALS

- A. The Contractor shall have no right or title to any of the equipment, materials or other items to be removed from the existing buildings or structures unless and until said equipment, materials and other items have been removed from the premises. The Contractor shall not sell or assign, or attempt to sell or assign any interest in the said equipment, materials or other items until the said equipment, materials or other items have been removed.
- B. The Contractor shall have no claim against the Owner because of the absence of such fixtures and materials.

3.08 CONDITION OF BUILDINGS, STRUCTURES AND EQUIPMENT

- A. The Owner does not assume responsibility for the actual condition of buildings, structures and equipment to be demolished and removed.
- B. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner so far as practicable.
- C. The information regarding the existing structures and equipment shown on the Drawings is based on visual inspection and a walk-through survey only. Neither the Engineer nor the Owner will be responsible for interpretations or conclusions drawn therefrom by the Contractor.

SECTION 02050 – DEMOLITION, REMOVALS, AND MODIFICATIONS

3.09 MAINTENANCE AND CLEAN UP

- A. Maintain the buildings, structures and public properties free from accumulations of waste, debris and rubbish, caused by the demolition and removal operations.
- B. Provide on-site dump containers for collection of recyclables, waste materials, debris and rubbish, and wet down dry materials to lay down and prevent blowing dust.
- C. At least once a week during the progress of the demolition and removal Work or as directed by the Engineer, clean the Site and properties (including sweeping roadways with a mechanical sweeper), and dispose of waste materials, debris and rubbish.

END OF SECTION

SECTION 02050 – DEMOLITION, REMOVALS, AND MODIFICATIONS

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SECTION 02110 – CLEARING

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Scope:
 - 1. Provide all labor, materials, equipment, and incidentals required to perform clearing and grubbing as shown and specified in the Contract Documents.
 - 2. The Work includes removing from the Site and disposing of trees, stumps, brush, roots, shrubs, vegetation, logs, rubbish, and other objectionable material.
 - 3. Pay all costs associated with transporting and disposing of debris resulting from clearing.
 - 4. Limits of Clearing and Grubbing: Clear and grub the areas shown or indicated on the Drawings.

1.02 SUBMITTALS

- A. Action Submittals: Submit the following
 - 1. Shop Drawings:
 - a. Plan for removing trees and other large vegetation not explicitly shown or indicated for removal in the Contract Documents.
 - b. Plan showing proposed limits of clearing and grubbing, if different from clearing and grubbing limits shown or indicated in the Contract Documents.

1.03 WARRANTY

- A. Contractor shall warrant that Work performed under this Section will not permanently damage trees, shrubs, turf, and plants designated to remain, or other adjacent work, facilities, or property. If damage resulting from Contractor's operations becomes evident during the correction period, Contractor shall replace damaged items and property at no additional cost to Owner.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 PREPARATION

- A. Protection:
 - 1. Throughout the Project, protect existing site improvements, including streets, drives, and Underground Facilities to remain (if any), and adjacent property and structures. Repair damage caused by Contractor to original condition or replace in kind, to satisfaction of Engineer, at no additional cost to Owner.
 - 2. Protect trees, shrubs, vegetation, and grassed areas to remain by providing temporary fencing, barricades, wrapping, or other methods shown, specified, or accepted by Engineer. Correct at Contractor's expense damage caused by Contractor outside the limits of clearing Work.
 - 3. Do not remove trees without approval of Engineer, unless shown or indicated for removal.
 - 4. Do not locate construction equipment, stored materials, or stockpiles within drip line of trees and vegetation to remain.
- B. Site Preparation:
 - 1. Obtain, pay costs associated with, and comply with applicable permits required for clearing and grubbing Work.
 - 2. Delineation of Clearing and Grubbing Limits:
 - a. Locate and clearly flag trees and vegetation to remain, and other materials to remain in the clearing and grubbing limits. Locate and clearly flag salvable vegetation to be relocated.
 - b. Provide flagging to delineate limits of areas to be cleared or grubbed. Review at Site with Engineer before commencing removal of trees, vegetation, and other materials to be removed.
 - c. Replace flagging that is lost, removed, or destroyed, until clearing and grubbing Work is complete, and Engineer allows removal of flagging.
 - 3. Erosion and Sediment Controls:

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- a. Provide applicable erosion and sediment controls before commencing clearing and grubbing Work.
- b. Continue providing erosion and sediment controls as clearing and grubbing Work progresses to previously uncleared, ungrubbed areas of the Site.

3.02 CLEARING AND GRUBBING

- A. Remove and dispose of all trees, shrubs, stumps, roots, brush, logs, rubbish, and debris within limits of clearing and grubbing shown or indicated in the Contract Documents, unless otherwise shown or indicated.
- B. Trees and Shrubs Improperly Destroyed or Damaged:
 1. For each tree or shrub to remain that is destroyed or damaged beyond repair by Contractor, provide replacement of the same species at locations to be designated by Engineer.
- C. Trees and shrubs to remain that have been damaged or require trimming shall be treated and repaired. Trees and shrubs intended to remain, that are damaged beyond repair or that are removed, shall be replaced by Contractor at no additional cost to Owner.
- D. Disposal of Cleared and Grubbed Materials:
 1. Dispose at appropriate off-Site location trees, stumps, rubbish, debris, and other cleared and grubbed material. Cleared or grubbed materials may remain at the Site only when allowed in the Contract Documents or when approved by Engineer in writing. Do not use cleared or grubbed material as fill, backfill, or in embankments.
 2. Dispose of cleared and grubbed material in accordance with all Laws and Regulations.
 3. Do not burn clearing debris at the Site, unless approved by Owner and authorities having jurisdiction. If burning is permitted, comply with requirements of authorities having jurisdiction and Laws and Regulations. If burning is permitted at the Site, also comply with Owner's requirements.
- E. Removal of Site Improvements: Comply with Section 02050, Demolition, Removals and Modifications.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope:
 - 1. Perform all excavating, backfilling and dis-posing of earth materials as shown, specified, and required for the purpose of site preparation, erosion control, surface drainage, constructing pipelines, concrete work, installation and removal of sheeting and bracings, grading, and other facilities.
 - 2. Also included is earthwork necessary for repair and replace-ment of roads, walks, pavements, grading, structures and other facili-ties as required to complete the Work as shown and specified. All materials necessary for fill, backfill, granular embedment and crushed stone are included.
 - 3. This Section also includes providing all backfill materials, including select fill, common fill, granular embedment, topsoil, crushed stone, and the satisfactory disposal of surplus and unacceptable materials.
 - 4. All necessary preparation of subgrade is included.
 - 5. All temporary means needed to prevent discharge of sediment to water courses from dewatering systems or erosion are included.
- B. Sources of Materials:
 - 1. General fill materials shall be obtained from on-site excavation work.
 - 2. Select fill materials shall be obtained from on-site sources.
 - 3. Crushed stone materials shall be obtained from off-site sources.
 - 4. Topsoil, except for topsoil stripped from the Work areas that meets the requirements specified under Section 02485, shall be obtained from off-site sources.
- C. Related Sections:
 - 1. Section 02050, Demolition, Removals and Modifications.
 - 2. Section 02110, Clearing.
 - 3. Section 02529, Concrete Curbs, Gutters and Sidewalks
 - 4. Section 02510, Paving and Surfacing.
 - 5. Section 03300, Cast-In-Place Concrete.
 - 6. Section 15051, Buried Piping Installation.

1.02 QUALITY ASSURANCE

- A. Permits and Regulations:
 - 1. Perform excavation work in compliance with applic-able requirements of governing authorities having jurisdic-tion.
- B. Design Criteria:
 - 1. All steel work for sheeting, shoring, bracing and other related Work shall be in accordance with the provisions of the AISC "Specifica-tions for the Design, Fabrication and Erection of Structural Steel for Buildings," except that field welding will be permitted.
 - 2. The Contractor shall be wholly responsible for installing and operating the system used to accomplish the sheeting and bracing shown on the Drawings, or otherwise required.
- C. Reference Standards: Comply with applicable provisions and recommen-dations of the following except as otherwise shown or specified.
 - 1. ASTM A 36, Structural Steel.
 - 2. ASTM A 328, Steel Sheet Piling.
 - 3. ASTM D 698, Moisture-Density Relations of Soils, using 5.5 lb (2.5 kg) Rammer and 12-inch (304.8 mm) Drop.
 - 4. ASTM D 1556, Density of Soil in Place by the Sand-Cone Method.
 - 5. ASTM D 6913, PARTICLE-SIZE DISTRIBUTION OF SOILS USING SIEVE ANALYSIS.
- D. Tests:
 - 1. The Owner will make tests and determine acceptability of the fill or material as listed below.

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2. Required Tests:
 - a. Select Fill Samples: Gradation, ASTM D 6913.
 - b. Compacted Select Fill: Compaction, ASTM D 698 and ASTM D 1556.
 - 1) Testing laboratory will submit copies of the following reports directly to the Engineer with copy to the Contractor:
 - (a) Gradation tests on borrow material.
 - (b) Field density tests.
 - (c) Optimum moisture-maximum density curve for each soil used for backfill.

1.03 SUBMITTALS

- A. Prepare drawings for the following items:
 1. Sheeting and bracing, or other protective system(s).
 2. Dewatering system.
- B. Drawings shall be prepared by a Professional Engineer licensed in the State of New York and recognized as expert in the specialty involved. Drawings shall be submitted to Engineer for record purposes only. Calculations shall not be submitted. Drawing submittals will not be checked and will not imply approval by Engineer of the Work involved. Contractor shall be solely responsible for designing, installing, operating and maintaining whatever system is necessary to satisfactorily accomplish all necessary sheeting, bracing, protection, underpinning and dewatering.
- C. Shop Drawings: Submit the following:
 - a. Sheeting and bracing, or other protective system(s).
 - b. Dewatering system.Shop Drawings shall be prepared by a Registered Professional Engineer recognized as expert in the specialty involved. Also, submit for approval, calculations and all other pertinent information. Contractor, however, will be responsible for designing, installing, operating and maintaining the system(s) as required to satisfactorily accomplish all necessary sheeting, bracing, protection, and dewatering.
- D. Samples: Submit for approval the following:
 1. At least two weeks prior to the date of anticipated use, submit, to the Owner, for approval, a representative sample of all on-site and off-site material required. Notify the Owner in writing of the source of each sample.
- E. Manufacturer's Data: Submit for approval the following:
 1. Manufacturer's specifications, performance characteristics and operating instructions for the compaction equipment.

1.04 JOB CONDITIONS

- A. Site Information:
 1. Existing boring information, if available, is included in the Supplemental Information.
 2. Additional test borings and other exploratory operations may be made by the Contractor at no cost to the Owner.
- B. Existing Structures:
 1. Shown on the Drawings are certain utilities, surface and under-ground structures located on or adjacent to the Work. This information has been obtained from existing records. It is not guaranteed to be correct or complete and is shown for the convenience of the Contractor. The Contractor shall explore ahead of the required excavation to determine the exact location of all structures and utilities. Underground facilities shall be supported and protected from injury by the Contractor. If underground facilities are broken or injured, repair and restore immediately at no additional cost to the Owner.
 2. Prior to execution of the Work, check and verify governing dimensions and elevations. The Contractor and the Owner shall jointly survey the condition of adjoining structures. Photographs and records shall be made of any prior settlement or cracking of structures, pavements, and the like, that may become the subject of possible damage claims.

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3. Establish benchmarks on all existing structures and submit the benchmark elevations to the Owner. Monitor elevations prior to dewatering and installation of sheet piling, and continue daily monitoring during the dewatering period and until sheet piling is removed or until directed to do so by the Engineer. Retain the services of a Licensed Land Surveyor, registered in the State of New York, to perform the monitoring work. All data shall be recorded and furnished to the Engineer daily. Immediately stop work and notify the Owner if any changes in benchmark elevations, additional cracking, sagging or other noticeable damage occurs. Work shall not proceed until the Contractor has the approval of the Owner.
- C. Existing Utilities:
 1. Locate existing underground utilities in the areas of Work. If utilities are to remain in place, provide adequate means of protection during earthwork operations.
 2. Should uncharted or incorrectly charted piping or utilities be encountered during excavation, consult Owner in keeping respective services and facilities in operation. Repair damaged utilities to the satisfaction of the Engineer.
 3. Do not interrupt existing utilities serving facilities occupied and used by the Owner or others, except when permitted in writing by the Engineer and then only after acceptable temporary utility services have been provided.
 4. Demolish and completely remove existing underground utilities indicated to be removed. Coordinate with the Owner for shut-off of services if lines are active.
- D. Protection of Persons and Property:
 1. Barricade open excavations occurring as part of this Work and post with warning lights. The Contractor shall provide "Jersey" type concrete barriers with reflective tape. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
 2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, under-mining, washout and other hazards created by earthwork operations.
 3. Consult the Engineer and obtain his approval before removing, trimming, or disturbing trees, shrubs, plants, fences, rails, walks, structures or other facilities that are encountered on the line of the excavation.
 4. Structures, utilities, sidewalks, pavements and other facilities removed or disturbed shall be replaced to their original condition, unless otherwise shown, specified or directed.
- E. Dust Control: Conduct all operations and maintain the areas of his activities, including sweeping and sprinkling of roadways, so as to minimize creation and dispersion of dust. In addition, the Contractor shall be responsible for controlling dust caused by his operation of vehicles and equipment, clearing or for any reason whatever, in accordance with Article GC-25 of the General Conditions.
- F. Roadways and Walks: Excavated material and materials of construction shall be so deposited, and the Work shall be so conducted, as to leave open and free for pedestrian traffic all crosswalks, and for vehicular traffic a roadway not less than 10 feet in width. Hydrants, valves, and other facilities which may require access during construction shall be kept accessible for use. During the progress of the Work, maintain such crosswalks, sidewalks, and roadways in satisfactory condition and the Work shall at all times be conducted so as to cause a minimum of inconvenience to the Owner.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

- A. Select Fill: Place select fill where shown or specified below and around structures, pipelines, roads, tanks, walks and other work. Well-graded granular material or bank run gravel, free from organic matter. Not more than 80 percent by weight shall pass through a No. 40 sieve; not more than 10 percent by weight through a No. 200 sieve; and 100 percent shall pass a 3-inch square sieve.
- B. General Fill (Common Fill): Provide approved soil materials for back-fill and fill, free of organics, clay, rock or gravel larger than 3 inches in any dimension, debris, waste, frozen

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materials and other deleterious matter. No more than 30 percent by weight shall pass through a No. 200 sieve except for topsoils.

- C. Granular embedment: Crushed rock or pea gravel with not less than 95 percent passing a 1/2-inch sieve, not less than 95 percent retained on a No. 4 sieve and maximum 5 percent passing a No. 10 sieve.
- D. Crushed stone: Crushed rock conforming to the following gradation:

SIEVE SIZE	PERCENT RETAINED ON SIEVE
2 inch	0
1-1/2 inch	0-10
1 inch	30-65
3/4 inch	85-100
3/8 inch	95-100

2.02 SHEETING, SHORING, AND BRACING

- A. Wood Sheeting:
 - 1. Temporary Work: New or used timber meeting the requirements for Douglas Fir Dense Construction grade or Southern Pine No. 2 Dense S3.
 - 2. Permanent Work: New pressure treated (CCA).
- B. Steel Sheeting:
 - 1. Temporary Work: Steel conforming to ASTM A328. Steel for soldier piles, wales and braces may be new or used and shall conform to ASTM A36.
 - 2. Permanent Work: New or used rolled steel sections of the continuous inter-locking type, conforming to ASTM A328.
- C. Used materials shall be in good condition, capable of interlocking for entire length, not damaged or excessively pitted and acceptable to the Owner.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Provide the Engineer with sufficient time and means to examine the areas and conditions under which excavating, filling, and grading are to be performed. Work shall not proceed until all unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

3.02 SITE PREPARATION

- A. The portions of the site on which the Work is to be constructed shall be cleared of all objectionable materials and debris (see Section 02110, Clearing).

3.03 STRIPPING AND STORING OF TOPSOIL

- A. Topsoil is defined as friable clay loam surface soil found in a depth of not less than 6 inches. Topsoil shall be substantially free of subsoil, clay lumps, stones, and other objects over 2 inches in diameter, and without weeds, roots, and other objectionable material.
- B. Strip topsoil which is satisfactory to whatever depths are encountered, and in such manner as to prevent intermingling with the underlying subsoil or other objectionable material. Remove heavy growths of grass from areas before stripping. Where trees are shown or directed to be left standing, stop topsoil stripping a sufficient distance from such trees to prevent damage to the main root system.
- C. Stockpile topsoil in storage piles where approved by the Engineer. Construct storage piles to freely drain surface water. Cover storage piles to prevent windblown dust. Topsoil in excess of quantity required shall remain the property of the Owner. Stockpile and cover excess-stripped topsoil in an area approved by the Engineer.

3.04 EROSION CONTROL

- A. General:

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1. In general, the construction procedures outlined herein shall be implemented to ensure minimum damage to the environment during construction.
 2. Whenever possible, access and temporary roads shall be located and constructed to avoid environmental damage. Provisions shall be made to regulate drainage, avoid erosion and minimize damage to vegetation. Special care shall be taken to eliminate depressions that could serve as mosquito pools.
 3. Where areas must be cleared for storage of materials or temporary structures, provisions shall be made for regulating drainage and controlling erosion, subject to the Engineer's approval.
 4. In the event of any temporary work stoppage, the Contractor shall take steps to prevent any temporary or permanent environmental damage to the area undergoing construction.
- B. Control Measures:
1. Temporary measures shall be applied to control erosion and to minimize the siltation of the existing drains, streambeds and natural ponding areas. Such measures shall include, but not be limited to, the use of berms, baled straw silt barriers, gravel or crushed stone, mulch, grasses, slope drains and other methods. These temporary measures shall be applied to erodible materials exposed by any activities associated with the construction of this Project.
 2. Temporary measures shall be coordinated with the construction of permanent drainage facilities and other work to the extent practicable to assure economical, effective, and continuous erosion and siltation control.
 3. Provide special care in areas with steep slopes. Disturbance of vegetation shall be kept to a minimum to maintain stability. Remove only those trees and shrubs and grasses that must be removed for construction. Protect the rest to preserve their aesthetic and erosion-control values.
 4. Install erosion and sediment control practices as specified herein. The practices shall be maintained in effective working condition during construction and until the drainage area has been permanently stabilized.
 5. Temporarily stabilize each segment of graded or otherwise disturbed land, including the sediment-control devices not otherwise stabilized by seeding and mulching or by mulching alone.
- C. Temporary Seeding and Mulching:
1. All disturbed areas shall be limed and fertilized prior to temporary seeding.
 2. Disturbed areas shall be maintained in a rough graded condition and temporarily seeded and/or mulched until completion of the Work.
 3. All areas on which temporary seeding has not been made by November 1st, shall be treated with mulch.
 4. Mulching shall be used in conjunction with seeding on critical areas and during poor weather. Use alone for temporary stabilization during months of November through April.
 5. Suitable Materials for Mulching:
 - a. Unrotted straw or salt hay - 1-1/2 to 2 tons/acre.
 - b. Wood-fiber or paper-fiber (hydroseeding) 1500 lbs./acre.
 - 1) Straw or salt hay mulches should be immediately anchored using peg and twine netting or a mulch anchoring tool or liquid mulch binders.
 - 2) After stabilization remove all straw bale dikes, debris, etc., from the site.
 - 3) Refer to Section 02485, Grassing and Plantings, for locations and types of permanent turf.

3.05 EXCAVATION

- A. General:
1. Perform all excavation required to complete the Work. All material excavated shall be unclassified. Excavations shall include all materials such as earth, sand, clay, gravel, hardpan, boulders, organic materials, decomposed rock, pavements, rubbish and all other materials within the excavation limits.

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2. Excavations shall be open type, shored and braced as shown on the plans and where necessary to prevent injury to workmen and to new and existing structures or pipelines.
 3. Excavations shall be made in the dry. Stockpile satisfactory excavated materials in areas approved by the Owner, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage.
 4. Dispose of excavated material and waste materials as specified herein under Article 3.10, Disposal of Excavated Materials.
- B. Pipeline Excavation:
1. No more than 100 feet of trench shall be opened in advance of pipe laying.
 2. Trench width shall be minimized to greatest extent practical but shall conform to the following:
 - a. Sufficient to provide room for installing, jointing and inspecting piping, but in no case wider at top of pipe than pipe barrel outside diameter plus 2 feet.
 - b. Enlargements at pipe joints may be made if required and approved by the Engineer.
 - c. Sufficient for sheeting, bracing and sloping.
 - d. Sufficient to allow thorough compacting of granular embedment adjacent to bottom half of pipe.
 - e. Do not use excavating equipment which requires the trench to be excavated to excessive width.
 3. At road crossings, trenching width shall be minimized by the use of sheeting, trench boxes on similar protection methods.
 - a. Where existing piping or duct bank cross the new pipeline or structural excavation, they shall be adequately supported and protected from damage due to construction. All methods for supporting and maintaining these facilities shall be subject to approval by the Engineer. Care shall be taken to insure that the existing pipeline grades and alignment are maintained and that the pipe joints are not disturbed. Backfill shall be carefully placed and tamped to prevent damage or future settlement. Any damage or misalignment of the existing piping due to construction or settlement shall be repaired by the Contractor at his expense.
 - 1) Where groundwater or perched groundwater seepage is encountered during construction, over-excavation of utility trench bottoms may be required to allow installation of stabilization material.
- C. Structure Excavation:
1. Excavation shall be made to the grades shown on the Drawings and to such widths as will give suitable room for construction of the structures, for bracing and supporting, pumping and draining. The bottom of the excavations shall be rendered firm and dry and in all respects acceptable to the Owner.
 2. Excavation shall be accomplished by methods which minimize disturbance of subgrade soils. For structures having multiple bearing levels or adjacent structures at different levels, excavation and foundation construction shall first be accomplished at the lowest levels to prevent undermining foundations and disturbing adjacent bearing soils at higher levels.
 3. Excavation equipment shall be satisfactory for carrying out the work in accordance with the Specifications. Earth shall not be plowed, scraped, or dug with machines so near to the finished subgrade as to result in excavation of, or disturbance of material below subgrade.
 4. When excavation for foundations has reached final depths, the Owner shall be notified and will inspect conditions. If materials and conditions are not satisfactory to the Owner, the Owner will issue instructions as to the procedures.
 5. For structures not pile supported, during final excavation to subgrade level, take precautions required to prevent disturbance of material. Hand excavate the final 6-inches as necessary to obtain a satisfactory undisturbed bottom.
- D. Roadway Excavations:

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1. Roadway excavation shall consist of excavation for the roadways in conformity with lines, grades, cross sections, and dimensions shown on the Drawings and shall include the excavation of all unsuitable material from the subgrade.
 2. The subgrade shall be compacted to a 90 percent maximum density.
- E. Unsuitable or Over-Excavation:
1. If any over-excavation occurs through error of the Contractor or for Contractor's convenience, it shall be refilled at the Contractor's expense with concrete, select fill or other material satisfactory to the Owner.
 2. If the Contractor fails to properly dewater the excavation or trench, or disturbs the subgrade or otherwise fails or neglects to conduct the excavation work in a manner that provides the surface of the sub-grade in proper condition for construction, the Contractor shall remove all disturbed material and replace it with concrete, select fill, or other approved material at his own expense. The condition of the subgrade shall meet with the approval of the Owner before any work is placed thereon.
 3. For structures not pile supported, if, in the opinion of the Owner, the material, in its undisturbed natural condition, at or below the grade of the excavation indicated on the Drawings is unsuitable for foundations, or if organic or silty soil extends below excavation depth, it shall be removed to such depth and width as the Owner may direct and be replaced with select fill or other suitable material as directed by the Owner.
 4. Where the structure or pipeline is to be placed below the ground water table, well points, cofferdams or other acceptable methods shall be used to permit construction of said structure or pipeline under dry conditions. Dry conditions shall prevail until concrete has reached sufficient strength to withstand earth and hydrostatic loads and until the pipelines are properly jointed, tested and backfilled. In addition, protect excavation from flooding until all walls and floor framing up to and including grade level floors are in place and backfilling has begun. Water level shall be maintained below top of backfill at all times.
 5. Pumping of water from excavations shall be done in such a manner to prevent the carrying away of unsolidified concrete materials, and to prevent damage to the existing subgrade.

3.06 SHEETING, SHORING AND BRACING

- A. General:
1. Sheeting, shoring and bracing shall be used where shown, and where necessary to prevent injury to workmen, structures, or pipe lines. Jetting for sheeting installation is prohibited.
 2. All municipal, county, state and federal ordinances, codes, regulations and laws shall be observed. All trenches shall be shored with the minimal protection of sheeting listed in OSHA Regulations, 29 CFR, Part 1926, Subpart P - Excavations, Trenching and Shoring. The Contractor shall comply with latest revisions of all OSHA regulations for all excavations, sheeting, shoring, and bracing whether they are individually listed here or not.
 3. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.
 4. Unless otherwise shown, specified, or ordered, all materials used for temporary sheeting shall be removed when work is completed. Such removal shall be made in a manner not injurious to the structure or its appearance or to adjacent Work.
 5. Provide permanent sheeting as shown. Cut off tops as required, but at least 2-feet below finished grade.
 6. The clearances and types of the temporary sheeting, insofar as they affect the character of the finished Work, will be subject to the approval of the Engineer but the Contractor shall be responsible for the adequacy of all sheeting, shoring, bracing and other related Work.
 7. Safe and satisfactory installation of the sheeting shall be the entire responsibility of the Contractor.
- B. Sheeting Left in Place:

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1. Steel sheet piling to be left in place shall be driven straight to the lines and grades shown or directed. Piles shall penetrate into firm materials with secure interlocking throughout the entire length of the pile. Damaged piling having faulty alignment shall be pulled and replaced with new piling.
 2. The type of guide structure used and method of driving steel sheet piling to be left in place shall be subject to approval of the Engineer.
 3. The Contractor shall cut off piling left in place to the grades shown or ordered by the Engineer and shall remove the cut offs from the site.
 4. Thoroughly clean wales, braces and all other items to be embedded in the permanent structure, and make provisions that the concrete surrounding the embedded element is sound and free from air pockets or harmful inclusions. The provisions shall include the cutting of holes in the webs and flanges of wale and bracing members, and the welding of steel diaphragm waterstops perpendicular to the centerline of brace ends which are to be embedded.
 5. Subsequent to removal of the inside face forms, and when removal of bracing is permitted, steel shall be cut back at least 2 inches inside the wall face and the opening patched with cement mortar. The concrete shall be thoroughly worked beneath wales and braces, around stiffeners and in any other place where voids may be formed.
- C. Removal of Sheeting and Bracing:
1. Unless otherwise shown on the Drawings or ordered in writing by the Engineer, all sheeting and bracing shall remain in place. If removal of sheeting and/or bracing is required, removal shall be done so as to not cause damage to the Work. Earth pressure shall be equal on both sides of excavation to ensure no unequal loads on pipe or structure. Use of vibratory extractors is prohibited.
 2. Defer removal of sheeting and bracing, where removal may cause soil to come into contact with concrete, until wall and floor framing up to and including grade level floors are in place and concrete has attained sufficient strength to withstand the soil loads.

3.07 BACKFILL AND COMPACTION

- A. Fill excavations as promptly as Work permits, but not until completion of the following:
- B. Acceptance by the Engineer of all Work within the excavation.
- C. Inspection, testing approval, and recording of locations of underground utilities, connections, branches, structures and other facilities.
- D. Removal of temporary shoring and bracing, and backfilling of voids with satisfactory materials.
- E. Removal of trash and debris.
- F. Excavation shall be kept dry during backfilling operations. Back-fills around piping and structures shall be brought up evenly on all sides.
- G. Place general fill and select fill materials in layers not exceeding 8 inches in thickness, and each layer shall be compacted as specified below.
- H. Backfill in pipe trenches which is below other pipes, structures, foundations, or paved areas shall be select fill and shall be placed in horizontal layers not exceeding 6 inches in depth and thoroughly compacted before the next layer is placed. Compaction layers shall be 6 inches up to the pipe spring line and 12 inches thereafter in trenches that are not below other pipes, structures, foundations, or paved areas.
- I. Backfill above and adjacent to pipe, and adjacent to buildings and tank walls shall be compacted by light weight equipment, such as "walk behind" vibratory plate compactors. Heavy self-propelled compactors shall not be used until the following criteria are met:
 1. A minimum of 18 inches of compacted backfill has been placed above the top of the pipe.
 2. Area to be compacted is a minimum distance of 3 pipe diameters away from the adjacent pipe.
 3. Area to be compacted is a minimum of 10 feet from building and tank walls and riser pipes.

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- J. Levels of backfill against concrete walls shall not differ by more than 2 feet on either side of walls unless walls are adequately braced or all floor framing is in place up to and including grade level slabs. Particular care shall be taken to compact structure backfill that will be beneath pipes, roads, or other surface construction or structures. In addition, wherever a trench passes through structural backfill, the structural backfill shall be placed and compacted to an elevation 12 inches above the top of the pipe before the trench is excavated. Compacted areas, in each case, shall be adequate to support the item to be constructed or placed thereon.
- K. Backfill in Pipe Trenches:
 - 1. Pipeline trenches may be backfilled prior to pressure testing the pipe, but no structure shall be constructed over any pipeline until it has been tested.
 - 2. All pipe larger than 6 inches in diameter shall be placed on existing Sand Stratum 4, Select Fill or granular embedment material. Pipe 6 inches in diameter and smaller shall be placed in granular embedment material unless the trench bottom has been graded to provide uniform and continuous support of the installed pipe.
- L. Backfill in Electrical Ductbank Trenches:
 - 1. Compacted backfill will be required for the full depth of the trench above the electrical ductbank. Where the trench for one ductbank passes beneath the trench for another pipe or ductbank select backfill shall be placed to the level of the bottom of the upper trench.
- M. Crushed Stone Placement:
 - 1. Crushed stone shall be placed where shown on the Contract Drawings.
 - 2. Place crushed stone in hand tamped lifts not to exceed 6 inches.
- N. Hydro hammers or "jumping jack" hammers shall not be used above pipes until a minimum of 3 feet of backfill has been placed and compacted.
- O. Compaction Density Requirements:
 - 1. Unless otherwise noted in the project Geotechnical Investigation Report, the degree of compaction required for all types of fills shall be 92 percent in accordance with ASTM D 698. Material shall be moistened or aerated as necessary to provide the moisture content that will facilitate obtaining the specified compaction.
 - 2. As indicated in the Geotechnical Investigation Report, compact the bottom of all footing excavation using a minimum of four (4) passes with vibratory plate, jumping jack, Rammax trench compactor or similar, and until no further settlement is visible prior to placing structural fill or constructing footings.
 - 3. Drainage stone shall be compacted with a vibratory plate compactor or vibratory rolling compactor. Three complete passes shall be made on each 8-inch thick loose layer of stone. Each pass shall overlap the adjacent previously compacted area a minimum of 20 percent. Density requirement for the drainage stone will be considered satisfactory upon completion of compaction.
 - 4. Owner's laboratory will perform tests necessary to provide data for selection and control of fill material placement and water content.
 - 5. Owner's laboratory will perform field density tests to insure that the specified density is being obtained during each day of compaction work. Number of tests will be determined by the Engineer.
 - 6. If the tests indicate unsatisfactory compaction, the Contractor shall provide the additional compaction necessary to obtain the specified degree of compaction. All additional compaction work shall be performed by the Contractor at no additional cost to the Owner until the specified compaction is obtained. This Work shall include complete removal of unacceptable fill areas and replacement and recompact-ion until acceptable fill is provided, as determined by the Engineer.
- P. Repair any damage, at no additional cost to the Owner, after-sett-le-ment that occurs. Make all repairs and replacements necessary within 30 days after notice from the Engineer.

3.08 GRADING

- A. Uniformly grade areas within limits of the Work, including adjacent transition areas. Smooth subgrade surface within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.
- B. Turfed Areas: Finish areas to receive topsoil to within not more than 1 inch above or below the required subgrade elevations.
- C. Walks: Shape surface of areas under walks to the line, grade and cross-section shown, with finish surface not more than 1 inch above or below the required subgrade elevation.
- D. Pavements: Shape surface of areas under pavements to the line, grade and cross-section shown, with finish surface not more than 1/2 inch above or below the required subgrade elevation.
- E. Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 1/4 inch when tested with a 10-foot straightedge.
- F. Compaction: After grading, compact subgrade surfaces to the depth and percentage of maximum density required.

3.09 REMOVAL OF UNSUITABLE MATERIALS

- A. Remove and dispose off site all unsuitable organic and/or inorganic materials. Within thirty (30) consecutive days after Notice to Proceed, submit to the Owner for review all required permits and a list of disposal sites for the unsuitable materials. If the disposal site is located on private property, the submittal shall also include written permission from the Owner of record.
- B. All unsuitable materials shall be disposed of in locations and under conditions that comply with Federal, State and local laws and regulations.
- C. Obtain an off-site disposal area prior to beginning demolitions or excavation operations.
- D. All unsuitable materials shall be hauled in trucks of sufficient capacity and tight construction to prevent spillage. Trucks shall be covered to prevent the escape of odors and the propagation of dust.
- E. When all unsuitable material disposal operations are completed, leave the disposal site in a condition acceptable to the Owner of the disposal site.
- F. Do not dump soil onto those areas designated as wetlands or waterways. Do not stockpile or store spoil, materials, tools or equipment on wetlands. Stockpiling of unsuitable organic material is not permitted on site.

3.10 ESTORING AND RESURFACING EXISTING ROADWAYS AND FACILITIES

- A. Place 1-1/2 inches of temporary bituminous pavement immediately after backfilling excavations in paved roadways. Maintain, in good and safe condition during progress of the entire Work, the surface of the paved area over the excavation, and promptly fill all depressions over and adjacent to the excavation caused by settlement of backfill. Immediately prior to constructing the permanent paving and base, remove and dispose of temporary pavement. Permanent replacement pavement shall conform to the requirements of Section 02510.
- B. Restore or replace pavement, gutters, curbs, walks, driveways and roadways disturbed or damaged by the Contractor's operations to original or better condition.
- C. After all other work has been completed in each area, place and grade topsoil to a depth of not less than 6-inches.

3.10 DRAINAGE AND DEWATERING

- A. Drainage and Dewatering:
 - 1. Provide and maintain adequate drainage and dewatering equipment to remove and dispose of all surface water and ground water entering excavations, or other parts of the Work. Each excavation shall be kept dry during subgrade preparation and continually

SECTION 02200 – EARTHWORK

thereafter until the structure to be built, therein is inspected by the Engineer and backfill operations have been completed and approved.

- a. The different working areas on the Site shall be kept free of surface water at all times. Install drainage ditches and dikes and perform all pumping and other Work necessary to divert or remove rainfall and all other accumulations of surface water from the excavations and fill areas. Perform diversion and removal of surface water in a manner that will prevent the accumulation of water behind temporary structures or at any other locations within the construction area where it may be detrimental.
 - b. Water used for working or processing, resulting from dewatering operations, or containing oils or sediments that will reduce the quality of the water downstream of the point of discharge, shall not be directly discharged. Such waters shall be diverted through a settling basin or filter before being discharged.
 - c. Contractor will be held responsible for the condition of any pipe, conduit or channel used for drainage purposes and all such pipes, conduits or channels shall be left clean and free of sediment.
 - d. Remove water from excavations as fast as it collects.
 - 1) Provide, install and operate sufficient trenches, sumps, pumps, hose, piping, well points, deep wells, etc., necessary to depress and maintain the ground water level below the base of the excavations during all stages of construction operations. The ground water table shall be lowered in advance of excavation, for a sufficient period of time so as to permit dewatering of fine grain soils, and maintained two feet below the lowest subgrade excavation made until the structure has sufficient strength and weight to withstand horizontal and vertical soil and water pressures from natural ground water. The system shall be operated on a 24-hour basis and standby pumping facilities and personnel shall be provided to maintain the continued effectiveness of the system. If, in the opinion of the Engineer, the water levels are not being lowered or maintained as required by these Specifications, install additional or alternate dewatering devices as necessary, at no additional cost to the Owner.
 - (a) Elements of the system shall be located so as to allow a continuous dewatering operation without interfering with the construction of the permanent Work. Where portions of the dewatering system are located in the area of permanent construction, submit details of the methods proposed to construct the permanent Work in this location for the approval of the Engineer. Controls of ground water shall continue until the permanent construction provides sufficient dead load to withstand the hydrostatic uplift of the normal ground water, until concrete has attained sufficient strength to withstand earth and hydrostatic loads, and until all waterproofing Work has been completed. Dispose of all water removed from the excavation in such a manner so as not to endanger any portion of the Work under construction or completed. Convey water from the excavations in a closed conduit. Before discontinuing dewatering operations or permanently permitting the rise of the ground water level, computations shall be made to show that any structure affected by the water level rise is protected by backfill or other means to sustain uplift. Use a safety factor of 1.25 when making these computations.
 - (1) Dewatering operations shall not be discontinued without the prior authorization of the Engineer.
 - (2) Design of dewatering system, including both drawings and calculations, shall be performed by a Registered Professional Engineer in the State of New York and shall be employed by Contractor. Dewatering system shall be designed so as to avoid settlement or damage to existing structures and utilities.
2. Disposal of Water Removed by Dewatering System:

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- a. Contractor's Dewatering System shall discharge to location directed by Owner, in accordance with State and Federal regulations.
- b. Dispose of all water removed from the excavation in such a manner as not to endanger public health, property, or any portion of the Work under construction or completed.
- c. Dispose of water in such a manner as to cause no inconvenience to Owner, Engineer, or others involved in Work about the Site.
- d. Convey water from the construction Site in a closed conduit. Do not use trench excavations as temporary drainage ditches.

END OF SECTION

SECTION 02207 – AGGREGATE MATERIALS

PART 1 – GENERAL

1.01 DESCRIPTION

- A. This Section includes requirements for furnishing all labor, materials and equipment to complete all work associated with the installation of aggregate material beneath foundations, as backfill and roadway subgrades and other related and incidental work as required to complete the Work shown on the Contract Drawings and specified herein.

1.02 RELATED SECTIONS

- A. Section 02200 – Earthwork.
B. Section 02510 – Paving and Surfacing.

1.03 PAYMENT

- A. Payment for work furnished and installed under this Section shall be included in the lump sum price bid for the Contract, as described in Section 01150 – Measurement and Payment.

1.04 REFERENCES

- A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes and standards refer to the most current issue available at the time of the Bid.
1. ASTM C127 – Test for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate.
 2. ASTM C136 – Test for Sieve Analysis of Fine and Coarse Aggregates.
 3. ASTM C535 – Test for Resistance to Degradation of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 4. NYSDOT Standard Specifications, latest edition.

1.05 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 – Submittals, submit the following:
1. Materials gradation and certification.
 2. ASTM C127, ASTM C136 and ASTM C535 test results.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Unsuitable materials shall not be used for backfill on-site. This includes contaminated, hazardous, or toxic materials, muck, peat, soft unstable materials, mud, organic and inorganic soils, frozen lumps, large rocks, wood, stumps, decaying matter, heterogeneous materials such as garbage, plastic, concrete, bricks, rubble, cinders, canvas, construction debris and other materials designated by the Engineer.
- B. Crushed Stone:
1. Crushed stone shall be well-graded and meet the requirements of NYSDOT Material 703-0201, Size Designation 3 or 3A as defined by NYSDOT Standard Specification Section 703. Gradation shall be in accordance with the following, as specified in NYSDOT Section 703, Table 703-4:

<u>Sieve Size</u>	<u>Percent by Weight Passing Size Designation 3</u>	<u>Percent by Weight Passing Size Designation 3A</u>
2-1/2 inches	100	-
2 inches	90-100	100
1-1/2 inches	35-70	90-100
1 inch	0-15	0-15
No. 200	0-0.7	0-0.7

SECTION 02207 – AGGREGATE MATERIALS

2. Crushed stone shall be free of shale and shale-like materials, coal/lignite sulfides, clay, wood and other unsuitable materials.

C. Crushed Gravel:

1. Crushed gravel shall be clean, durable sharp-angled gravel and meet the requirements of NYSDOT Material 703-0202, Size Designation 3 or 3A, as defined by NYSDOT Standard Specification Sections 703. Gradation shall be in accordance with the following, as specified in NYSDOT Section 703, Table 703-4:

<u>Sieve Size</u>	<u>Percent by Weight Passing Size Designation 3</u>	<u>Percent by Weight Passing Size Designation 3A</u>
2-1/2 inches	100	-
2 inches	90-100	100
1-1/2 inches	35-70	90-100
1 inch	0-15	0-15
No. 200	0-0.7	0-0.7

2. Crushed gravel shall be free of shale and shale-like materials, coal/lignite sulfides, clay, wood and other unsuitable materials.

D. Select Backfill:

1. Select backfill shall be well-graded and free of lumps larger than 3-inches, rocks larger than 3-inches and unsuitable material.
2. Select fill used for embankment construction shall be a silty or clayey soil material with a Maximum Liquid Limit (LL) of fifty (50) and a Plasticity Index (PI) between seven (7) and twenty (20).
3. Select fill used as subgrade support shall be a coarse aggregate material meeting the gradation requirements of #57 or #78 aggregates in accordance with ASTM C33 or Aggregate Base Course (ABC).
4. Select fill used for backfilling shall be a granular soil material with a Maximum Plasticity Index (PI) of six (6) and meet the requirements of Paragraphs 5 or 6 below.
5. Select Fill Type A shall be well-graded aggregate, meeting the requirements of NYSDOT Item 304.14, Subbase Course, Type 4 as defined by NYSDOT Standard Specification Section 304. Gradation shall be in accordance with the following, as specified in NYSDOT Section 304, Table 304-1:

<u>Sieve Size</u>	<u>Percent Weight Passing</u>
2-inches	100
1/4-inch	35-65
No. 40	5-40
No. 200	0-10

6. Select Fill Type B shall be well-graded aggregate, meeting the requirements of NYSDOT Item 203.07, Select Granular Fill as defined by NYSDOT Standard Specification Section 203. Gradation shall be in accordance with the following, as specified in NYSDOT Section 203-2.02, Article C.

<u>Sieve Size</u>	<u>Percent Weight Passing</u>
4-inches	100
No. 40	0-70
No. 200	0-15

E. Select Sand:

1. Select sand shall be defined as Sand Backfill, from Section 203-2.02, Paragraph I of the NYSDOT Standard Specifications. Select sand shall meet the requirements of Sections 203-1 and 203-2, of the NYSDOT Standard Specifications for materials and gradation.

SECTION 02207 – AGGREGATE MATERIALS

The gradation shall be as defined in Section 203-2.02, Paragraph I, of the NYSDOT Standard Specifications.

<u>Sieve Size</u>	<u>Percent Weight Passing</u>
1/2-inch	100
1/4-inch	90-100
No. 200	0-5

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Stockpiling:
 - 1. Stockpile materials on-site within the principal work area, staging area or at locations indicated designated by the Engineer.
 - 2. Stockpile differing materials separately to prevent mixing.
 - 3. Direct surface water away from the stockpile site so as to prevent erosion or deterioration of materials.
- B. Stockpile Cleanup: Remove stockpile, leave area in a clean and neat condition. Grade site surface to prevent free-standing surface water.

3.02 FIELD QUALITY CONTROL

- A. Field inspection and testing may be performed by the Owner.
- B. Test and analysis of aggregate material shall be performed in accordance with ASTM D698, D1557, ASTM D2167, ASTM D4318 ASTM D6938, and ASTM C136.
- C. Provide delivery tickets showing constituents, gradation and source.

END OF SECTION

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PART 1 – GENERAL

1.01 DESCRIPTION

- A. Scope:
 - 1. The work to be done under this Section includes, but is not limited to, conducting all activities on the project in such a manner that damage is prevented to adjacent pipes, structures, property and work, and such that construction noise, ground vibrations and ground and structure displacements are consistently maintained below the maximum levels specified in this Section.
 - 2. Notifying the Engineer prior to conducting any noise and vibration producing construction activity, and conducting appropriate monitoring at nearby structures in accordance with the plan prepared by the Contractor's independent specialist and approved by the Engineer.
 - 3. The Contractor's independent specialist shall provide, install, and set up engineering seismographs and sound level meters adjacent to or on structures, utilities or other potentially affected areas, as appropriate.
 - 4. Protecting vibration and sound level monitoring equipment, and other monitoring equipment that exists or is installed as required by the Contract Documents.
 - 5. Submitting noise and vibration monitoring reports.
 - 6. Resolution of complaints, damage and exceedances of threshold and limit value criteria.
- B. Related Sections:
 - 1. Section 02050, Demolition, Removals, and Modifications
 - 2. Section 02200, Earthwork

1.02 REFERENCES

- A. All construction noise and vibration control work shall be in accordance with:
 - 1. FTA – Trans Noise and Vibration Impact Assessment
 - 2. ANSI S1.4 & S1.43 Specification for Sound Level Meters
 - 3. The State of New York.

1.03 JOB CONDITIONS

- A. Engage a qualified, independent specialist to install and monitor engineering seismographs adjacent to or on adjacent structures or utilities, for the purpose of monitoring and ensuring compliance with the noise and vibration specified herein. The Contractor's independent specialist may also monitor related geotechnical instrumentation such as observation wells, piezometers and inclinometers.
- B. Vibration and sound level monitoring shall be performed by the Contractor's independent specialist using personnel experienced in the correct placement and monitoring of engineering seismographs and sound level meters.
- C. Vibration and noise monitoring shall be performed continuously during all demolition and construction activities at the site.

1.04 SUBMITTALS

- A. Submit qualifications for the independent specialist whose services have been selected by the Contractor for performing the noise and vibration monitoring work demonstrating at least 5 similar assignments completed successfully during the last 5 years.
- B. Before beginning work that may cause noise or vibrations, submit a Construction Noise and Vibration Monitoring and Control Plan including:
 - 1. Instrument specifications and calibrations.
 - 2. Table of expected noise and vibration producing activities including: description of activity, location, and anticipated dates and times of activities.
 - 3. Table of structures, utilities, levees and other noise and/or vibration sensitive receptors (including identification of historic structures and sites) that may be impacted by noise and vibration including: structure description, street address, name and address of Owner, and names of occupants.

SECTION 02228 – CONSTRUCTION NOISE AND VIBRATION CONTROL

4. Proposed monitoring locations.
 5. A Construction Vibration Assessment performed in accordance with the guidance in Section 7 of the FTA Transit Noise and Vibration Impact Assessment Manual (September 2018) for construction activities.
 6. A Construction Noise Assessment performed in accordance with the guidance in Section 7 of the FTA Transit Noise and Vibration Impact Assessment Manual (September 2018) for construction activities.
 7. Preliminary evaluation of structure susceptibility to vibration induced damage.
 8. Monitoring program procedure including reporting procedures.
 9. Noise and Vibration Mitigation Plan (including damage prevention).
 10. Sample Noise and Vibration Data Report.
 11. Plan to deal with and resolve complaints.
- C. Before beginning work that may cause noise or vibrations, initiate a Construction Noise and Vibration Monitoring and Control Program. Perform the following actions:
1. Within 2 working days of receipt of each seismograph and noise meter at the site, submit copy of specifications, manual, factory calibration and manufacturer's test equipment certification.
 2. Submit background noise and vibration data reports for each building, utility, levee or other sensitive receptor in accordance with Table 2 of this Section.
 3. Submit weekly Noise and Vibration Data Reports, within 3 days of the end of each week.
 4. Submit Noise and Vibration Data Reports within 1 working day of requests by the Engineer in response to complaints by adjacent property owners.
- D. Submit pre-condition surveys of potentially impacted properties, at least two weeks before the start of vibration producing activities.
- E. Submit post-condition surveys of potentially impacted properties, no later than four weeks after the completion of vibration producing activities.
- F. The Engineer shall be notified immediately if any noise or vibration readings exceed the threshold or limiting values specified herein.

PART 2 – PRODUCTS

2.01 EQUIPMENT

- A. Noise Meters: Provide and operate Type 1 or Type 2 sound level meters consistent with ANSI and ASTM E1503 and E1686 requirements for monitoring noise levels from construction activities and equipment:
1. Noise level range: 40 to 120 db, or mid-scale.
 2. Metric: Leq, 1-hour average.
 3. A-weighted frequency response.
 4. Response time: slow setting for continuous or intermittent noise; fast setting for impulsive noise (a momentary sound such as a horn).
 5. Windscreen: place factory-supplied windscreen over microphone during all measurement periods.
 6. Position: the meter microphone should be positioned at a height of 4 feet above ground level and at least 10 feet away from a reflecting surface (such as a wall). The microphone can be hand-held or tripod mounted (tripod preferred).
 7. Data shall be collected either by manually reading and recording noise levels or by storing and downloading the data remotely depending on the capabilities of the meters used. The date, time, monitoring location and nature of construction activities shall be reported with the data.
 8. Field calibration: Noise meters shall be field calibrated before and after each measurement, or at least once per hour, whichever is more frequent using a calibrator specified for use with the meter and the manufacturer's instructions for calibration.
- B. Seismographs: Provide portable seismographs for monitoring the velocities of ground vibrations resulting from construction activities, with the following minimum features:

SECTION 02228 – CONSTRUCTION NOISE AND VIBRATION CONTROL

1. Seismic range: 0.01 to 8 inches per second with an accuracy of 5% and no more than a 3 db roll off at the low frequency end.
 2. Flat frequency response: 2 to 200 Hertz.
 3. Three-component sensor.
 4. Fourth channel for air blast monitoring.
 5. Two power sources: Internal rechargeable battery and charger and 115 volts AC. Battery must be capable of supplying power to monitor vibrations continuously for at least 24 hours.
 6. Direct writing to printer and to USB flash drive.
 7. Instruments must be capable of producing strip chart recordings of readings on site within one hour of obtaining the readings. Provide computer software to perform frequency analyses of data obtained.
 8. Continuous mode and histogram mode capabilities for recording vibrations.
 9. Histogram mode must include frequencies of each peak vibration.
 10. Capability of downloading data remotely via internet.
- C. Factory calibration: Provide factory calibrations for each instrument. Perform seismograph calibrations using a shake table and a reference sensor traceable to the national institute of standards and technology. Perform noise meter calibrations using a calibrator traceable to the national institute of standards and technology. Recalibrate the instruments at least once every 12 months.

PART 3 – EXECUTION

3.01 GENERAL

- A. Prepare a Construction Noise and Vibration Monitoring and Control Plan. Preconstruction components of the Plan shall be completed prior to construction and submitted to the Engineer for approval at least two weeks prior to the onset of construction.
1. All noise and vibration monitoring instruments shall be installed in the presence of the Engineer. Allow access to the work area at all times for the purpose of observing instrumentation and obtaining data. Determine the elevation and location of all instrumentation a minimum of one week prior to excavation or demolition.
 2. The Contractor shall be responsible for any and all damage incurred to utilities during instrumentation installation.
 3. Protect and maintain instrumentation until the end of the Contract. Any instrumentation damaged or otherwise rendered non-functional shall be repaired or replaced with a new installation within five working days at no additional cost to the Owner. Repair or replacement work shall conform to the requirements specified herein for the respective type of geotechnical instrumentation.
 4. Provide and maintain well-delineated protection devices at the surface on all instrumentation.
 5. Monitor construction activity noise for two one-hour periods each week when Contractor's activities are most noise intensive. The Monitoring Plan shall identify the one-hour daytime and one-hour nighttime monitoring periods to be used throughout the monitoring program.
 6. Monitor construction activity noise at actual or representative sensitive receptor locations. Sensitive receptor locations that are adjacent to one another and would be expected to experience equivalent exposure to construction noise may be clustered by selecting a representative monitoring location. The monitoring locations shall have an unobstructed line of sight to the construction site. The selected monitoring locations and rationale for selection shall be identified in the Monitoring Plan and shall be used throughout the monitoring program.
 7. When no construction activity occurs within 1000 feet of a monitoring location during any single week, no monitoring needs to be performed at that location during that week. Provide an explanation of that circumstance in the Noise and Vibration Data Report for that week.

SECTION 02228 – CONSTRUCTION NOISE AND VIBRATION CONTROL

- B. Execute a Construction Noise and Vibration Monitoring and Control Program. Perform the Program consistent with the requirements and conditions specified in the Construction Noise and Vibration Monitoring and Control Plan.
- C. Use every effort and every means possible to minimize noise caused by its operations. Provide working machinery and equipment designed to operate with the least possible noise, including the use of shields, soundproof housings, enclosures, or other physical barriers to restrict the transmission of noise. Compressors shall be equipped with silencers or mufflers on intake and exhaust lines. Wherever practicable, electricity shall be used for power to reduce noise. Where required by agencies having jurisdiction, certain noise producing work may have to be performed during other than regular working hours or at specified periods only.
- D. If the need arises, the Contractor shall assist the Engineer and the Owner with community coordination activities relative to public noise exposure.

3.02 GENERAL NOISE LEVEL RESTRICTIONS

- A. Comply with local noise ordinances.
- B. As part of the Construction Noise and Vibration Monitoring and Control Plan, prepare a Construction Noise Assessment in accordance with the guidance in Section 7 of the FTA Transit Noise and Vibration Impact Assessment Manual for construction activities. Determine the potential for construction noise impacts on noise sensitive receptors, develop a mitigation plan to prevent impacts to the maximum extent practicable, and develop a Monitoring Plan.
- C. Contractor assumes all responsibility and liability for any noise impacts on sensitive receptors.
- D. Ambient noise measurements will be taken and mitigation measures identified and utilized to ensure compliance with local noise ordinances.
- E. Noise monitoring shall not be conducted during precipitation events or in winds greater than 12 miles per hour.
- F. If a Maximum Acceptable Construction Noise Level is reached:
 - 1. Immediately notify the Engineer.
 - 2. Meet with the Engineer to discuss response action(s).
 - 3. Submit an up-to-date report within 24 hours for all instruments for which the Maximum Level was reached, as well as on any other instruments requested by the Engineer.
- G. In addition to the above steps, if a Maximum Acceptable Construction Noise Level is reached, initiate the following response actions, as directed by the Engineer.
 - 1. Increase instrument monitoring frequencies.
 - 2. Install and monitor additional instruments.
 - 3. Modify construction procedures.
 - 4. Implement Mitigation Measures specified in Article 3.10 of this Section or as identified in the Construction Noise and Vibration Monitoring and Control Plan, so that the Maximum Level is not exceeded.
- H. If the Maximum Level is reached, the Contractor may be directed to suspend activities in the affected area with the exception of those actions necessary to avoid exceeding the Maximum Level.
- I. If complaints about noise are received, promptly conduct additional monitoring at additional times, locations and frequencies, as directed by Engineer, and immediately inform Engineer of the results of such monitoring, at no additional cost to the Owner.

3.03 SPECIFIC NOISE LEVEL RESTRICTIONS

- A. Noise levels at the construction site limits shall not exceed values provided in local ordinances.
- B. Ensure that appropriate measures are in place during construction to protect the sensitive receptors from noise impacts to the maximum extent practicable. These measures shall be identified within the Noise and Vibration Mitigation Plan.

3.04 GROUND VIBRATION LIMITS

- A. As part of the Construction Noise and Vibration Monitoring and Control Plan, the Contractor shall prepare a Construction Vibration Assessment in accordance with the guidance in Section 7 of the FTA Transit Noise and Vibration Impact Assessment Manual for construction activities. Determine the potential for construction vibration impacts on vibration sensitive receptors, develop a mitigation plan to prevent impacts to the maximum extent practicable, and monitor construction activity vibration as needed.
- B. Contractor assumes all responsibility and liability for any vibration damage to surrounding buildings and structures as a result of the Contractor's activities if deemed the result of the fault of the Contractor.
- C. Table 02228-A, located after "end of section" designation, indicates threshold and limiting values for seismographs. these values are defined collectively as response values. the actions associated with these response values are defined. response values are subject to adjustment by the engineer as indicated by prevailing conditions or circumstances.
- D. If a Threshold Value is reached:
 - 1. Immediately notify the Engineer.

SECTION 02228 – CONSTRUCTION NOISE AND VIBRATION CONTROL

2. Meet with the Engineer to discuss response action(s).
 3. Submit an up to date report within 24 hours for all instruments for which the Threshold Value was reached, as well as on any other instruments requested by the Engineer. Continue to submit daily reports until all instrument readings fall below the specified Threshold Values, or unless otherwise directed by the Engineer.
- E. In addition to the above steps, if a Threshold Value is reached, initiate the following response actions, as directed by the Engineer.
1. Increase instrument monitoring frequencies.
 2. Install and monitor additional instruments.
 3. Modify construction procedures.
 4. Implement Mitigation Measures as specified in Contract Documents and this Section of as identified in the approved Construction Noise and Vibration Monitoring and Control Plan, so that the Limiting Value is not exceeded.
- F. If a Limiting Value is reached:
1. If limiting values of vibration are exceeded, all work by the Contractor in the vicinity of the exceedance shall stop until a meeting takes place between the Contractor and the Engineer to assess the cause of the exceedance.
 2. Immediately notify the Engineer.
 3. Meet with the Engineer to discuss response action(s).
 4. Submit an up to date report within 24 hours for all instruments for which the Limiting Value was reached, as well as on any other instruments requested by the Engineer. Continue to submit daily reports until all instrument readings fall below the specified Threshold Values, or unless otherwise directed by the Engineer.
 5. A submittal shall be prepared and submitted to the Engineer indicating what activity caused the exceedance and what steps the Contractor will take to prevent further exceedances of the limits. No work in the vicinity of the exceedance shall be restarted until the submittal is reviewed and approved by the Engineer.
- G. Implement Mitigation Measures as specified in Contract Documents or as identified in the approved Construction Noise and Vibration Monitoring and Control Plan, so that the Limiting Value is not exceeded.
- H. If complaints about noise or vibrations are received, promptly conduct additional monitoring at additional times, locations and frequencies, as directed by Engineer, and immediately inform Engineer of the results of such monitoring, at no additional cost to Owner.

3.05 GROUND BORNE NOISE AND VIBRATION LEVEL RESTRICTIONS

- A. Ensure that appropriate measures will be in place during construction to protect the sensitive receptors and historic structures from damage and foundation cracking to the maximum extent practicable. These measures shall be identified within the approved Construction Noise and Vibration Mitigation Plan.

3.06 SEISMOGRAPH INSTALLATION

- A. Install seismographs in accordance with Manufacturer's installation instructions.
- B. Firmly mount seismographs on the surface slab of concrete or asphalt, firmly set them in undisturbed soil, or rigidly attach them to the structure of buildings.

3.07 PROTECTION OF INSTRUMENTS

- A. Protect all instruments and appurtenant fixtures, leads, connections, and other components of instrumentation systems from damage due to construction operations, weather, traffic, and vandalism.
- B. If an instrument is damaged, repair or replace the damaged instrument at no additional cost to the Owner, including damage resulting from Contractor. Contractor's actions to instruments installed by others. The Engineer will be the sole judge of whether repair or replacement is required. The Engineer

SECTION 02228 – CONSTRUCTION NOISE AND VIBRATION CONTROL

may impose a work stoppage in the vicinity of the damaged instrument until it is again operational, at no additional cost to the Owner.

3.08 DATA COLLECTION

A. Comply with the schedule in Table 02228-2B, located after ""End of Section"" designation.

3.09 MITIGATION MEASURES

A. As part of the Construction Noise and Vibration Monitoring and Control Plan, prepare a Noise and Vibration Mitigation Plan. The Plan shall identify potential noise and vibration impacts during construction activities, and the measures the Contractor will use to minimize those impacts.

B. Measures to minimize construction noise and vibration impacts must be evaluated for effectiveness by the Contractor. Such measures may include, but are not limited to:

1. Minimize the use of other loud construction equipment during nighttime hours.
2. Sequence operations, combining noisy events to occur at the same time on order to reduce the total length of the noise generating activity, and avoid nighttime construction.
3. Use alternative construction methods such as: drill pile instead of impact pile driving, using quieted equipment, and alternative demolition techniques.
4. Use shields, impervious fences or other physical barriers to inhibit the transmission of noise.
5. Use sound retardant housings or enclosures around noise producing equipment.
6. Use effective intake and exhaust mufflers on internal combustion engines and compressors.
7. Use electric instead of diesel powered equipment.
8. Use covered hoppers, storage bins, and chutes with sound deadening material.
9. Use hydraulic tools instead of pneumatic impact tools.
10. Minimize use of air or gasoline driven saws.
11. Conduct truck loading, unloading, and hauling operations so that noise and vibration are minimized.
12. Place operation limitations on machines and trucks.
13. Site stationary equipment to minimize noise and vibration impact on the community.
14. Plan noisier operations during times of highest ambient noise levels.
15. Keep noise levels relatively uniform, avoid peaks and impulse noises.
16. Turn off idling equipment.
17. Phase in startup and shutdown of equipment.

3.10 NOISE AND VIBRATION COMPLAINT RESOLUTION

A. As part of the Construction Noise and Vibration Monitoring and Control Plan, prepare and implement a plan for responding to and resolving noise and vibration complaints that may arise during construction activities.

3.11 SCHEDULES

A. Schedules, listed below, following the "End of Section" designation, are part of this Specification Section:

1. Table 02228-A, Response Values
2. Table 02228-B, Monitoring Schedule

END OF SECTION

SECTION 02228 – CONSTRUCTION NOISE AND VIBRATION CONTROL

TABLE 02228-A, RESPONSE VALUES

INSTRUMENT	THRESHOLD VALUE	LIMITING VALUE
Seismographs at buildings: Continuous or Steady State Vibration (see Note 1)	Peak Particle Velocity: 0.3 in/sec for frequencies less than 30 Hz 0.4 in/sec for frequencies greater than 60 Hz	Peak Particle Velocity: 0.5 in/sec for frequencies less than 30 Hz 0.8 in/sec for frequencies greater than 60 Hz
Seismographs at buildings: Transient or Impact Vibration (see Note 2)	Peak Particle Velocity: 0.75 in/sec for frequencies less than 60 Hz 1 in/sec for frequencies greater than 90 Hz	Peak Particle Velocity: 1.5 in/sec for frequencies less than 60 Hz 2 in/sec for frequencies greater than 90 Hz
Special Response Values for Instruments at Historic Buildings	One-half the velocities listed above	One-half the velocities listed above
Special Response Values for Instruments at Buried Pipeline Utilities	Peak Particle Velocity = 2 in/sec	Peak Particle Velocity = 3 in/sec
Special Response Values for Instruments at Levees	Peak Particle Velocity = 1.5 in/sec	Peak Particle Velocity = 2 in/sec

Notes:

1. Response Values for Continuous or Steady State Vibrations apply to vibrations such as vibratory pile drivers, jack hammers, reciprocating pavement breakers, compactors, large pumps and compressors, bulldozers, trucks, cranes, and other large machinery. Use linear interpolation for frequencies between 30 Hz and 60 Hz.

2. Response Values for Transient or Impact Vibrations apply to vibrations such as blasting, drop chisels, clam shell buckets, impact pile drivers, wrecking balls, building demolition, gravity drop ground compactors and gravity drop pavement breakers. Use linear interpolation for frequencies between 60 Hz and 90 Hz.

SECTION 02228 – CONSTRUCTION NOISE AND VIBRATION CONTROL

TABLE 02228-B, MONITORING SCHEDULE

INSTRUMENT	SCHEDULE
Noise meters	<p>Obtain noise measurements during the designated one-hour daytime monitoring period, in the Leq metric, and the designated one-hour nighttime monitoring period one week before construction begins at the selected noise monitoring locations to establish background noise levels.</p> <p>Obtain, obtain noise measurements during the designated one-hour daytime monitoring period, in the Leq metric, and the designated one-hour nighttime monitoring period each week during construction activities at the selected noise monitoring locations.</p> <p>Submit data reports weekly.</p>
Seismographs	<p>Continuously, in histogram mode (5-minute intervals), for one week before construction begins, to obtain background vibration levels.</p> <p>At the start of vibration-inducing construction activities, determine peak particle velocity and corresponding frequencies produced by single hammer blows or blasts or other vibration-producing activities to establish the maximum energy which can be used without surpassing acceptable vibration levels in nearby structures. Perform separate tests for each building.</p> <p>Continuously in histogram mode (5-minute intervals) during vibration-producing construction activities within 300 feet of seismograph location. Submit reports weekly.</p>

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SECTION 02260 – EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Furnish all labor, materials, tools, incidentals, and equipment necessary for furnishing, installing, and maintaining such excavation support which may be required to protect existing structures, roads, walkways, utilities, and other improvements against loss of ground or caving embankments without producing damage to adjacent structures, roads, walkways, and utilities, and to provide safe working conditions.
- B. Wood and steel sheeting
- C. Sheeting box
- D. Steel H-Section (soldier) piles, and lagging.

1.02 RELATED SECTIONS

- A. Section 02200 – Earthwork

1.03 PAYMENT

- A. The cost to install, remove, and/or leave sheeting in place shall be included in the bid price.

1.04 REFERENCES

- A. Occupational Safety and Health Standards - Excavations; Final Rule (29 CFR Part 1926) - OSHA Standards.
- B. ASTM A572 - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
- C. ASTM A36 - Standard Specification for Carbon Structural Steel.
- D. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength.
- E. AWD D1.1: Structural Welding Code.
- F. Southern Pine Inspection Bureau. (SPIB)

1.05 INFORMATIONAL SUBMITTALS

- A. Provide details of proposed excavation support system. Include the proposed method, sequence, and timing of all installation operations, catalog data and manufacturer's specifications for all equipment and materials and proposed means of protecting existing structures.
- B. Design and supporting calculations shall be prepared by or under the supervision of a Professional Engineer licensed in the State of New York. These documents shall bear the seal and signature of the professional engineer.

1.06 SUBMITTALS

- A. Submit installation record drawing for each temporary sheeting and bracing element to the Engineer not later than two (2) days after installation is completed. Include the project name and number, contractors, element locations, dimensions, tip elevations, cut-off elevations, deviations, and any unusual occurrences during installation.

1.07 QUALITY ASSURANCE

- A. Perform all work of this Section in accordance with OSHA Standards.
- B. Sheeting shall be installed by persons regularly engaged in sheeting installation and who have a minimum of five (5) years of experience with the type of system being installed.
- C. Sheeting shall be installed under the direct supervision of the professional engineer who designed the sheeting system. This does not require the professional engineer to be present during all phases of its installation, but does require him/her to inspect the work as the work progresses on a part time basis sufficient to adequately certify the system. He/she shall certify, in writing, that sheeting was installed in accordance with the supporting calculations and that the installer complied with recognized procedures, methods, and techniques.

SECTION 02260 – EXCAVATION SUPPORT AND PROTECTION

- D. An amount equal to 15% of the scheduled value will be withheld until the certification has been provided for record purposes only.

1.08 COORDINATION

- A. Coordinate work under provisions of Section 01005.
- B. Coordinate work with all other Sections requiring temporary sheeting and bracing.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Timbers: Douglas Fir Standard Grade or Southern Yellow Pine conforming to the requirements of the Southern Pine Inspection Bureau, with an extreme fiber bending stress of not less than 1200 psi. All timber shall be full size, i.e. not dressed. Used timber may be furnished if equal in strength to that of corresponding new timber. Where conditions require tight sheeting to prevent loss of ground, tongue and groove wood sheeting shall be used. Size and dimensions shall be capable of being driven to the required depths and capable of supporting excavation sides and soil pressures when braced; free from wormholes, wind shakes, loose knots, decayed or unsound portions or defects which would impair its strength or tightness; 3 inches (76 mm) thick minimum.
- B. Steel Sheeting: Corrugated "Z" shape cross-section; of size and dimensions capable of being driven to the required depths and capable of supporting excavation sides and soil pressures when braced; structurally sound; new or used and shall be of the continuous interlock type; special shapes for corner construction and transition points.
- C. Sheeting Boxes: Steel, of size and dimensions capable of supporting excavation sides and soil pressures; structurally sound.
- D. Structural Steel: ASTM A36.
- E. Tiebacks: ASTM A722 or ASTM A416.
- F. Welds: In accordance with AWS "Structural Steel welding Code – D1.1".
- G. Hardware: Bolts, nuts, and washers shall conform to the requirements of ASTM A307.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine the areas and conditions wherever support of excavation is to be installed.
- B. Conduct a pre-construction condition assessment and documentation of adjacent structures, on-site and off-site, affected by the work prior to the start of support of excavation operations. The pre-construction condition assessment shall consist of the Contractor and the Owner conducting a joint inspection of the condition of all structures affected by the work to establish their present condition. Prepare a record with photographs and written descriptions to record any conditions that may become the subject of possible damage claims.
- C. Verify that the installation of the sheeting will not fall within the restricted boundary line as may be delineated on the Contract Drawings.
- D. Verify that the existing soil substrate, site conditions, and elevations are as indicated on the plans.
- E. Verify proposed locations of excavations are as indicated on the plans.
- F. The method of sheeting shall be at the sole discretion of the Contractor.

3.02 PREPARATION

- A. Erosion control methods shall be placed prior to beginning the installation of sheeting.
- B. Excavate to a depth no greater than 4 feet (1.2 m) from existing grade.
- C. Assemble and drive the sheeting in accordance with shop drawings prepared by the Contractor's engineer.

SECTION 02260 – EXCAVATION SUPPORT AND PROTECTION

- D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage or other evidence of movement to ensure that systems are stable.
- E. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.
- F. Install excavation support and protection systems to insure that excessive or unusual loadings are not transmitted to any new or existing structure.
- G. Pile hammers may be impact or vibratory hammers. Maintain hammers in good operating condition and operate in accordance with the manufacturer's requirements. Fit hammer with an anvil base and/or jaws to hold/clamp the piles in proper alignment throughout installation.

3.03 INSTALLATION - SHEETING

- A. Drive sheeting in place to thoroughly support both sides of the excavation using a sheeting hammer. Use a steam or pneumatic hammer for steel sheeting.
- B. Water jetting of sheeting will not be permitted. Do not loosen adjacent ground that might result in collapse.
- C. Install wales and braces or shores tight and in accordance with shop drawings.

3.04 INSTALLATION - SHEETING BOX

- A. Place box in trench utilizing a means that will not damage structural integrity of the box.
- B. Excavate ahead of the sheeting box only enough to advance the sheeting box and only immediately prior to moving the sheeting box.
- C. Backfill on both sides of the sheeting box as it is moved.

3.05 MONITORING

- A. Monitor movement of the temporary sheeting and bracing systems as well as movement at adjacent structures, utilities and roadways near excavations and temporary sheeting and bracing systems.
 - 1. Fit all structures located adjacent to the subject work with a minimum of two (2) monitoring points in both the vertical and lateral direction.
 - 2. All cracks within structures located adjacent to the subject work shall be identified, and a crack monitor installed, during either the pre-construction surveys or installation of the monitoring points. The crack monitor shall be Avongard Calibrated Crack Monitor, or equal approved by the Owner.
 - 3. Read all monitoring points and crack monitors a minimum of two (2) times prior to the start of installation of temporary sheeting and bracing and/or excavation, a minimum of one (1) time per day during excavation support installation, immediately following the completion of the excavation support installation, immediately after the excavation achieves subgrade elevation, a minimum of two (2) times per week thereafter, and as directed by the Engineer and/or Owner.
 - 4. Monitoring entries/reports shall be identified by the date, time, and control point number.
 - 5. Stop all work and notify the Owner immediately if the recorded movement at any monitoring point reaches 1/4 inches.
 - 6. Submit a monitoring plan developed by the design engineer of the temporary sheeting and bracing.
 - 7. Conduct all pre-construction condition assessment and documentation of adjacent structures, on-site and off-site.
 - 8. Notify Engineer immediately of any sign of distress such as cracking or movement occurs in any adjacent structure, utility or roadway during installation of temporary sheeting and bracing, subsequent excavation, service period of supports, subsequent backfill and construction, or removal of temporary sheeting and bracing.
 - 9. Contractor shall be exclusively responsible to address damage to roadway, structure, utility, pipes, etc. both on-site and off-site, as a result of operations.

3.06 REMOVAL OF SHEETING

- A. Remove sheeting only as backfilling progresses.
- B. Carefully remove sheeting such that compacted backfill is not displaced. Removing sheeting in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities and utilities. Add additional backfill to the areas vacated by the sheeting. Promptly repair at own expense damage that can be reasonably attributed to removal of excavation support system.
- C. Remove all sheeting from the site once its use is no longer required.
- D. The Contractor may request permission to leave sheeting or bracing in place. The Engineer may grant permission on the condition that the cost of sheeting and bracing is borne by the Contractor.
- E. Sheeting where shown on plans to be left in place, shall be cut and removed to a depth of 5 feet (1.2 m) below finished grade elevation. Cost of sheeting and bracing to be left in place shall be borne by the Contractor.

END OF SECTION

**SECTION 02385 –
HELICAL FOUNDATION PILES**

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Helical piles and appurtenances for support of structures.

1.02 SUBMITTALS

- A. Submit under provisions of General Requirements.
- B. Product Data: Provide data on helical piles and appurtenances including washers and nuts.
- C. Shop Drawings: Indicate profiles, sizes, spacing and locations of helical piles, attachments, fasteners, connections, and rated loads. Design service life shall be 50 years. Provide erection and fabrication drawings. Indicate welded connections with AWS A2.0 welding symbols. Indicate net weld lengths. Shop drawings and erection drawings shall bear the seal and signature and a Licensed Professional Engineer registered in the State of New York.
- D. Written Installation Record (field log) of each helical pile prepared by a Special Inspector under the supervision of a Professional Engineer registered in the State of New York. The pile log shall bear the seal and signature and a Licensed Professional Engineer registered in the State of New York. These records shall include:
 - 1. Project name and location.
 - 2. Name of contractor's foreman or representative who witnessed the installation.
 - 3. Date and time of installation.
 - 4. Location and reference number of each pile.
 - 5. Description of lead section and extensions installed.
 - 6. Overall depth of installation referenced from bottom of foundation.
 - 7. Torque reading for the last three (3) feet of installation, if practical. In lieu of this requirement, the terminal torque shall be recorded as a minimum.
 - 8. Any other information relating to the installation.
- E. Welder's Certificates: Submit certificates certifying that welders employed on the work have met AWS qualifications within the previous 12 months.
- F. Submit copies of calibration reports for each torque indicator or torque motor, and all load test equipment to be used on the project. The calibration tests shall have been performed within forty-five (45) working days of the date submitted. Helical Pile installation and testing shall not proceed until the Owner has received the calibration reports. These calibration reports shall include, but are not limited to, the following information:
 - 1. Name of project and Contractor
 - 2. Name of testing agency
 - 3. Identification (serial number) of device calibrated
 - 4. Description of calibrated testing equipment
 - 5. Date of calibration
 - 6. Calibration data
- G. As-built Drawings: Submit for record purposes as-built drawings signed and sealed by a licensed professional engineer in New York. Indicate profiles, sizes, and locations of piles, attachments, fasteners, connections and rated loads.
- H. Manufacturer's Certificates: Certify that products meet or exceed specified requirements.

1.03 QUALIFICATIONS

- A. Fabricator: Company specializing in performing the work of this section with minimum 5 years documented experience.
- B. Installer: Company specializing in performing the work of this section with minimum 3 years documented experience.
- C. Design connections, not detailed on the drawings, shall be prepared under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of New York.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle products to the site under the provisions of this Section.
- B. Schedule deliveries of materials to the site at intervals, which will ensure uninterrupted progress of the work.
- C. Do not store or handle materials in a manner that will damage or distort materials or supporting structures.
- D. Do not store materials directly on the ground.
- E. Store materials in a manner that will permit easy access for inspection and identification.

1.05 FIELD MEASUREMENTS

- A. Verify that field measurements are as shown on the plans and approved shop drawings.
- B. The Contractor is responsible for the proper location and elevations of the work.

PART 2 - PRODUCTS

201 MATERIALS

- A. Helical Piles: Shall be designed to support the nominal compressive load as shown on the plans. The overall length, helix configuration and minimum effective torsional resistance of a helical pile shall be such that the required geotechnical capacity is developed by the helix plate(s) in an appropriate bearing stratum.
 - 1. Helical piles, extensions and appurtenances shall be hot-dip galvanized steel in accordance with ASTM-A153.
 - 2. Shaft: Steel hollow shaft round with 3.5" Ø.
 - 3. The helical pile shafts and plates shall receive a hot-dip galvanized steel coating to protect against corrosive elements in the soil.
- B. Structural Steel Members: ASTM A36.
- C. Welding Materials AWS D1.1: type required for materials being welded.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work of this Section.
- B. Beginning of installation means installer accepts existing conditions.

3.02 INSTALLATION

- A. All helical piles should be installed as shown on the approved shop drawing. All changes in pile location shall be approved by the Contractor's engineer prior to installation.
- B. The Contractor shall obtain the services of a licensed Professional Engineer registered in the State of New York to supervise all helical pile operations. The supervisory engineer shall keep a complete record (log) of the pile installation operation.
- C. Helical piles shall be installed to a minimum torque of 3000 ft. lbs. subject to the following provisions:
 - 1. If the minimum torque requirement has not been satisfied at the maximum depth level, the Contractor shall have the following options:
 - a. Install the pile deeper using additional extensions until the specified torque level is obtained.
 - b. Remove the existing pile and install a pile with larger and/or more helices. The revised pile shall be installed beyond the termination depth of the original pile, as directed by the engineer.
 - c. Add additional piles as recommended by the Engineer.
 - 2. If the maximum torque rating of the pile and/or installing unit has been reached prior to satisfying the minimum depth requirement, the Contractor shall have the option to:
 - a. Increase the terminal torque to a maximum of 10,000 ft. lbs.
or
 - b. After consulting with the Engineer of record, the Contractor may reduce the size of the helix as required to achieve the minimum depth while still achieving the minimum torque.
 - 3. Installation equipment shall have clockwise and counter-clockwise rotation capabilities and be capable of applying adequate down pressure and torque simultaneously to suit project soil conditions and load requirements.
- D. If underground obstructions are encountered during installation, the Contractor shall have the option of removing the obstruction if possible or relocating the pile with the Engineer's approval the later option may require the relocation of adjacent piles.
- E. The helical pile shall be connected to the structure using a PTS approved steel bracket or slab-supporting channel as shown on the Engineer's Plan. These connection devices shall be capable of safely transferring the structural loads to the helical pile.
- F. Helical Pile Installation shall comply with the Building Code of New York City as well as NYC Building Code Bulletin 2014-20.

3.03 FIELD QUALITY CONTROL

- A. Field supervision by a Licensed Professional Engineer registered in the State of New York shall be provided by the Contractor. The cost for the supervision will not be eligible under the cash allowance for testing.

- B. Field inspection will be performed under provisions of this Section.
- C. Helical pile plumbness shall be within 2 degrees of design alignment.
- D. Top elevation of helical pile shall be within +1 inch to -2 inches of design vertical elevation.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope:
 - 1. Provide all labor, materials, equipment and inci-dentals as shown, specified, and required to do landscape work on all areas used by the Contractor for the Work, and on all areas disturbed by the Contractor's construction activities. This includes seeding/sodding around the new facility and manholes.
 - 2. Types of work required include, but are not limited to, the following:
 - a. Provide topsoil from off-site sources if topsoil stockpiled under Section 02200, Earthwork, is insufficient to complete the Work of this Section.
 - b. Provide new turf areas and recondition existing turf areas.
 - c. Provide mulches and all other material necessary to complete the seeding job as specified.
 - d. Maintenance work as specified.
 - e. Provide soil amendments, fertilizers, wood pine chunk bark and miscellaneous materials.
 - f. Provide sod (an alternate to seeding).
 - g. Remove where noted existing shrubs and trees from areas of new construc-tion, store and re-plant on-site where directed by Engineer.
- B. Coordination:
 - 1. Review installation procedures under other Sections and coordi-nate the installation of items that shall be installed with the land-scaping.
 - 2. Obstructions Below Ground and Utilities: Exercise extreme caution in all operations, as there are underground electric, traffic signal and telephone cables, sewer lines and water lines throughout the entire area. Study and be familiar with the location of these obstructions and underground utilities. Repair all damage to obstructions and underground utilities at no expense to the Owner.
- C. Related Sections:
 - 1. Section 02110, Clearing.
 - 2. Section 02200, Earthwork.

1.02 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Work under this section shall be done by workers specialized in landscape work. Provide the services of a foreman with 2-years minimum experience in the planting and caring of plant material who will personally supervise all Work.
- B. SOURCE QUALITY CONTROL:
 - 1. Analysis and Standards: Package standard products with manufac-turer's certified analysis. For other materials, provide analy-sis by recognized laboratory made in accordance with methods established by the Association of Official Analytical Chemists, wherever applic-able or as further speci-fied.
 - 2. Topsoil stockpiled for reuse: Topsoil will be inspected by the Engineer before reuse. At the time of inspection, the Engineer may re-quire representative soil samples to be tested for physical properties, hydrogen-ion value, organic matter, and available phosphoric acid and potassium. Supply twenty-pound samples to the Owner for testing. If deficiencies in the topsoil are found from this analysis, correct at no additional expense to the Owner.
 - 3. Provide sod procured from areas having growing conditions similar to those areas on which the sod is to be used.
 - 4. Machine-cut sod into rectangular sections, exercising care to retain the native soil on the roots of the sod, during strip-ping, transportation and planting.
 - 5. Cut and move sod only when soil moisture conditions are such that favorable results can be expected.

SECTION 02485 – GRASSING AND PLANTINGS

6. Rectangular sections of sod may vary in length but shall be equal in width and of a size that permits the sod to be lifted and rolled without breaking.
7. Caliper trees up to 4 inches in caliber at a point 6 inches above ground and trees over 4 inches in caliber 12 inches above ground.
8. Do not use woody plant material from regions south of latitude 39 degrees unless such material has been lined out in nurseries located north of latitude 39 degrees for at least 2 growing seasons. Latitude 39 degrees is approximately a line from Annapolis, MD to Cincinnati, OH.
9. Reference Standards: Comply with applicable provisions and recommendations of the following, except where otherwise shown or specified.
 - a. ASTM C602 - Agricultural Liming Materials.
 - b. ASTM D2487 - Classification of Soils for Engineering.
 - c. Association of Official Analytical Chemists, Official Methods of Analysis.
 - d. Official Seed Analysis of North America, Standards of Quality.
 - e. FSO-F-241D, Fertilizer, Mixed, Commercial.
 - f. FSO-P-166E, Peat Moss; Peat, Humus; and Peat, Reed-sedge.
10. Plant Nomenclature: Conform to the latest edition of "Standardized Plant Names" as adopted by the American Joint Committee of Horticultural Nomenclature (AJCHN).
11. Size and Grading Standards: Conform to the current edition of "American Standard for Nursery Stock" (ASNS) - Sponsor - the American Association of Nurserymen Inc. (AANI), unless otherwise specified.

1.04 SUBMITTALS

- A. Samples: Submit for approval the following:
 1. Wood pine chunk bark: One pound bag.
- B. Shop Drawings: Submit for approval the following:
 1. List of Plants: Before plant material is shipped to the project site, submit a complete itemized list of all plants including the source of supply.
 2. Planting schedule showing scheduled dates for each type of plant-ing in each area of Site.
 3. Before delivery of off-site topsoil, written statement giving the location of the properties from which the topsoil is to be obtained, the names and addresses of the suppliers, the depth to be stripped and the crops grown during the past 2 years.
 4. Manufacturer's specifications and installation instructions for all materials required.
- C. Tests by the Owner: Submit topsoil, seed, soil amendments and fertilizer to the Owner's testing facility for testing:
 1. Before delivery of off-site topsoil, a soil analysis will be made by the Owner's testing laboratory for porosity, the percentages of silt, clay, sand and organic matter and the pH and the mineral and plant nutrient content of the topsoil. Supply topsoil with 5 percent minimum organic matter.
 2. Before delivery of seed, soil amendments and fertilizer an analysis will be made by the Owner's testing laboratory stating the mechanical and chemical analysis of the materials proposed for use.
- D. Certificates: Submit for approval the following:
 1. Certificates of inspection as may be required by governmental authorities to accompany shipments, and manufacturer's or vendors certified analysis for soil amendments and fertilizer materials. For standard products submit other data substantiating that materials comply with specified requirements.
 2. Certificates from seed vendors certified statement for each seed mixture required, stating botanical and common name, percentage by weight and percentages of purity, germination, and weed seed for each species.
 3. Before delivery of sod, submit written statement giving the location(s) of the property from which the sod is to be obtained and the names and addresses of the suppliers.
 4. Certificates of inspection substantiating that sod contains no noxious weeds or other material that might be detrimental to the proposed planting.

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5. Furnish with each planting material delivery sizes and variety of plant material, certificates of inspection required by State and Federal agencies, label for each plant indicating name and size.

1.04 JOB CONDITIONS

- A. Environmental Requirements:
 1. Proceed with and complete the Work as rapidly as portions of the Site become available, working within the seasonal limitations for each kind of landscape work required.
 2. Do not spread seed when wind velocity exceeds 5 miles per hour.
 3. Do not seed when drought, or excessive moisture, or other unsatisfactory conditions prevail.
- B. Scheduling:
 1. Seed or install materials only during normal planting seasons for each type of work required. Correlate seeding with specified maintenance periods to provide maintenance until completion of Work.
 2. Sod: Time delivery so that sod will be placed within 24 hours after stripping.
 3. Protect sod against drying and breaking of rolled strips.
 4. If sod is stacked place roots to roots or grass to grass.
 5. Protect sod from exposure to wind and sun and from freezing.
 6. Plant deciduous, woody plants between September 15 and May 15 whenever temperature is above 40 degrees F and soil is in workable condition, unless otherwise approved in writing.
 7. Plant evergreens between August 15 and September 15 or during April or May before the start of new growth.
 8. Plant Bare root Perennials between April 15 to May 30; Field Potted to Container Grown Perennials April 15 to October 15.
 9. If project requires planting to occur at other times or deciduous plants are in-leaf, spray plants with anti-desiccant prior to planting operations.

1.05 GUARANTEE

- A. Guarantee turf and plantings through the specified maintenance period.
- B. Replacement plantings shall be guaranteed an additional twelve (12) months.

1.06 ALTERNATES

- A. The Contractor, with the approval of the Engineer, may substitute sod as specified herein for the seeding specified. Submit a request to the Engineer in writing.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Topsoil:
 1. Stockpile topsoil for re-use in landscape work. If quantity of stockpiled topsoil is insufficient, provide additional topsoil as required to complete landscape work.
 2. Provide off-site topsoil as required, which is fertile, friable, natural loam, surface soil, capable of sustaining vigorous plant growth, free of any admixture of subsoil, clods of hard earth, plants or roots, sticks or other extraneous material harmful to plant growth. Supply topsoil with the following analysis:
 - a. 3/4-inch: 100 percent passing
 - 1) 1/4-inch: 97-100 percent passing
 - 2) No. 100: 40 to 70 percent passing
 - 3) No. 200: 20 percent minimum
 - b. pH 5.0 to pH 7. If approved by the Engineer, natural topsoil not having the hydrogen-ion value specified may be amended by the Contractor at his own expense.
 - c. Organic content not less than 5 percent, not more than 20 percent.
 - d. Free of pests and pest larvae.
- B. Soil Amendments:

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1. Lime: Natural limestone containing not less than 80 percent of total carbonates, ground so that not less than 100 percent passes a 10-mesh sieve, not less than 70 percent passes a 100-mesh sieve and not less than 50 percent passes a 200-mesh sieve.
 2. Superphosphate: Soluble mixture of treated minerals; approxi-mate 0-20-0 formulation, 18 percent available phosphoric acid.
 3. Commercial Fertilizer: Complete fertilizer of neutral charac-ter, with a minimum of 50 percent nitrogen derived from natural organic sources or urea form; 50 percent of the nitrogen shall be inorganic. Available phosphoric acid derived from superphos-phate, bone, or tankage. Potash derived from muriate of potash, containing 60 percent potash. Uniform in composition, free-flowing and suitable for application with approved equipment. Provide fertilizer with the following percentages of available plant nutrients:
 - a. For turf, provide fertilizer with not less than 6 percent phos-phoric acid and not less than 4 percent potassium, and nitrogen not less than 10 percent. Provide nitrogen in a form that will be available to the turf during the initial period of growth.
 4. Sand: Washed of fine to medium texture.
- C. Turf Materials:
1. Lawn: Seed shall be state-certified seed of the latest season's crop and shall be delivered in original sealed packages bearing the producer's guaranteed analysis for percentages of mixtures, purity, germination, weedseed con-tent, and inert material. Seed shall be labeled in confor-mance with U.S. Department of Agricul-ture rules and regula-tions under the Federal Seed Act. Seed that has become wet, moldy, or otherwise damaged will not be accept-able. On-site seed mixing shall be done only in the presence of the Owner. The seed mixture shall be proportioned as follows:
 2. Mixtures:
 - a. Mixture A to be seeded, in general, on areas not regularly mowed.

MIXTURE A	Mixture		Germination	
	Tolerance	Tolerance		
Proportions of Mixture	Minus	Plus	Germination	Minus
25% Lynn Rye	3%	5%	90%	6%
25% Baron Blue	3%	5%	85%	7%
25% Penn Fine Rye	6%	3%	5%	6%
25% Mustang Fescue	6%	3%	5%	6%

- b. Mixture B to be seeded, in general, on areas regularly mowed and well-maintained.

MIXTURE	Mixture		Germination	
	Tolerance	Tolerance		
Proportions of Mixture	Minus	Plus	Germination	Minus
50% Merion Blue Grass	3%	5%	80%	7%
30% Penn Lawn Fescue	3%	5%	90%	6%
20% NK106 Hybrid Rye	3%	5%	85%	7%

- D. Miscellaneous Landscape Materials:
1. MULCH:
 - a. Anti-Erosion Mulch: Provide clean, seed-free wood fiber.

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- b. Product and Manufacturer: Provide one of the following:
 1. Superior Fiber as manufactured by Wolbert Master and Associates, Inc.
 2. Silva Fiber as manufactured by Weyerhaeuser Corporation.
 3. Or equal.
 4. Water: Potable.
 5. Base Film: Provide 10 mil thick black polypropylene film in 10-foot widths.
 6. Chunk Bark Mulch: Provide chunks of pine wood mulch with a nominal face dimension of 2 to 4 inches to a minimum finished depth of 5 inches.
 7. Wrapping: Provide a standard manufactured tree wrapping paper, brown in color, two layers cemented together by asphaltum, crepe surface. Provide twine for tying, lightly tarred, medium coarse sisal (lath) yarn.
 8. Stakes, Deadmen and Guy Stakes: Sound, durable White or Red Cedar, or other approved wood, free of insect or fungus infestation.
 9. Guy Wire or Cable: No. 12 galvanized iron wire or cable.
 10. Protective Hose: 2-ply garden hose cut to required lengths to protect tree trunk's from damage by wires.
 11. Tree Wound Paint: Antiseptic, waterproof, adhesive, elastic tree wound paint containing no kerosene, coal tar, creosote, or other material harmful to cambium or living tissue.
 12. Anti-desiccants: Wilt-Pruf by Wilt-Pruf Products, Inc., P.O. Box 469, Essex, CT 06426, (203) 767-7033.
- E. Sod: Provide strongly rooted machine-cut sod, not less than 2 years old and free of seeds and undesirable native grasses. Provide only sod capable of growth and development when planted (viable, not dormant) and in strips not more than 18-inches wide by 14 feet-0 inches long by 1-1/2 inches thick (excluding top growth and thatch). Provide sod composed of mixture B above.
- F. Trees and Shrubs:
1. All plant materials used shall be true to botanical name, size and shall be legibly tagged in conformity with AJCHN and ASNS standards:
 2. Varieties: Names of varieties not listed conform generally with names accepted by the nursery trade.
 3. Nursery grown stock.
 4. Acclimated plants true to genus and species.
 5. Well-developed root and branch systems. Do not prune branches before delivery.
 6. Free of disease, insect eggs, bark abrasions, and disfiguring knots.
 7. Buds intact and reasonably closed at time of planting.
 8. Balled and burlapped from soil which will hold a natural solid ball of earth of minimum specified size held in place securely by burlap and stout rope. Broken, loose, or manufactured balls will be rejected.
 9. Conform to size indicated or larger, or within the minimum maximum size when so indicated. Larger plants cut back to specified dimensions will not be accepted.
 10. 10. Substitutions: No substitutions shall be accepted, except with the written approval from the Owner's Representative.
- G. Trees:
1. Single erect leader from ground to top, surrounded with uniformly arranged branches unless otherwise specified in the plant list.
 2. Free from frost cracks, broken bark, and dead or broken branches.
 3. Transplanted, or root pruned 360 degrees at least once during the previous 3 years.
- H. Herbaceous Perennial Plants
1. Container-grown plants -- grown to a specified size in a container.
 2. Bare root plants -- purchased free of any growing medium regardless of growing method.
 3. Bare root plants will not be accepted as substitutes for specified container grown plants.
 4. Field-potted plants -- field-grown plants where are potted for delivery as they are dug from the field.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine the subgrade, verify the elevations, observe the conditions under which the grassing work is to be performed, and notify the Engineer of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.
- B. Inspect existing trees and shrubs to be relocated for injury and insect infestation. Prune as required before moving. Discard damaged trees and shrubs as directed by the Engineer.
- C. Do not begin moving or storing of trees until deficiencies are corrected.

3.02 PREPARATION

- A. Determine location of underground utilities and perform Work in a manner which will avoid possible damage. Hand excavate, as required, to minimize possibility of damage to underground utilities. Maintain grade stakes until removal is mutually agreed upon by all parties concerned.
- B. Layout individual tree and shrub locations and areas for multiple plantings. Stake locations and outline areas and secure the Engineer's acceptance before start of planting work. Make minor adjustments as may be requested.
- C. Move existing trees with full ball of earth. Take all measures necessary to avoid breaking earth ball. Dig earth ball same diameter as drip line of tree and to a depth 1/2 the diameter of earth ball minimum. Do not cut roots over 1/2-inch in diameter. Alter earth ball shape as required to avoid cutting roots. If trees cannot be planted immediately, cover earth ball with planting soil and maintain in moist condition. Keep plants out of full sun. Support plants with stakes to maintain upright and stable position. Plant as specified herein. Apply anti-desiccant as specified herein. Trees lost due to improper moving techniques shall be replaced in kind and size at no additional expense to the Owner.
- D. Seedbed Preparation:
 - 1. Loosen subgrade of seedbed areas to a minimum depth of 4 inches. Remove stones over 1-1/2 inches in any dimension and sticks, roots, rubbish and other extraneous matter. Limit preparation to areas that will be planted promptly after preparation.
 - 2. Spread topsoil to minimum depth of 6 inches after natural settlement and light rolling. Do not spread topsoil while in a frozen or muddy condition.
 - 3. Apply ground limestone, by machine, at a rate of 2,000 pounds per acre over all areas to receive turf, as required, to bring the soil to a neutral pH. Work lightly into the top 3 inches of topsoil at least five days before applying the commercial fertilizers.
 - 4. Apply commercial fertilizers at a rate of 1500 pounds per acre within 10 days of seeding.
 - 5. Thoroughly and evenly incorporate commercial fertilizers with the soil to depth of 3 inches by dicing, or other approved method. In areas inaccessible to power equipment, use hand tools.
 - 6. Apply superphosphate at the rate of 20 pounds per 1000 square feet and incorporate into the top 3 inches of topsoil.
 - 7. Grade seedbed areas to smooth, even surface with loose, uniformly fine texture. Remove all stones and extraneous foreign material in excess of 1 inch in diameter. Roll and rake and remove ridges and fill depressions, as required to meet finish grades. Limit fine grading to areas which can be planted immediately after grading.
 - 8. Moisten prepared seedbed areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting. Do not create a muddy soil condition.
 - 9. Restore turfed areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.
- E. Preparation of Planting Beds:
 - 1. Remove all existing soil from planting beds to the depth required so that finished plantings are level with adjacent final lines, grades and elevations after addition of planting soil to the depth shown on the Drawings and after light rolling and natural settlement.

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2. Loosen subgrade of planting bed areas to a minimum depth of 6-inches using a culti-mulcher or similar equipment. Remove stones over 1-1/2-inches in any dimension, and sticks, stones, rubbish and other extraneous matter.
 3. Place approximately 1/2 of total amount of planting soil required. Apply 10 pounds of superphosphate per 1000 square feet of bed. Work into top of loosened subgrade to create a transition layer, then place remainder of the planting soil.
- F. Excavation for Trees and Shrubs:
1. Excavate pits with vertical sides and with bottom of excavation slightly raised at center to provide proper drainage. Loosen hard subsoil in bottom of excavation.
 - a. For existing trees and shrubs to be replanted, make excavations at least twice as wide as the ball diameter and equal to the ball depth, plus the following allowance for setting of ball on a layer of compacted backfill:
 - 1) Allow for 6-inches setting layer of planting soil mixture.
 2. Dispose of subsoil removed from landscape excavation. Do not mix with planting soil or use as backfill.

3.03 INSTALLATION

- A. Planting Trees and Shrubs:
1. Set existing trees to be replanted on layer of compacted planting soil mixture, plumb, and hold rigidly in center of pit or trench with top of ball at same elevation as adjacent finished landscape grades. Maintain previous relationship that plant had to existing soil line at trunk or main leader. Do not set plants in depressions or on mounds. When set, place additional backfill around base and sides of ball, and work each layer to settle backfill and eliminate voids and air pockets. When excavation is approximately 2/3-full, water thoroughly before placing remainder of backfill. Water again after placing final layer of backfill. Remove burlap from top and sides of balls; retain on bottoms.
 2. Dish top of backfill to allow for mulching. Provide dish 4 feet in diameter approximately 4-inches deep around each tree.
 3. For spring planting, provide additional backfill berm around edge of excavations to form shallow saucer to collect water.
 4. Place water permeable base film over finished planting beds prior to placing planting bed mulch.
 - a. Lap joints 4-inches minimum.
 - b. Use one hold down pin per 4 square feet of film.
 - c. Take precaution not to tear or puncture base film further when placing planting bed mulch.
 5. Mulch pits, trenches and planted areas. Provide not less than 5-inches of planting bed mulch and finish level with adjacent finish grades.
 6. Guying/Staking: Deciduous and evergreen trees, shall immediately after setting to proper grade, be guyed with stakes and no. 12 gauge malleable galvanized wire. Wires shall not come in contact with the tree, but shall be covered with rubber hose at points of contact. Set tree stakes into solid ground below bottom of plant before backfilling. Place stakes at the outer edge of the roots or ball in line with the prevailing wind at a 10 degree angle from the tree trunk. Stakes shall not be driven where utility lines are within five feet of finished grade, but shall be placed by digging holes for them. All stakes shall be placed outside the perimeter of planting pits. Safety flags shall be hung on all wires. Plants shall stand plumb after staking and all stakes and wires are to be maintained.
 7. Pruning: Prune immediately after planting using sharp tools. Remove approximately 1/3 of the wood of deciduous plants, maintaining the natural habit of the plant. Broken or badly bruised branches shall be removed with a clean cut. Cut no leaders. No plants shall be pruned prior to delivery. Paint pruning cuts 3 inches in diameter or over with tree wound paint.
 8. Fertilizing: Fertilizer shall be a slow release soluble type. Fertilizer shall be equally distributed around each plant in accordance with recommendation of fertilizer manufacturer for each type of plant.

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9. Mulching: After planting has been approved by the Owner, place a layer of shredded wood fiber mulch, two to three inches thick around plants. The boundaries of this mulch shall be six inches greater in diameter than the planting pit. All shrub beds shall be completely covered with mulch. Water plants thoroughly after mulching.
- B. Seeding:
1. Seed only between April 15 and May 30 and between August 15 and October 1.
 2. Sow seed at a rate of 150 pounds per acre using a spreader or seeding machine.
 3. Distribute seed evenly over entire area by sowing equal quantity in 2 directions at right angles to each other.
 4. Sow not less than the quantity of seed specified.
 5. Cultivator-packer, or approved similar equipment, may be used to cover the seed and to firm the seedbed in one operation. In areas inaccessible to cultivator-packer:
 - a. Rake the seeded ground and roll in two directions with a water ballast roller, weighing not less than 100 pounds per linear foot.
 - b. Take care during raking that seed is not raked from one spot to another.
 6. Protect seeded areas against erosion by spreading specified lawn mulch after completion of seeding operations.
 - a. Protect seeded areas against hot, dry weather or drying winds by applying straw mulch not more than 24 hours after completion of seeding operations.
 7. Do not leave seeded areas unmulched for longer than 3 days. Reseed areas which remain without mulch for longer than 3 days.
 8. Mulch shall be spread uniformly over the seeded area at the rate. Recommended by the manufacturer in writing.
 9. Prevent foot or vehicular traffic, or the movement of equipment, over the mulched area. Reseed areas damaged as a result of such activity.
 10. Water seeded areas thoroughly with a fine spray.
- C. Hydro-Seeding:
1. Hydro seeding may be substituted for mechanical seeding with the approval of the Owner.
 2. All requirements of "Seeding" hereinbefore specified shall apply except as modified herein.
 3. Areas to be hydro-seeded shall be scarified sufficiently to break up the surface crust immediately before seeding as approved by the Owner except where the ground is loose and friable as immediately following grading or as otherwise approved.
 4. Hydro-seeder slurry shall be a homogeneous mixture of seed, mulch, limestone and fertilizer that shall remain in suspension in water under agitation. The slurry shall be evenly distributed over the area to be seeded and shall be applied in accordance with the following application rates per acre of surface seeded.
 5. 6,000 gallons of water, 2,000 pounds of wood fiber mulch, 200 pounds of grass seed mixture, 1,200 pounds of ground limestone, 90 pounds of 10-6-4 fertilizer.
 6. Grass seed mixture used for Hydro-Seeding shall conform to "Mixture A" as specified in this Section.
- D. Reconditioning Existing Turf:
1. Recondition areas outside of the clearing line damaged by the Contractor's operations including storage of materials and equipment and movement of vehicles. Also recondition existing turf areas where minor regrading is required.
 2. Provide fertilizer, seed or sod and soil amendments as specified for new turf and as required to provide a satisfactory reconditioned turf. Provide new topsoil as required to fill low spots and meet new finish grades.
 3. Cultivate bare and compacted areas thoroughly to provide a satisfactory planting bed.
 4. Remove diseased and unsatisfactory turf areas; do not bury into soil. Remove topsoil containing foreign materials resulting from the Contractor's operations including oil drippings, stone, gravel and other loose building materials.
 5. In areas approved by the Engineer, where substantial turf remains (but is thin), mow, rake, aerate if compacted, fill low spots, remove humps and cultivate soil, fertilize, and seed.

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Remove weeds before seeding or if extensive, apply selective chemical weed killers as required. Apply a seedbed mulch, if required, to maintain moist condition.

6. Water newly planted areas and keep moist until new turf is established.
- E. Sodding Lawns:
1. Do not lay sod on ground that is frozen, dust dry or that has not been uniformly prepared as specified.
 2. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod strips; do not overlap. Stagger strips to offset joints in adjacent courses. Work from boards to avoid damage to subgrade or sod.
 3. Place sod strips in straight lines parallel to one another.
 4. Immediately upon completion of a section of sodding, tamp, roll lightly and water, to ensure contact with subgrade and elimination of air pockets.
 5. Work sifted soil into minor cracks between pieces of sod; remove excess to avoid smothering of adjacent grass.
 6. Peg sod on slopes as required to prevent slippage. Use 1-inch by 1-inch by 6-inch wooden pegs with one end sharpened.
 7. Water sod thoroughly with a fine spray immediately after planting. Water sufficiently to insure penetration of moisture to bottom of prepared topsoil layer not just to bottom of sod blanket.

3.04 MAINTENANCE

- A. Begin maintenance immediately after planting.
- B. Maintain turf for 60 days minimum, and longer as required to establish an acceptable stand, as determined by the Engineer.
- C. Supply required irrigation materials, equipment, and water.
- D. Maintain lawns by watering, fertilizing, weeding, mowing, trimming and other operations such as rolling regrading and replanting as required to establish a smooth, acceptable lawn, free of eroded or bare areas.
 1. Cutting Height: Mow lawns as soon as there is enough top growth to cut with mower set at the specified height for the principal species planted. Repeat mowing as required to maintain specified height. Do not remove more than 1/3 of grass height. Do not mow when grass is wet. Time initial and subsequent mowings as required to maintain the following grass height:
 - a. Mow grass at 2-1/2-inch height. Do not mow lower than 1-1/2 inches.
 2. Apply fertilizer after first mowing and when the grass is dry. Use fertilizer that will provide not less than 1.0 pound of actual nitrogen per 1000 square foot of lawn area.
 3. Maintain grass for at least one mowing or for specified period whichever is first.
 4. After grass has started, reseed repeatedly all areas greater than 8 inches square which fail to show a uniform stand of grass for any reason whatsoever until all areas are covered with a satisfactory stand of grass, as determined by the Engineer, is achieved.
- E. Maintain plantings immediately following planting operations and continue throughout the guarantee period. Establishment of plantings shall consist of keeping plants in healthy, growing conditions by watering, weeding, cultivating, pruning, spraying, tightening of guys, re-mulching and by any other necessary operations of establishment. Water all plants at least once a week between April 1 and October 31 with approximately 5 gallons per square yard (1-inch layer of water) per watering unless otherwise directed. Provide additional watering during periods of dry weather when required or when directed. Treat plants with good horticultural preventative or remedial measures to control insects, diseases or rodents.

3.05 CLEANUP AND PROTECTION

- A. During landscape work, store materials and equipment where directed. Keep pavements clean and work area in an orderly condition.

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- B. 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.
- C. Remove all rubbish, equipment and rejected materials from the Site.
- D. Protection includes all temporary fences, barriers and signs and other work incidental to proper maintenance.

3.06 INSPECTION AND ACCEPTANCE

- A. When the Work is completed, including maintenance, the Engineer will make an inspection to determine acceptability.
- B. Where inspected Work does not comply with the requirements, replace re-jected Work and continue specified maintenance until rein-spected by the Engineer and found to be acceptable.

END OF SECTION

SECTION 02505 – LEAKAGE TESTS

PART 1 – GENERAL

1.01 DESCRIPTION

- A. This Section includes requirements for leakage testing for all pipelines and structures required to be watertight or airtight.

1.02 PAYMENT

- A. Payment for work furnished and installed under this Section shall be included in the lump sum price bid for the Contract, as described in Section 01150 – Measurement and Payment.

1.03 REFERENCES

- A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced Specifications, codes, and standards refer to the most current issue available at the time of Bid.
 1. ACI 350.1R – Testing Reinforced Concrete Structures for Watertightness.
 2. ASTM C361 – Reinforced Concrete Low-Head Pressure Pipe.
 3. AWWA C600 – Installation of Ductile Iron Water Mains and Their Appurtenances.
 4. New York State Building Code.

1.04 SUBMITTALS

- A. All submittals, including the following, shall be provided as specified in the General Conditions.
- B. Submit testing procedures for approval at least thirty (30) days prior to the test.
- C. Testing Report: Prior to placing the piping system or structure in service, submit for review and approval a detailed bound report summarizing the leakage test data, describing the test procedure and showing the calculations on which the leakage test data is based.

1.05 QUALITY ASSURANCE

- A. Written Notification of Testing: Provide written notice at least two weeks prior to date of testing.
- B. Do not conduct tests without an approved written procedure.
- C. Conduct leakage tests in the presence of the Engineer. Repeat tests in the presence of local authorities having jurisdiction if required by them.
- D. Furnish all labor, equipment, air, water and materials, including meters, gauges, blower, pumps, compressors, fuel, water, bulkheads, temporary weirs, valves, plugs and accessory equipment.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 GENERAL

- A. Test all pipelines and structures required to be watertight or airtight for leakage. Repair or replace piping and structures which fail the leakage test to the satisfaction of the Engineer and retest until leakage test results are acceptable.
- B. Operation of Existing Facilities: Conduct all tests in a manner to minimize as much as possible any interference with the day-to-day operations of existing facilities or other contractors working on the site.
- C. Test drain lines by an Infiltration Test as specified.
- D. Test all other pipelines with water under the specified pressures.
- E. Test vents and drains in plumbing systems and all cast iron soil pipe lines in accordance with the New York State Building Code unless otherwise specified. Unless specified otherwise, test all vents and drains on process piping as for plumbing systems.
- F. Leakage in pipelines of other-than-circular section shall not exceed an amount based on a circular section having an equivalent inner perimeter.

3.02 – PRESSURE TESTS OF EXPOSED PIPING

- A. Testing: Pressure test exposed pipelines for leakage by maintaining the fluid in the pipe at the specified pressure for a period of one (1) hour. Examine all accessible joints during the test. Stop all visible leakage.
- B. Test Pressures: Test the various pipelines at the test pressures shall be verified in the field for the existing pipes.

3.03 – PRESSURE TESTS OF BURIED OR CONCEALED DUCTILE IRON PIPELINES

- A. Testing:
 - 1. Completely backfill all harnessed sections of buried piping before such sections are tested. Non-harnessed sections of buried piping shall be tested before backfilling.
 - 2. Pressure test buried or concealed pipelines for leakage by maintaining the fluid in the pipe at the specified pressure for a minimum period of 4 hours.
 - 3. Pressure test the piping for leakage as a whole or in sections, valved or bulkheaded at the ends. Apply the specified pressure to the piping through a tap in the pipe by means of a hand pump or other approved method. Do not use air for testing.
 - 4. Test the piping at the test pressures specified in the Specifications.
 - 5. Allowable Leakage: Stop all visible leakage. Do not allow leakage for any piping, as determined by the above test, to exceed the allowable leakage for ductile iron water mains as given by the following formula in Section 4 of AWWA C600 in which L is the allowable leakage in gallons per hour, S is the length of water main tested in feet, D is the nominal diameter of the pipe in inches and P is the average test pressure in psi gauge:
 - a. $L = S \times D \times (P)^2$
 - b. 133,200

3.04 – VALVE TESTING

- A. Testing: Operate valves in the section under test through several complete cycles of closing and opening. In addition, have the test pressure for each valve, when in the closed position, applied to one side of the valve only. Test each end of the valve in this manner.
- B. Test Pressure: Test each valve at the same test pressure as that specified for the pipe in which the valve is installed.
- C. Leakage: Stop all external and internal leakage through the valves.
- D. Movement: Stop all valve movement or structural distress.

3.05 – LEAKAGE TESTS FOR GRAVITY SEWERS

- A. Submerged Testing Procedure: When the groundwater level is above the sewer, test sewers for infiltration as follows:
 - 1. Measure the infiltrated flow of water by means of a weir set up in the invert of the sewer at a known distance from a temporary bulkhead or other limiting point of infiltration.
 - 2. Test after the sewer or sewers have been pumped out, if necessary.
 - 3. Do not start testing until normal infiltration conditions are established in the work to be tested.
 - a. Inspect gravity sewer visually for infiltration.
 - b. Pump the sewers dry and make sure the groundwater level is above the crown of the sewer.
 - c. Inspect the sewer on the inside, and seal all visible leaks completely.
- B. Non-submerged Testing Procedure: If the groundwater level is below the top of the sewer, test for leakage as follows:
 - 1. Construct a bulkhead in the sewer at the manhole at the lower end of the section under test.
 - 2. Fill the section being tested with water until the level of water is 4-feet above the crown of the sewer in the manhole at the upper end of the test section. For concrete sewers, allow the water to remain in the piping for at least twelve (12) hours before conducting the tests.
 - 3. Leakage will be the measured amount of water added to maintain the water at that level.

SECTION 02505 – LEAKAGE TESTS

4. Carry on tests for a minimum of eight (8) hours with readings at one (1) hour intervals.
5. In computing the length of sewer contributing infiltration or leakage, include the length of house connections tested, if any, in the total length.
6. The quantity of infiltration or leakage for sewers shall not exceed 100 gallons per inch of diameter per mile per 24 hours for any section of the system.
7. Repair: When the measured infiltration or leakage exceeds the specified amount, locate and repair defective manholes, pipe or pipe joints. If the defective portions cannot be located, remove and reconstruct as much of the original work as necessary to obtain a sewer within the allowable infiltration limits upon such retesting as necessary.
8. Regardless of the amount of infiltration or leakage measured, repair and seal in an approved manner all visible or detectable leaks in the sewers, manholes, structures, and other appurtenances.

3.06 REPAIR OF PIPING LEAKS

- A. Procedures: Repair leaks as follows:
 1. Replace broken pipe or joint assemblies found to leak.
 2. When leakage occurs in excess of the specified amount, locate and repair defective valves, pipe, cleanouts, and/or joints.
 3. If defective portions cannot be located, remove and reconstruct as much of the original work as necessary to obtain piping that meets the leakage requirements specified herein and retest, all at no additional cost to the County.

3.07 LEAKAGE TESTS FOR CONCRETE STRUCTURES

- A. Leakage tests of wet wells, tanks, channels, containment areas, and other water retaining structures shall be performed following the requirements of ACI 350.1R and as specified herein. Supply all materials and labor needed to conduct the test as directed by the Engineer.
- B. Prior to start of leakage testing, the following requirements shall be met:
 1. All elements of the structure which resist any portion of the retained liquid pressure shall be in place and at specified strength levels. All concrete shall be fully cured.
 2. Structure walls shall not be backfilled prior to leakage testing.
 3. All valves, gates, blind flanges, and other non-concrete items which control the flow or otherwise retain the liquid contents of the structure, shall be checked for watertightness. If not watertight, means shall be taken to assure watertightness during the period of the leakage test.
 4. The portions of the structure to be tested shall be cleaned of all construction debris, standing water, soil, foreign materials and any other material which interferes with the exposed concrete surfaces of the structure.
 5. Defective concrete shall be repaired.
 6. Notify the Engineer a minimum of twenty-four (24) hours prior to start of filling of structure for leakage testing. Leakage testing shall not start until the structure is inspected by the Engineer.
 7. Filling the Structure with Water:
 8. The portion of the structure to be tested shall be filled at a rate not to exceed 2-feet-per-hour.
 9. The structure shall be filled to the normal operating depth of the structure as indicated on the Contract Drawings. Where no operating depth is indicated or where operating depth is controlled by flowing over a weir, the structure shall be filled to a depth 6-inches below the weir or top of wall elevation, whichever is lower.
 10. Water in the structure shall be maintained at the specified test elevation for a minimum of three days prior to the start of the leakage test.
 11. After water has been brought to the test elevation, the exposed elements of the structure shall be inspected for leakage. All locations which exhibit any amount of leakage flow shall be repaired prior to the start of leakage testing.
 12. The leakage test duration shall be determined by the Engineer based on ACI 350.1R but shall not be less than three (3) days.

SECTION 02505 – LEAKAGE TESTS

- C. Leakage Allowance:
1. For unlined concrete structures, the maximum allowable leakage rate shall be 0.075-percent of the volume per twenty-four (24) hour period.
 2. For concrete structures with walls lined by a waterproof material, the maximum allowable leakage rate shall be 0.050-percent of the volume per twenty-four (24) hour period.
- D. Test Locations:
1. Structure cells which are less than 1,000-square-feet in area shall have measurements of water level taken at two (2) locations which are located approximately 180-degrees apart.
 2. Structure cells which are greater than 1,000-square-feet in area shall have measurements of water level taken at four (4) locations which are located approximately 90-degrees apart.
 3. Each test location shall be marked and given a reference number. A reference point shall be marked on the face of the wall above the test water surface in a manner which will prevent its movement or deterioration during the period of the test.
 4. Test locations must be approved by the Engineer.
- E. Evaporation and Precipitation Measuring:
1. In open structures, a clear plastic calibrated open-top container not less than 18-inches in diameter and depth shall be partially filled, floated in the tank, and held in position near each measurement location.
 2. The container shall be located so as not to be shaded by tank walls and away from any items passing over it, such as beams or pipes.
- F. Test Measurements:
1. Leakage tests shall not be started when periods of severe weather conditions or major changes in average daily temperature are predicted.
 2. The following measurements shall be recorded at each test location at the start of the test period and at twenty-four (24) hour intervals thereafter:
 - a. Distance from reference point to test water surface.
 - b. Depth of water in the floating container.
 - c. Temperature of the test water at 18-inches below water surface.
 - d. Temperature of the water in the evaporation-precipitation container at mid-depth.
- G. Leakage Determination:
1. The change in water surface elevation at each test location shall be averaged and adjusted as follows.
 2. The total change in test water surface elevation shall be adjusted by the average change in water surface elevation in the evaporation-precipitation containers.
 3. Where averaged water temperature measurements vary by more than 3-degrees from start to completion of the test period, adjustment in tank volume shall be determined by change of water density resulting from the change in the average water temperature.
- H. Retesting:
1. The leakage test shall be considered as failed if the specified leakage allowance is exceeded or if any leakage is observed.
 2. If the test becomes unreliable due to excessive precipitation or other external factors, it shall be restarted.
 3. If a leakage test fails, it may be retested immediately without repairs if approved by the Engineer. If subsequent leakage tests fail, repair all probably areas of leakage, and the leakage test shall be repeated. The structure shall be retested until it meets the specified leakage criteria. Repairs shall be made to the probably leakage areas before each retest.

END OF SECTION

SECTION 02510 – PAVING AND SURFACING

PART 1 – GENERAL

1.01 DESCRIPTION

- A. This Section includes requirements for furnishing all labor, equipment and materials and performing all operations in connection with the construction of asphalt concrete pavement, asphalt concrete overlay, reinforced concrete pavement, gravel roads, concrete curb and gutter, repair and reconstruction of existing asphalt concrete pavement, repair of existing gravel roads, and pavement markings complete as shown on the Contract Drawings and specified herein.
- B. All new roads including the replacement of portions of the existing roads shall be to the limits, grades, thicknesses and types as shown on the Drawings. Patches for pipe crossings and areas damaged during the construction work shall be asphalt, unless otherwise indicated.

1.02 RELATED SPECIFICATIONS

- A. Section 01300 – Submittals.
- B. Section 02200 – Earthwork.
- C. Section 03300 – Cast-in-Place Concrete.

1.03 PAYMENT

- A. Payment for work furnished and installed under this Section shall be included in the lump sum price bid for the Contract, as described in Section 01150 – Measurement and Payment.

1.04 REFERENCES

- A. Except as otherwise provided in the Specifications or on the plans, all work shall be in accordance with the New York State Department of Transportation Standard Specifications, September 1, 2021 or latest edition, except that any reference to “NYSDOT”, “Department” or “Unit” shall mean the “County”. When reference to these Specifications is intended, the description will be NYSDOT Specifications.

1.05 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 – Submittals, submit the following:
 - 1. Manufacturer’s plant design mixes shall bear the approval of NYSDOT’s Director, Materials Bureau. The written approvals shall not be older than one year from the date of proposed paving work of the Contract Documents.
 - 2. A completed materials list showing all items to be furnished and installed under this Section.
 - 3. Certificates that materials, mixtures and products comply with Specification requirements signed by Contractor.

1.06 QUALITY ASSURANCE

- A. Except with the approval of the Engineer, the placing of concrete or asphalt concrete surface paving shall be subject to the Seasonal and Weather Restrictions set forth in NYSDOT Specifications. Do not place bituminous concrete mixes on wet surfaces or surfaces with temperatures less than 45-degrees Fahrenheit. Place bituminous concrete top course mixes only during period of April 1st up to and including the third Saturday of November.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Select Fill: Place select fill as necessary to complete the embankments, shoulders, subgrade foundation and replacement for removed unsuitable material in accordance with NYSDOT Section 203, and Section 02200 - Earthwork
- B. Sub-base Course: In accordance with NYSDOT Item 304.14, meeting the gradation requirements of Section 733-04, Table 733-04A, Type 4

SECTION 02510 – PAVING AND SURFACING

- C. Base Course: In accordance with NYSDOT Item 402.010912, meeting the composition requirements of Section 402.
- D. Asphalt Binder Course:
 - 1. Asphalt binder shall be in accordance with NYSDOT Item 402.258902, meeting the composition requirements of Section 403-2, Table 403-1, Binder Type 3.
 - 2. The job mix formula shall be delivered to the Engineer at least two (2) weeks prior to beginning paving operations.
- E. Asphalt Top Course:
 - 1. Asphalt top course shall be in accordance with NYSDOT Item 402.128302, meeting the composition requirements of Section 402.
 - 2. The job mix formula shall be delivered to the Engineer at least fourteen (14) calendar days prior to beginning paving operations.
- F. Reinforcing Materials:
 - 1. Welded Wire Reinforcement: ASTM A1064, sheet type only. Ensure that sheets are free from loose flaky rust, loose scale, oil, grease, mud, or other coatings that might reduce the bond with concrete.
 - 2. Support for Reinforcement: Conform to recommendations by CRSI: Manual of standard practice.
- G. Concrete Materials:
 - 1. Portland Cement: ASTM C150 Type V. Do not use air entraining cement.
 - 2. Aggregates: ASTM C33 and the requirements specified herein. Use same type aggregate as specified in Section 02207 Aggregate Materials.
 - 3. Air-entraining Admixture: ASTM C260.
 - 4. Curing Materials: Wet cotton mats.
 - 5. Retarders: Retarding admixtures meeting the requirements established in ASTM C494, Type B or D. Use retarders only with prior written approval of the Engineer.
 - 6. Joints:
 - a. Dowels: Furnish plain steel bars conforming to ASTM A615, grade 60. Fabricate dowels or cut to length at the shop or mill prior to delivery to the site. Ensure that dowels are free of loose flaky rust and scale, clean and straight. Before delivery, paint a minimum of two thirds the length of each dowel with one coat of epoxy paint. Shear dowels to length provided that the deformation from true shape caused by shearing does not exceed 0.04 inch on the diameter of the dowel and does not extend more than 0.04 inch from the end of the dowel.
 - b. Joint Filler: Contraction Joints: Sawable type contraction joint inserts shall conform to ASTM D994. Ensure that non sawable contraction joint inserts have sufficient stiffness to permit placement in plastic concrete without undue deviation from a straight line and conform to the physical requirements of ASTM D994, with the exception of Resistance of Sawing.
 - 7. Water shall be fresh and free from injurious amounts of oil, acid, salt, alkali, organic matter or other deleterious substances.
- H. Concrete Pavement Base Course:
 - 1. Suitable base course material shall be in accordance with NYSDOT Section 304-1.02, Option D and shall consist of:
 - a. Processed materials such as crushed stone, crushed gravel, slag, or
 - b. Blends of natural and/or processed materials.
 - 2. Requirements for gradation specified herein shall apply to the completed base course. The contractor shall obtain materials meeting the gradation requirements after mixing, placing, compacting, and other operations. Ensure that the aggregates have a maximum size of 3 inches and are continuously graded as specified in NYSDOT table 733-04A.
 - a. The values are based on aggregates of uniform specific gravity, and the percentages passing the various sieves are subject to appropriate correction by the Engineer when aggregates of varying specific gravities are used.

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3. Ensure that base course material passing a No. 200 sieve has a liquid limit not greater than 25 and a plasticity index not greater than 5 as determined by Atterberg Limits tests
- I. Concrete Mixing:
 1. Proportioning and design of mixes shall be as specified in Section 03300 – Cast-in-Place Concrete.
 2. Use ready-mixed concrete as specified in Section 03300 – Cast-in-Place concrete.
- J. Equipment:
 1. Furnish and maintain at the jobsite, in good condition, one (1) 12-foot straightedge for each paving spread in testing hardened Portland cement concrete surfaces. Straightedges constructed of aluminum or magnesium alloy must have blades of box or box-girder cross section with flat bottom, adequately reinforced to ensure rigidity and accuracy. The straightedges must have handles for operation on the pavement.
 2. Equipment and tools used in the performance of the work under this Section shall be subject to the approval of the Engineer before the work is started and shall be always maintained in satisfactory working condition. The equipment shall be adequate and capable of producing the required compaction, and meeting grade controls, thickness control, and smoothness requirements as specified herein.
- K. Concrete Curb and Gutters:
 1. Concrete shall be Class B in accordance with the requirements of Section 03300 – Cast-in-Place Concrete, except that concrete shall be air-entrained to provide an air content of 6-percent +/- 1.5-percent.
 2. Pre-molded expansion joint filler for expansion joints shall conform to ASTM D 1751 and shall be a minimum of 1/2-inch thick.
- L. Asphalt Tack Coat: NYSDOT Section 407, Tack Coat and Section 702, Bituminous Materials, Material Designation 702-9000, Grade RS-1h

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Embankment: Construct and compact embankment and subgrade in accordance with Section 02200 – Earthwork
- B. Subgrade:
 1. The subgrade, where shown on the Drawings and determined by the Engineer, shall be treated in accordance with NYSDOT Section 203. The subgrade shall be formed true to crown and grade, and shall be compacted with a minimum of four (4) passes of a 15 ton vibratory roller to conform to the maximum densities determined by AASHTO T99 Standard Specifications. In trenches or other areas that are difficult to access or maneuver, impactor rammers, plate or small drum vibrators or pneumatic buttonhead compaction equipment may be used, in accordance with NYSDOT Section 203.
 2. Hand excavate, shape and compact subgrade around utility poles, where clearances with existing pipes or structures are very small and along curbs, and along pavement edges.
 3. If soft areas or areas with unsuitable material are encountered below excavation depth shown on drawings, perform additional excavation and fill with crushed stone. Do not place subbase or pipe bedding materials until all soft, muddy or irregular areas in the subgrade have been corrected.
- C. Base Course: The finished subbase course of all paving shall be of the thickness shown on the Drawings, formed true to crown and grade. No fill material except new subbase shall be placed on top of existing gravel
- D. Subbase Course: Place and compact subgrade course in accordance with NYSDOT Section 304-1 and 304-3, Subbase Course, Description and Construction Details, and Section 203-3.12 Compaction. Thicknesses shall be as shown on the Drawings
- E. Asphalt Binder Course: Place and compact Binder Course in accordance with NYSDOT Sections 403-1 and 403-3, Hot Mix Asphalt Pavements for Utilities, Description and

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Construction Details. Thicknesses shall be as shown on the Drawings, formed true to crown and grade.

F. Asphalt Top Course:

1. Prior to placement of the asphalt concrete top course, the base/binder course shall be inspected for damage or defects and repaired to the satisfaction of the Engineer. The surface of the base/binder course shall be approved by the Engineer.
2. The asphalt tack coat shall be applied to the surface of the approved Base or Binder course, existing pavement edges, castings, and concrete surfaces as described in NYSDOT Section 407. Contact surfaces of curbing, gutters, manholes and other similar structures shall be painted with a thin uniform coating of tack coat material just prior to the placing of the bituminous concrete mixture against them. All bituminous materials shall be cleaned from exposed surfaces of curbs, gutters, manholes and other similar structures. Equipment for applying the tack coat shall be power oriented pressure spraying or distributing equipment suitable for the materials to be applied and approved by the Engineer.
3. Place and compact the Asphalt Top Course in accordance with NYSDOT Sections 403-1 and 403-3, Hot Mix Asphalt Pavements for Utilities, Description and Construction Details. Thicknesses shall be as shown on the Drawings.

G. Concrete Pavement Base Course:

1. Preparation of Subgrade: Prior to constructing base course, clean previously constructed subgrade of foreign substances. Ensure that subgrade meets specified compaction and surface tolerances. Correct to line and grade, ruts or soft, yielding spots that may appear in the subgrade areas as having inadequate compaction, and deviations of the surface from requirements set forth herein. For subgrades containing sands, sand-gravels, or any other cohesionless material in harmful quantities as defined by the Engineer, stabilize the surface with aggregate prior to placement of the base course. Stabilize by mixing base-course material into the existing subgrade and compact by approved methods. The stabilized material will be considered as part of the underlying course and will meet requirements for the underlying course. Do not disturb the finished subgrade. Maintain subgrade in a satisfactory condition until base course is placed.
2. Mixing and Placing Materials: Mix materials by stationary-plant, traveling plant, or road-mix method. Place in such a manner as to obtain uniformity of the base course material and at a uniform optimum water content for compaction. Make such adjustments in mixing or placing procedures or in equipment as directed by the Engineer to obtain true grades, to minimize segregation and degradation, to reduce or accelerate loss or increase of water, and to insure a satisfactory base course meeting requirements of this specification.
3. Compaction Criteria: Compact each layer of subgrade and base course including shoulders with approved compaction equipment. Maintain water content at optimum or at the percentage specified during compaction. In places not accessible to the rollers, compact material with mechanical tampers.
 - a. For materials exhibiting a well-defined moisture density relationship, the degree of compaction required is 95 percent of the maximum dry density obtained by the test procedure presented in ASTM D1557, Method D. Ensure that the moisture content during compaction is between plus 3 and minus 2 percent of optimum as determined by ASTM D1557, Method D. For materials which do not exhibit a well-defined moisture density relationship, the degree of compaction required is 85 percent of the relative density as outlined in ASTM D4253 and D4254.
4. Layer Thickness:
 - a. Compacted thickness of base course is indicated on the drawings. For a compacted layer of 6 inches, place material in a single layer. For a compacted thickness of more than 6 inches, ensure that no single layer of the placed material is in excess of 6 inches or less than 3 inches when compacted.
 - b. Correct surface deviations by removing material and replacing with new material or by reworking existing material and compacting, as directed by the Engineer.

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5. Edges of Base Course: Place approved satisfactory material along edges of base course in such quantities as will compact to the thickness of the course being considered, or, when the course is being constructed in two or more layers, to the thickness of each layer of the course. Allow in each operation at least 1-foot width of the shoulder to be rolled and compacted simultaneously with rolling and compacting of each layer of base course, as directed by the Engineer.
 6. Grade Control: Maintain lines and grades including crown and cross slope for the base course by means of line and grade stakes.
 7. Stock Piling Material: In general, no stockpiles will be allowed at the site. Only small stockpiles of materials may be approved to be placed on designated areas as determined by the Engineer.
 8. Prior to stockpiling of material, clear and level storage sites. Stockpile approved satisfactory material in the manner, and at the locations, designated by the Engineer. Stockpile aggregates on designated cleared and level areas so as to prevent segregation.
 9. Weather Limitations: Construct base course when atmospheric temperature is above 35 degrees F. When the temperature falls below 35 degrees F, protect areas of completed base course against detrimental effects of weather by approved methods. Correct areas of completed base course damaged by rainfall or other weather conditions to meet specified requirements.
- H. Concrete Pavement:
1. Placing Welded Wire Reinforcement: Furnish and install the wire reinforcement shown on the drawings. Position wire reinforcement on suitable metal chairs prior to concrete placement. Lap one spacing of wire reinforcement pattern with transverse reinforcing members touching and wire together.
 2. Placing Concrete:
 - a. Deposit concrete as close as possible to its final position in pavement cross section.
 - b. Place concrete continuously and at a uniform rate without unscheduled stops except for equipment failure or other emergencies.
 - c. Do not drop concrete freely more than 3 feet.
 - d. Do not allow workers with foreign material on their footwear or construction equipment that might deposit foreign material to walk or operate in or on the concrete during placement and finishing operations.
 - e. Do not use re-tempered concrete or concrete which is non-plastic and unworkable, or does not meet the specified mix properties, or which is contaminated by foreign materials.
 - f. Vibration:
 - 1) Consolidate concrete with mechanical vibrating equipment during spreading.
 - 2) Supplement consolidation by hand-spading, rodding, or tamping to maintain concrete members free of honeycomb, rock pockets and voids.
 - 3) Do not insert vibrators into lower layers of concrete that have begun to set.
 - 4) Do not allow vibrators to touch forms, tie bars, dowels, or other embedded items.
 - 5) Bring pavement surfaces to correct elevation and strike off.
 - 6) Use bull float, darby or highway straightedge to level surface free of lumps or hollows.
 - 7) Placing During Cold Weather:
 - (a) Discontinue concrete placement when air temperature reaches 40 degrees F and is falling.
 - (b) Do not resume until air temperature reaches 35 degrees F and is rising.
 - (c) Furnish and install covers for maintaining concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing.
 - 8) Placing During Warm Weather: During periods of warm weather when the maximum daily air temperature is likely to exceed 85 degrees F.

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- (a) Sprinkle forms and/or underlying material with water immediately before concrete is placed.
 - (b) Place concrete at coolest temperature practicable, but in no case will the temperature of concrete when placed exceed 90 degrees F.
 - (c) Cool aggregates and/or mix with water as necessary.
 - (d) Chipped ice in mixing water may be required to cool concrete, subject to approval of the Engineer.
 - (e) Place concrete continuously and rapidly at a rate of not less than 100 feet of paving lane per hour.
 - (f) Alternately, place concrete as individual slabs in checkerboard pattern.
 - (g) Keep finished surface of newly laid pavement damp by applying a water fog or mist with approved spraying equipment.
- I. Finishing Operations:
 - 1. Machine or Hand Finish: The sequence of operations is as follows: finishing, floating, straight-edging, texturing, and edging of joints.
 - 2. Finishing and Floating:
 - a. As soon as placed and vibrated, strike-off concrete and screed to crown and cross section and to such elevation above grade that, when consolidated and finished, surface of pavement will be at the required elevation.
 - b. Tamp surface until required compaction and reduction of internal and surface voids are accomplished.
 - c. Immediately following final tamping of surface, float pavement longitudinally from bridges resting on side forms and spanning but not touching concrete.
 - d. If necessary, place and screed additional concrete, and then float until a satisfactory surface is produced.
 - e. Advance floating operation not more than half the length of float and continue floating over new and previously floated surfaces.
 - 3. Surface Correction and Testing:
 - a. After finishing and floating, but while concrete is still plastic, eliminate minor irregularities and score marks in pavement surface by means of straightedges.
 - b. Operate straightedges from sides of pavement or from bridges.
 - c. Test surface for trueness with a 12-foot straightedge held in successive positions parallel and at right angles to centerline of pavement.
 - d. Cover whole area as necessary to detect variations.
 - e. Advance straightedge along pavement in successive stages of not more than one-half the length of the straightedge.
 - f. Fill depressions with freshly mixed concrete, strike off, consolidate, and refinish.
 - g. Strike-off projections above required elevations and refinish.
 - h. Continue straightedge testing and finishing, until entire surface of the concrete is free from observable departure and conforms to surface requirements specified herein.
 - 4. Texturing:
 - a. Before surface sheen disappears and concrete becomes nonplastic, give surface of pavement a burlap drag texture.
 - b. Apply surface texture by dragging surface of pavement, in the direction of concrete placement, with an approved multiple-ply burlap drag at least 3 feet in width and equal in length to the width of slab.
 - c. Securely fasten leading transverse edge of the drag to a lightweight pole or traveling bridge, with a least 1 foot of the burlap in contact with the pavement during dragging operation.
 - d. Operate drag with burlap moist.
 - e. Clean burlap as necessary.
 - f. Drag so as to produce a uniform finished surface having a fine sandy texture without disfiguring marks.

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5. Edging: After texturing, carefully finish edge of pavement along forms and at joints, where indicated or directed by the Engineer, with an edging tool to form a smooth rounded surface of the required radius. Eliminate tool marks and smooth edges true to line.
 6. Curing and Protection:
 - a. General: Protect concrete against loss of moisture and rapid temperature changes for at least seven (7) days from the beginning of curing operation. Protect unhardened concrete from rain, flowing water and wind. Furnish and install covers as necessary to prevent cracking of the pavement due to temperature changes. If any selected method of curing does not afford the proper curing and protection against concrete cracking and pavement is damaged, remove and replace damaged payment and employ another method of curing as directed by the Engineer.
 - b. Curing Methods: Cure concrete for at least seven days by one or more of the following methods:
 - 1) Keep concrete surface continuously wet by covering with water.
 - 2) Cover concrete surface with specified mat, saturated and continuously wet. Ensure that mat covers concrete surfaces and edges, with 6-inches lap over adjacent mat.
- J. Field Test Specimens:
1. General: Prepare concrete samples in the field to determine slump, air content, and strength of concrete. Make test specimens to determine conformance with strength requirements and, when required, to determine the time at which pavements may be placed in service. Determine air content in conformance with ASTM C173. Mold test specimens and cure in conformance with ASTM C31. Furnish materials, labor, and facilities required for molding, curing, and protecting test specimens at the site and under the supervision of the Engineer. Curing facilities for test specimens include furnishing and operating water tanks equipped with temperature-control devices that automatically maintain the temperature of the water at 73 degrees F plus or minus 5 degrees F. Also, furnish and maintain at site, boxes or other facilities suitable for storing specimens while in mold at temperature of 73 degrees F plus or minus 10 degrees F. Perform tests of fresh concrete and of hardened concrete specimens.
 2. Specimens for Strength Tests: Make a group of test specimens per each 400 square yards of pavement placed. Mold each group of test specimens from the same batch of concrete. A group of specimen consist of four (4) beams to be tested as follows: One specimen at 7 days of age, two at 28 days, and one as a spare. Perform strength tests in accordance with ASTM C78, flexural tests from concrete beams.
- K. Plan Grade and Surface Smoothness:
1. Plan Grade: Ensure that finished surfaces of pavements do not vary more than ½ inch above or below plan grade line or elevation established and approved at jobsite. Finished surfaces of new abutting pavements will coincide at their juncture.
 - a. Grade Conformance Tests: Check pavement for conformance with plan grade requirements. Test finished surface of each approved pavement area by running lines of levels at intervals of 25 feet or less longitudinally and transversely to determine elevation of completed pavement. Furnish level surveys to Engineer as surveys are completed. Within 30 days after receipt of level surveys the Engineer will inform this Contractor in writing of areas defective in plan-grade requirements.
 2. Surface Smoothness: Ensure that finished surfaces of pavements have no abrupt change of 1/8 inch or more and do not deviate from the testing edge of an approved 12-foot straightedge more than ¼ inch.
 - a. Surface-Smoothness Determinations: After concrete has hardened sufficiently to permit walking thereon, but not later than 36 hours after placement, test surface of pavement with a straightedge 12-foot. Test across longitudinal construction joints within 48 hours after the end of the curing period of the concrete placed in the adjacent lane. Operate straightedge in such manner as to reveal surface irregularities exceeding tolerances specified herein. Test entire area of pavement in both longitudinal and transverse direction on parallel lines 10 feet or less apart. Hold

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straightedge in contact with surface and move ahead one-half the length of the straightedge for each successive measurement. Carry lines of straightedging continuously across joints.

3. Deficiencies and Corrections:
 - a. High Areas: In areas not meeting surface smoothness and plan grade requirements, reduce such high areas either by rubbing freshly finished concrete with carborundum brick and water when concrete is less than 36-hour old or by grinding hardened concrete with an approved surface grinding machine after concrete is 36 hours old or older. In areas corrected by grinding, surface of hardened concrete shall not exceed 5 percent of area of any integral slab and depth of grinding not exceed $\frac{1}{4}$ inch. Remove pavement areas requiring plan grade, or surface smoothness or edge slump corrections in excess of the limits specified herein. Replace as specified herein. Retexture areas exceeding 25 square feet that have been corrected by rubbing or grinding by transverse grooving. Form grooves $\frac{1}{8}$ inch by $\frac{1}{4}$ inch on 2-inch centers into and taper to zero depth within the non-corrected surface. Areas in which rubbing or grinding has been performed shall meet thickness tolerances specified herein.
- L. Tolerance in Pavement Thickness: Ensure that thickness is not less than $\frac{1}{4}$ -inch of that shown on the drawings
- M. Removal and Replacement of Defective Pavement Areas:
 1. Remove defective pavement areas and replace as specified herein with pavements of thickness and quality required by these specifications.
 2. In no case will the removal and replacement of concrete result in a slab less than the full paving width or a joint less than 10 feet from a regularly scheduled transverse joint.
 3. Remove defective pavement carefully so that adjacent pavement is not damaged and existing keys or dowels at the joint are left intact.
 4. When a portion of an un-fractured slab is replaced, make a saw cut 2 inches deep transversely across the slab in the required location.
 5. Remove concrete and provide an essentially vertical face in the remaining portion of the slab.
 6. Prior to placement of fresh concrete, clean face of slab of debris and loose concrete, and then thoroughly coat with a thixotropic epoxy-resin grout manufactured specifically for bonding fresh Portland cement concrete to existing hardened concrete.
 7. Apply epoxy resin coating approximately $\frac{1}{16}$ inch thick, by scrubbing a thin coat of epoxy grout into the surface with a stiff-bristle brush followed by a second application.
 8. Place strips of polyethylene sheeting on vertical joint faces of adjacent slabs at juncture with slab to be patched as a bond-breaking medium.
 9. Place fresh dry packed Portland cement concrete while the epoxy resin is still tacky and in such a manner that grout coating will not be removed.
 10. Construct longitudinal and transverse joints of the replaced slab or portion thereof as indicated on the drawings.
 11. No payment will be made for the defective pavements removed nor for the cost of removing the defective pavements.
- N. Joints:
 1. General: Install joints conforming to details indicated on the drawings.
 2. Located longitudinal construction joints between paving lanes as indicated. Install dowels, keys or keys with tie bars in the longitudinal construction joints as specified herein. Edge longitudinal construction joints and saw to obtain a groove at the top conforming to details and dimensions indicated on the drawings.
 3. Install transverse construction joints at the end of each day's placing operations and at any other points within a paving lane when concrete placement is interrupted for thirty minutes or longer. Insofar as practicable, install transverse construction joints in the location of a planned joint. When concrete placement cannot be continued, install the transverse construction joint within the slab unit but not less than 10 feet from a planned transverse joint. Dowel transverse construction joints as shown. When the construction

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joint is located at planned transverse joints, paint $\frac{1}{2}$ of each dowel and oil to permit movement at the joint. Edge joints and saw to obtain a groove at the top conforming to the details and dimensions indicated. When concrete placing is resumed, use planned joint spacing beginning with the first regularly scheduled transverse joint.

4. Contraction Joints: Transverse and longitudinal contraction joints shall be of the weakened-plane or dummy-groove type. Construct transverse contraction joint, as specified herein.
 - a. Construct sawed joints by sawing a groove in the hardened concrete with a $\frac{1}{8}$ inch thick blade to the full depth as indicated on the drawings and specified herein.
 - 1) After expiration of curing period, widen upper portion of groove by sawing to width and depth indicate on the drawings.
 - 2) Vary time of sawing depending on existing and anticipated weather conditions, so as to prevent uncontrolled cracking of pavement.
 - 3) Commence sawing of joints as soon as concrete has hardened sufficiently to permit cutting concrete without chipping, spalling, or tearing.
 - 4) Inspect sawed faces of joints for undercutting or washing of the concrete due to early sawing.
 - 5) Delay sawing if undercutting or washing is sufficiently deep to cause structural weakness or excessive roughness in the joint.
 - 6) Saw joints at required spacing consecutively in sequence of concrete placement. Use a chalk line or other suitable guide to mark alignment of joint.
 - 7) The saw cut shall not vary more than $\frac{1}{2}$ inch from the true joint alignment.
 - 8) Before sawing a joint, examine concrete closely for cracks.
 - 9) Saw joint if a crack has occurred near the joint location.
 - 10) Discontinue sawing when a crack develops ahead of the saw cut.
 - 11) Workers and inspectors must wear clean, rubber-soled footwear.
 - 12) Limit number of persons walking on the pavement to those actually performing the sawing operation. Immediately after joint is sawed, thoroughly flush saw cut and adjacent concrete surface with water until all waste from sawing is removed from the joint.
 - 13) Respray membrane-cured surface damaged during the sawing operations as soon as surface become dry.
 - b. Construct insert type contraction joints by installing a performed insert in the plastic concrete to form a weakened plane to induce cracking. The insert materials shall conform to ASTM D994 or D2628, whichever is applicable. Construct inserts so materials can be removed to form a groove in the concrete as specified herein. The type of insert used will be approved by the Engineer prior to installation. Furnish inserts in heights for the various depths of joints shown and in lengths equal to the width of the paving lane. Use insert type contraction joints when directed by the Engineer if excess uncontrolled cracking occurs with sawed joints.
 - 1) Install insert in plastic concrete immediately following final machine finishing with a maximum of two joint spacings between finishing machine and inserter. Perform additional straightedge and texturing operations without disturbing installed insert. Securely join together adjacent sections of joint inserts within each slab unit. Extend insert across full width of slab. Thoroughly consolidate concrete against and for full depth of insert. Form insert perpendicular to finished grade of the pavement and straight in alignment at the prescribed joint locations shown. The top of the insert should be flush or not more than $\frac{1}{8}$ inch below pavement surface.
 - 2) After curing period, form a groove for joint sealer as specified herein. Remove top portion of fiberboard or sawable preformed inserts by sawing with a power saw to form a groove of required dimensions. Saw so as to abrade concrete surfaces in the joint groove. Remove traces of filler or insert. Remove non-sawable insert material as prescribed by manufacturer. Show dimensions and characteristics of groove formed. Ensure that grooves have edges free of ravels

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and spalls, and are straight from edge to each of the pavement and do not vary more than ½ inch from alignment.

- c. Dowels and Tie Bars - Fixed Form Installation:
 - 1) Use bonded-in-place method.
 - 2) Place tie bars and dowels across joints where indicated.
 - 3) Correctly align and securely hold in proper horizontal and vertical position during placing and finishing operations.
 - 4) Install tie bar in front of paver along longitudinal contraction joints, by insertion into the unconsolidated concrete.
 - 5) Do not install by removing and replacing dowels in preformed holes.
 - 6) Hold dowels in longitudinal and transverse construction joints securely in place parallel to the surface, by means of devices fastened to the form.
 - 7) Hold dowels in joints, by means of rigid metal frames or basket assemblies of approved type.
 - 8) The assemblies shall consist of a framework of metal bars or wires arranged to provide rigid support for the dowels throughout the paving operation, with a minimum of four continuous bars or wires extending across the paving lane.
 - 9) Weld dowels to assembly or hold firmly by mechanical locking arrangements that prevents dowels from rising, sliding out, or becoming distorted during paving operations.
 - 10) Hold dowel assemblies securely in proper location by means of suitable pins or anchors.
 - 11) Space dowels on longitudinal construction joints as indicated on the drawings except that when the planned spacing cannot be maintained because of form length or interference with form braces, use closer spacing with additional dowels.
 - 12) Omit dowels in longitudinal joints when the center of the dowel would be located within a horizontal distance from a transverse joint equal to ¼ of slab thickness.
 - 13) Paint the portion of each dowel intended to move within the concrete or expansion cap with one coat of red-lead or blue-lead paint.
 - 14) Wipe clean the painted portion and coat with a thin even film of lubricating oil before concrete is placed.
 - 15) Fill pipe used as dowels with a stiff sand-asphalt mixture or Portland cement mortar, or fit the ends of the pipe dowels with tight-fitting plugs of approved material extending into the pipe.
- 5. Sealing Joints: Seal joints, immediately following curing of concrete or as soon as weather conditions permit. Saw filler-type joints, immediately before sealing of the joints. Seal joints using the materials and procedures specified in Specification 07900.
- O. Concrete Curb and Gutter: The expansion joint filler for concrete curb and gutters shall be cut to conform to the cross section of the curb. Expansion joints shall be spaced at intervals of not more than 25-feet or where meeting existing curb. Formed control joints shall be installed at intervals not exceeding 10 feet. Depth of joint shall be 1/3 the thickness. Curved forms shall be used where radii are indicated; straight segments shall not be permitted. Upon removal of the forms, exposed curb faces shall be immediately rubbed down to a smooth and uniform surface. No plastering shall be permitted.
- P. Underground Utility Lines: Where an underground utility line is beneath the new roadway, the backfilling shall be carried out with special care, and the final consolidation shall be accomplished by a vibratory roller. Construction of the roadway over the trench shall be deferred as long as practicable
- Q. Junction with Other Paving:
 - 1. Where new asphalt concrete pavement abuts existing asphalt concrete pavement, the existing pavement shall be cut back to insure obtaining the specified compaction of the new pavement courses and interlocking adjoining courses. Existing subbase courses shall be cut back from the subgrade level of the new pavement on a one on one slope into

SECTION 02510 – PAVING AND SURFACING

the existing pavement, and the asphalt courses of the existing pavement shall be removed for an additional 18 inches back from the slope. The edge of the existing asphalt courses shall be saw cut straight and true. The faces between new and existing asphalt courses shall receive an application of joint sealer.

2. Where new rigid concrete pavement abuts existing rigid concrete or asphalt concrete paving, the existing paving shall be saw cut straight and true. An expansion joint of a ½ inch minimum thickness with filler material and sealant shall be placed between the new concrete pavement and the existing rigid concrete or asphalt concrete paving.
 3. Joints shall be sealed with hot-poured rubber asphalt before any traffic is permitted. The joint opening shall be cleaned of all extraneous matter. The contact faces of the joint shall be dry at the time of sealing. Compressed-air jets, power-driven wire brushes and any such additional equipment necessary to clean the joint and dry the contact faces shall be provided. The compound shall not be placed when the air temperature in the shade is less than 50 degrees F. The heating kettle in which the compound is prepared for pouring shall be of a type with indirect heating, the double boiler type, with built-in agitator and equipped with a thermometer to measure the temperature of the sealer. Direct heat will not be permitted.
 4. Pouring of this compound for sealing the joints shall be done by the use of hand pots, mechanical methods or any other method which will give satisfactory results. Pouring shall be done in such a manner that the compound is not spilled on the exposed surface. Any excess compound on the surface shall be removed immediately.
 5. Cover the sealer with fine sand or cement dust to prevent removal of the material by traffic.
- R. Asphalt Concrete Overlay: Where asphalt concrete is proposed to be placed over an existing asphalt or rigid concrete surface, the surfaces shall be thoroughly cleaned by power brooming and a tack coat shall be applied in accordance with the NYSDOT Standard Specifications for Roads and Structures, prior to installing the overlay. The overlay shall be applied in accordance with Subsections 2.6 and 3.5 and Standard Details shown on the Drawings.
- S. New Pavement: Where thicknesses for new pavement are not shown on the Contract Drawings, provide thicknesses in accordance with the "Typical Pavement Restorations" detail shown on the Contract Drawings.

3.02 FIELD QUALITY CONTROL

- A. Control material, equipment and construction procedures by submittals, approvals and inspections as specified herein.
1. Perform sampling and testing:
 - a. Obtain samples for laboratory tests in conformance with ASTM D75. Sampling of materials may be observed by the Engineer.
 - b. Perform a minimum of one test for every 1,000 cubic feet of base course in place.
 2. Tests:
 - a. Perform sieve analyses in accordance with ASTM C117, C127 C128, C136, and D6913.
 - b. Perform Atterberg Limits in accordance with ASTM D 4318.
 - c. Perform compaction tests in accordance with ASTM D1557 or ASTM D4253 and D4254, as applicable.
 - d. Perform wear tests in accordance with ASTM C131.

END OF SECTION

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SECTION 02529 – CONCRETE CURBS, GUTTERS AND SIDEWALKS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope:
 - 1. Provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish and install concrete curbs, gutters and side-walks.
 - 2. Types of Work covered by these Specifications are conventionally formed or machine formed curbs, gutters and sidewalks.
 - 3. Thickness and extent of curbs, gutters and sidewalks are shown on the Drawings.
- B. Related Sections:
- C. Section 02200, Earthwork.
 - 1. Section 02510, Paving and Surfacing.
 - 2. Section 03200, Concrete Reinforcing
 - 3. Section 03251, Concrete Accessories
 - 4. Section 03300, Cast-In-Place Concrete.

1.02 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 - 1. ASTM D 6690, Concrete Joint Sealer, Hot Poured Elastic type.
- B. Applicator Qualifications: Minimum of two years installing curbs, gutters and sidewalks.

1.03 SUBMITTALS

- A. Samples: Submit for approval the following: Samples, manufacturer's product data, test reports and material certifications as required in referenced Sections for concrete work.
- B. Certificates: Submit for approval the following: Manufacturer's certification that sealer meets Specification requirements.
- C. Shop Drawings: Submit for approval the following: Copies of dimensioned layout of the Work, showing pattern, expansion joints and reinforcing.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Reinforcing Bars and Welded Wire Reinforcement: Deformed steel bars and smooth wire fabric shall comply with requirements of Section 03200, Concrete Reinforcing.
 - 1. Furnish wire fabric in flat sheets, not rolls.
- B. Concrete Materials: Comply with requirements of applicable Division 3 - Concrete Work Sections for formwork, concrete materials, admixtures, bonding materials, curing materials and others as required.
- C. Expansion Joint Material: Comply with requirements of Section 03251, Concrete Accessories, for preformed expansion joint fillers.

2.02 CONCRETE MIX, DESIGN AND TESTING

- A. Comply with requirements of applicable provisions of Section 03300, Cast-In-Place Concrete, for concrete mix designs, sampling and testing, and quality control.
- B. Design the mix to produce concrete having properties of compressive strength, slump range and air content as specified in Section 03300.

PART 3 - EXECUTION

3.01 SUBGRADE PREPARATION

- A. Preparation of the subgrade including compaction shall be completed for the full width of the Work:

SECTION 02529 – CONCRETE CURBS, GUTTERS AND SIDEWALKS

1. Examine the substrate and the conditions under which Work is to be performed and notify the Engineer of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.
2. Verify that earthwork is completed to correct line and grade.
3. Do not commence Work until conditions are satisfactory, and approved by the Engineer.
4. Where the subgrade is constructed by excavation of existing grade, the top 6-inches of the subgrade shall be compacted to at least 90 percent of maximum density at optimum moisture content.
5. Where the subgrade is constructed on fill:
 - a. The existing grade shall be made smooth and compacted per Section 3.1.A.
 - b. The subgrade shall be brought to the final lines and grades utilizing select fill as specified in Section 02200, Earth-work. The compaction requirements of Section 02200 apply.
6. Base: Base shall be provided as shown on the Drawings. The material shall be select fill as specified in Section 02200, Earthwork, and compacted as specified.

3.02 FORM CONSTRUCTION

- A. Set forms to line and grade. Install forms over full length of curbs, gutters and sidewalks.

3.03 REINFORCEMENT

- A. Locate, place, and support reinforcement as specified in Section 03200, unless otherwise shown. Size of reinforcement shall be as shown.

3.04 CONCRETE PLACEMENT

- A. General: Comply with the requirements of Section 03300 for mixing and placing concrete, and as specified.
- B. Place concrete for curbs and gutters using methods which prevent segregation of the mix. Consolidate concrete along the face of forms with an internal vibrator.
- C. For sidewalks, place concrete in one course, monolithic construction, for the full width and depth of walks.
- D. Machine Formed: Automatic curb, gutter and sidewalk machine may be used for forming, at the Contractor's option. Concrete shall have proper-ties as specified in Section 03300, except that maximum slump shall be 2-1/2 inches and air content shall be 2 percent of design. Machine forming shall produce curbs, gutters and sidewalks to the required cross-section, lines, grades, finish, and jointing, as specified for conventionally formed concrete. If results are not acceptable, remove and replace at the Contractor's expense.

3.05 JOINTS

- A. General: Construct expansion, contraction, and construction joints with faces perpendicular to surface of the curb, gutter and sidewalk. Construct transverse joints at right angles to the Work centerline and as shown.
- B. Contraction Joints: Provide these joints at 10 feet on centers for curbs and gutters and 5 feet on centers for sidewalks.
- C. Construction Joints: Place joints at locations where placement operations are stopped for a period of more than 1/2-hour, except where such pours terminate at expansion joints.
- D. Expansion Joints: Provide 1/2-inch expansion joint filler where Work abuts structures; at returns; and at 30 foot spacing for straight runs. If curb, gutter, and sidewalk are not poured monolithically, provide expansion joints where each abuts the other.
 1. Place top of expansion joint material not less than 1/2 inch or more than 1 inch below concrete surface. Apply joint sealer on top of expansion joint material flush with concrete surface, and in accordance with manufacturer's instructions.

3.06 CONCRETE FINISHING

- A. Smooth the exposed surface by screeding and floating.

SECTION 02529 – CONCRETE CURBS, GUTTERS AND SIDEWALKS

- B. Work edges of gutter and sidewalks, back top edge of curb, and trans-verse joints; and round to 1/4-inch radius.
- C. Complete surface finishing by drawing a fine-hair broom across surface, perpendicular to line of traffic.

3.07 CURING

- A. Protect and cure finished concrete curbs, gutters and sidewalks, complying with applicable requirements of Section 03300.

3.08 REPAIR AND CLEANING

- A. Repair or replace broken or defective curbs, gutters and sidewalk as directed by the Engineer.
- B. Sweep Work and wash free of stains, discolorations, dirt or other foreign material.

END OF SECTION

SECTION 02529 – CONCRETE CURBS, GUTTERS AND SIDEWALKS

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SECTION 02604 – UTILITY STRUCTURES

PART 1 – GENERAL

1.01 DESCRIPTION

- A. This Section includes requirements for furnishing all labor, equipment and tools required for the design, fabrication, delivery and installation of utility structures and appurtenances in accordance with the Contract Drawings and specified herein.

1.02 RELATED SECTIONS

- A. Section 02200 – Earthwork.
- B. Section 03200 – Concrete Reinforcing.
- C. Section 03250 – Concrete Accessories.
- D. Section 03300 – Cast-in-Place Concrete.
- E. Section 03400 – Precast Concrete.

1.03 REFERENCES

- A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes and standards refer to the most current issue available at the time of the Bid.
 - 1. ASTM C478 – Specification for Precast Reinforced Concrete Manhole Sections.
 - 2. ASTM C857 – Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
 - 3. ASTM C990 – Specification for Joints in Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants.

1.04 SUBMITTALS

- A. Submit samples and/or shop drawings in accordance with Section 01300 – Submittals.
- B. In addition to the items listed in Section 03400 – Precast Concrete, shop drawings shall include but not be limited to the following:
 - 1. Complete layout and installation drawings and schedules with clearly marked dimensions.
 - 2. Material certificates on all piping materials.
 - 3. Structural design calculations sealed by a professional engineer registered in the State of New York. Design calculations for precast manholes and vaults shall include confirmation structures adequately resist flotation when completely empty and subjected to groundwater full height of structure.
 - 4. Results of leakage test.

1.05 QUALITY ASSURANCE

- A. Design Criteria:
 - 1. Minimum structural design loading for underground precast concrete vaults shall be as indicated in ASTM C857, unless otherwise noted herein. Precast items subjected to vehicular traffic shall be designed for H-20 traffic loading. Other precast items shall be designed for a vertical live load of 300 psf.
 - 2. Walls of precast items shall be designed for a vertical surcharge of 100 psf.
 - 3. Precast manholes and vaults shall be designed to resist flotation when totally empty and subjected to groundwater full height of the manhole/vault.
- B. Fabrication and Casting:
 - 1. Fabrication and casting shall conform to Section 03400, Precast Concrete, and to Section 03300, Cast-in-Place Concrete.
 - 2. All base sections designated to receive concrete ballast and all electrical manholes shall extend monolithically a minimum of 6 inches beyond the outside face of the wall for the entire periphery. All other utility structures shall have a standard base.
 - 3. Utility structures built around existing pipe shall have a cast-in-place base slab.

SECTION 02604 – UTILITY STRUCTURES

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Handling, transporting and storing of precast items shall comply with Section 03400 – Precast Concrete.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Precast Manholes, Vaults and Meter Boxes:
 - 1. Precast utility structures shall be furnished with waterstops, sleeves and openings as noted on the Contract Drawings. Box-out for wall pipes shall conform accurately to the sizes and elevations of the adjoining pipes. Precast utility structures shall be watertight and conform to the requirements of ASTM C478 and ASTM C857 with the following modifications there to:
 - a. Materials shall conform to Section 03400 – Precast Concrete.
 - b. Manholes shall meet the following criteria:
 - 1) Manhole section shall have an internal diameter of 4-feet, unless otherwise noted on the drawings and details. For the storm water manholes specified for this project 10-foot and 12-foot diameter manholes are specified.
 - 2) Minimum manhole wall thicknesses shall be 5-inches for 4-foot and 5-foot diameter manholes, 6-inches for 6-foot diameter manholes and 7-inches for 7-foot diameter manholes.
 - (a) Manholes and utility structures shall meet the following criteria:
 - (1) Include ballast concrete and/or other means necessary to ensure that manholes resist flotation when empty and subjected to groundwater full height of structure.
 - (2) The date and name of the manufacturer shall be marked inside of each precast section.
 - (3) No more than two lift holes may be cast or drilled in each section.
 - (4) Dimensions shall be as shown on the Contract Drawings.
 - (5) Covers and frames shall be as specified.
 - (6) Mechanical details such as piping, electrical and other details shall be as shown on the Contract Drawings.
 - 3) Joints between manhole and utility structure riser sections and at base slabs shall be groove-type.
- B. Brick shall be sound, hard-burned common brick conforming to ASTM C 32, Grade MS.
- C. Mortar: A 1:1:5 ratio of Portland cement, masonry cement and sand, respectively. Add water as required to create a workable consistency.
- D. Concrete shall conform to Section 03300 – Cast-in-Place Concrete.
- E. Reinforcing shall conform to Section 03200 – Reinforcing Steel.
- F. Precast concrete shall conform to Section 03400 – Precast Concrete.
- G. Concrete block shall be solid, rectangular concrete masonry units conforming to ASTM C 139.
- H. Castings shall conform to Section 05540 – Metal Castings and shall be of the size and type shown on the Contract Drawings.
- I. Steps:
 - 1. Steps shall be constructed of Grade 60 steel reinforcing rod (min. 1/2-inch) and completely encapsulated with a wear resistant and chemical resistant rubber.
 - 2. Each step shall have a minimum vertical load resistance of 800-pounds and a minimum pull-out resistance of 400-pounds.
 - 3. The steps shall have 11-inch minimum tread width and shall be placed at 16-inches on center, as shown on the Contract Drawings.
 - 4. Steps shall be cast in place with the concrete.
 - 5. Steps shall only be installed as shown on the Contract Drawings or required in the Specifications.

SECTION 02604 – UTILITY STRUCTURES

- J. Joint Sealant shall be a preformed flexible sealant conforming to the requirements of ASTM C 990, paragraph 6.2, Butyl Rubber Sealant.
- K. Flexible Rubber Sleeve:
 - 1. The spring set type shall have a stainless steel interior power sleeve or expander.
 - 2. The cast-in-place type shall conform to ASTM C923 and shall include stainless steel take up clamps.
 - 3. Flexible seal assemblies shall permit at least an 8-degree deflection from the center line of the opening in any direction while maintaining a watertight connection.
- L. Rubber Bladder:
 - 1. The rubber bladder seal shall conform to ASTM C923 suitable for pressure testing at 10-psi minimum, with a 3/8-inch minimum wall thickness.
 - 2. The rubber bladder seal shall contain an environmentally-safe, anti-bacterial compound which turns into a high viscosity gel when in contact with pressurized water.
- M. Covers and Frames:
 - 1. Covers and frames shall comply with Section 05540, Metal Castings, and shall be provided by the utility structure manufacturer.
 - 2. Manhole covers and frames shall meet the following requirements:
 - a. Locate so that there is ready access to the manhole steps.
 - b. Clear opening shall be a minimum of 22 inches, unless otherwise indicated on the Drawings.
 - c. Watertight manhole frames and covers shall be suitable for 20 psi internal pressure and shall be of cast-in-place type.
 - d. Non-watertight manhole cover assemblies shall be vented.
 - e. Vault covers shall have lifting handles and shall be bolted with stainless steel bolts complying with Section 05050, Metal Fastening.
 - f. All frames and covers shall be given one shop coat of asphalt or coal tar varnish, unless otherwise specified.
 - g. Frames and covers shall be identical throughout the Contract.
- N. Grates:
 - 1. Grates shall comply with Section 05540, Metal Castings.
 - 2. Curb inlet frames and grates shall include frame, grate and curb piece/hood.
- O. Concrete Ballast shall be Class B concrete in conformance with Section 03300 – Cast-in-Place Concrete. Ballast shall be provided as necessary to ensure that manhole resists flotation when empty and subjected to full height groundwater conditions.
- P. Flexible joint sealer shall be a rubber ring waterstop.
- Q. Epoxy bonding agent shall conform to Section 03250 – Concrete Accessories.
- R. Filter Fabric: Mirafi 140NS or approved equal.

2.02 MANUFACTURERS

- A. Precast manholes and utility structures shall be as manufactured by Oldcastle, Tindall Products, Long Island Precast, Penn-Cast Products or approved equal.
- B. Joint sealant shall be Pro-Stik Butyl Sealant by Press-Seal, Butyl-Nek Join Sealant by Henry, CS-102 Butyl Rubber Sealant for all Precast Structures by ConSeal or approved equal.
- C. Flexible Rubber Sleeve: The spring set type shall be the PSX assembly by Press-Seal Gasket Corporation, the Kor-N-Seal assembly by National Pollution Control Systems or Lock Joint Flexible Manhole Sleeve by Interpace Corp.
- D. Watertight manhole frames and covers shall be Neenah Model R-1915, Type P or L or approved equal.
- E. Non-watertight manhole cover assemblies shall be Campbell Foundry model 1733 1000 for storm sewers, 1733 for sanitary sewers, and 1763 for all other services, East Jordan Iron Works Model 173402 for storm sewers, 173345B02 for sanitary sewers, or approved equal.

SECTION 02604 – UTILITY STRUCTURES

- F. The rubber bladder shall be NPC Contour Seal by Kor-N-Seal or approved equal.
- G. Curb inlet frames and grates shall be Campbell Foundry Model 2605 (frame), galvanized reticuline grate with lock, 6-1-7 (curb box); East Jordan Iron Works Model 02046332A01 Curb Inlet Assembly with Reticuline Grate and Curb Hood; or approved equal.
- H. Flexible joint sealer shall be as manufactured by Fernco Joint Sealer Co. or approved equal.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Installation shall conform with Section 03400 – Precast Concrete, and with the manufacturer's recommendations or to Section 03300 – Cast-in-Place Concrete.
- B. Frames and covers or grates shall be set so that tops are at elevations indicated on the Drawings or flush with finished grade where no elevation is indicated.
- C. Joints between riser sections shall be sealed with joint sealant.
- D. All openings in utility structures shall have flexible rubber sleeves sized to fit the connecting pipe and installed to provide watertight joints in accordance with the manufacturer's recommendations. The interior of the sleeve shall be filled with Class B concrete.
- E. Openings that are too large for flexible rubber sleeves shall utilize rubber bladder seals which are expanded by water injected using a pressure pump.
- F. Install units plumb and level.
- G. All lift holes and joints shall be filled with non-shrink grout conforming to Section 03600, grout inside and out.
- H. The manhole frames shall be set to their required elevations either with grade rings or with two or three courses of brick masonry laid around the top of the upper wall section. Such brick work shall be given a 1-inch mortar coat on the inside and out.
- I. Concrete ballast shall be placed so that it bears directly on the utility structure base against the outer wall monolithically encircling the structure for the full height indicated on the Drawings. Additional ballast may be required where the depth or elevation of the structure varies from the Drawings.
- J. Brick or concrete block shall be laid with broken joints and all horizontal and vertical joints filled with cement-sand mortar. Outside of walls shall be plastered with a minimum 1-inch thick coat of cement-sand mortar troweled smooth.
- K. Connection to Existing Pipe:
 - 1. Verify the diameter and invert elevation of existing pipe to be connected to new utility structures prior to beginning work on the structures.
 - 2. Provide adequate protection to prevent damage to the existing pipe.
 - 3. Provide adequate means for plugging and/or transferring the existing flow in the pipe to allow for the construction of inverts and grouting.
 - 4. Cut off the existing pipe sufficiently for connection to the new structure and remove.
 - 5. Thoroughly clean all foreign matter and coat the pipe surface with epoxy adhesive where the pipe joins the new structure.
 - 6. Install a flexible joint sealer around the pipe.
 - 7. Grout inside and outside of wall penetration with non-shrink grout.
- L. Backfill structures in accordance with Section 02200, Earthwork.
- M. Clean all structures of any accumulation of silt, debris, or foreign matter and keep clean until final acceptance of the work.
- N. Excavation shall conform to Section 02200, Earthwork.
- O. Structure bases shall bear on a minimum of 8 inches of compacted stone unless otherwise indicated on the Drawings.
- P. Channel Inverts:

SECTION 02604 – UTILITY STRUCTURES

1. Inverts shall be placed using Class B concrete with forms sufficient to provide a smooth half-round shape as shown on the Drawings. Manhole bases employing full depth precast inverts are acceptable.
2. Where the slope of the line does not change through a manhole, a constant slope shall be maintained in the invert. Where slope changes occur within a given manhole, the transition shall be smooth and shall occur at the approximate center of the manhole.
3. Inverts shown on the Drawings are taken at the center of the manhole unless otherwise noted.

3.02 INSTALLATION

- A. Adjustments to Existing Utility Structures
 1. Adjust structures vertically as shown on the Contract Drawings or cast iron adjustment rings by approved methods.
 2. Clean covers and inlet castings of all foreign materials and paint with one coat of coal tar epoxy.
- B. Adjusting Collars and Final Adjustments
 1. Adjusting collars shall be as shown on the Drawings. Final adjustments shall be made so that the manhole ring and cover will be smooth and flush with the finished grade of the adjacent surface, or as otherwise indicated on the Drawings for manholes shown above grade.
- C. Place and secure filter fabric around exterior of leaching rings prior to backfilling.

3.03 FIELD QUALITY CONTROL

- A. Flushing and Testing
 1. Obstruction - After backfilling, all sewers shall be inspected for obstructions and shall be flushed with water. Flushing shall be a minimum velocity of 2.5 feet per second for a duration acceptable to the Engineer. Flushing shall remove all dirt, stones, pieces of wood and other debris which accumulated in the sewer during construction. The Contractor shall provide a means acceptable to the Engineer for removal of debris flushed from each section of sewer. If after flushing, any obstructions remain, they shall be removed at the Contractor's expense.
 2. Visual Inspection - Sewer lines shall be visually inspected from every manhole by use of mirrors, television cameras, or other devices for visual inspection, and the lines shall all exhibit a fully circular pattern when viewed from one manhole to the next. Lines which do not exhibit a true line and grade or have structural defects shall be corrected to meet these qualifications.
 3. Leakage - Sewers shall be tested for leakage. The program of testing shall fit the conditions as mutually determined by the Engineer and the Contractor. The Contractor shall take all necessary precautions to prevent any joints from drawing while the sewers or their appurtenances are being tested. The Contractor shall, at his own expense, correct any excess leakage and repair any damage to the pipe and their appurtenances, or to any structures resulting from or caused by these tests.
 4. Leakage Test Procedure - Each section of sewer shall be tested by closing the lower end of the sewer to be tested and the inlet sewer of the upper manhole with stoppers and filling the pipe and manhole with water to a point 6 feet above the crown of the open sewer in the upper manhole, or, if ground water is present, 6 feet above the sections average adjacent ground water level as indicated by a monitor well installed adjacent to each manhole. The line shall be filled with water prior to testing and allowed to stand until the pipe has reached its maximum absorption, but not less than two (2) hours. After maximum absorption has been reached, the head shall be re-established and tested for at least six (6) hours maintaining the head specified above by measured additions of water. The sum of these additions shall be the leakage for the test period.
 - a. If ground water is present to a height of at least 6 feet above the crown of the sewer at the upper end of the pipe section to be tested, the leakage test may be made by measuring the rate of infiltration using a suitable weir or other measuring device

SECTION 02604 – UTILITY STRUCTURES

approved by the Engineer. Whether the test is made by infiltration or exfiltration, the allowable leakage shall not exceed 100 gallons per day per inch of diameter per mile of sewer being tested.

- b. Where the actual leakage exceeds the allowable, the Contractor shall discover the cause and correct it before the sewer will be accepted. For the purpose of this subsection, a section of sewer is defined as that length of sewer between successive manholes or special structures or stub outs for future connections.
 - 1) Low Pressure Compressed Air Test - If the leakage cannot be located by infiltration or exfiltration testing, this type test may be used. The pipeline shall be considered acceptable, when tested at an average pressure of 3.0 psi greater than the average back pressure of any groundwater that may submerge the pipe, if the section under test does not lose air at a rate greater than 0.0030 cfm per sq. ft. of internal pipe surface.
 - 2) Deflection Test - No sooner than thirty (30) days after final backfill installation, each section of PVC pipe shall be checked for vertical deflection using an electronic deflecto-meter or a rigid "Go-No-Go" device. Vertical deflection shall not exceed five (5) percent of the inside pipe diameter for PVC pipe.
 - (a) Where the actual deflection exceeds the allowable, the Contractor shall discover the cause and correct it before the pipe will be acceptable. For the purpose of this subsection, a section of sewer is defined as that length of sewer between successive manholes or special structures or stubouts for future connections.
 - 3) Cost of Testing and Repairs - Any and all work necessary to bring the line into conformance with the infiltration and deflection specifications shall be performed by the Contractor at no extra cost to the County. All apparent sources of infiltration and excessive deflection shall be repaired by the Contractor.
 - 4) Furnish all water, plugs, hoses, pumps and other equipment necessary for the proper flushing and testing of the sewers.

END OF SECTION

SECTION 02710 – STORM DRAINS AND ROOF DRAINS

PART 1 – GENERAL

1.01 DESCRIPTION

- A. This Section includes requirements for furnishing all labor, equipment and materials in connection with the installation of exterior underground storm drains and roof drains as shown on the Contract Drawings and specified herein.

1.02 RELATED SPECIFICATIONS

- A. Requirements of related work are included in Division 2 and Division 15 of the Specifications.
- B. Section 01300 – Submittals.

1.03 PAYMENT

- A. Payment for work furnished and installed under this Section shall be included in the lump sum price bid for the Contract, as described in Section 01150 – Measurement and Payment.

1.04 REFERENCES

- A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes and standards refer to the most current issue available at the time of the Bid.
 1. ASTM C76 – Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.
 2. ASTM C150 – Standard Specification for Portland Cement.
 3. ASTM C443 – Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
 4. AWWA C110 – Standard Specification for Ductile Iron Pipe & Fittings for Water and Other Liquids.
 5. AWWA C151 – American National Standard for Ductile Iron Pipe, Centrifugally Cast, for Water.
 6. ASTM D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and other Gravity-Flow Applications.
 7. ASTM D3350 – Standard Specifications for Polyethylene Plastic Pipe and Fitting Material.
 8. ASTM F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
 9. ASTM F810 – Standard Specifications for Smoothwall Polyethylene (PE) Pipe for Use in Drainage and Waste Disposal Fields.
 10. AASHTO M294 – Standard Specifications for Corrugated Polyethylene Pipe (12-inches to 36-inches).
 11. AASHTO Section 30 – Thermoplastic Pipe.

1.05 SUBMITTALS

- A. Furnish and submit shop drawings and certificates for the piping work in accordance with Section 01300 – Submittals.

1.06 QUALITY ASSURANCE

- A. An infiltration and exfiltration test for the pipe shall be made at the place of manufacture. Certified test results shall be submitted to the Engineer. The infiltration or exfiltration allowance shall not exceed 250-gallons per inch of pipe diameter per mile per day. One (1) joint test for every 200-feet of pipe shall be furnished.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Special care shall be exercised during delivery, distribution, and storage of the pipe and fittings in order to prevent damage. Damaged pipe will be rejected and shall be replaced at the expense of the Contractor. Storage of pipe and fittings, prior to use, shall be in such a manner as to keep the materials clean and dry.

PART 2 – PRODUCTS**2.01 MATERIALS**

- A. Reinforced Concrete Pipe (RCP) – Culverts and Storm Drains:
1. Pipe and Fittings:
 - a. RCP and fittings shall conform to ASTM C506 – Standards Specification for Reinforced Concrete Arch Culvert, Storm Drain and Sewer Pipe, ASTM C76 – Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe, and AASHTO M206 – Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain and Sewer Pipe, unless otherwise noted on the Contract Drawings.
 - b. Pipe sizes shall be as indicated on the Contract Drawings.
 - c. RCP for elliptical pipe and fittings shall conform to ASTM C507 – Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe and AASHTO M-207M/M 207-08 – Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe. Reinforced Concrete Round Pipe and joints shall be of Class III and manufactured according to ASTM C76.
 - d. Joints: Pipe may be provided with bell and spigot or tongue and grooved ends. Pipe joints shall be made with rubber gaskets of an approved type and manufacture. Gaskets shall be of the flat or O-ring type. The design of joints and the physical requirements for rubber type gaskets shall conform to ASTM Standard C443.
 - e. Joint Lubricant: Joint lubricant shall be of the type recommended by the manufacturer. Use of petroleum-based lubricants shall not be permitted.
- B. High Density Polyethylene (HDPE) Pipe and Fittings – Building Perimeter Drain Pipe:
1. Materials shall conform to ASTM F810 and shall be made from a material conforming with the minimum requirements of cell classifications 424410C or E as defined and described in the latest version of ASTM D3350.
 2. Wall thickness shall be a minimum of 0.275-inches.
 3. Joints shall be bell-and-spigot type and provide a soil-tight connection.
 4. Perforations shall be a minimum of three (3) holes at 360-degrees.
- C. Cast-Iron Soil Pipe:
1. Hub-and-Spigot Materials: ASTM A74, service class with ASTM C564 rubber gaskets.
 2. Hubless Pipe and Fittings: ASTM A 888 or CISPI 301. Heavy-Duty, FM-Approved Couplings: ASTM A 666, Type 304, stainless-steel housing; stainless-steel bands; and sleeve with two bands.
- D. Backfill Material: Locally-available materials shall be used for pipe backfill if the Contractor demonstrates that the soil meets one of the acceptable soil classifications outlined in Table 1. Imported materials meeting the criteria of Table 1 may also be used.
1. TABLE 1 – ACCEPTABLE BACKFILL MATERIAL AND COMPACTION REQUIREMENTS

DESCRIPTION	SOIL CLASSIFICATIONS			Minimum Standard Proctor Density %
	ASTM D 2321	ASTM D 2487	AASHTO M 43	
Graded or crushed, crushed stone, gravel	Class I	--	5 56	Dumped

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Well-graded sand, gravels and gravel/sand mixtures, poorly graded sand, gravels and gravel/sand mixtures; little or no fines	Class II	GW GP SW SP	57 6	93%
Silty or clayey gravels, gravel/sand/silt or gravel and clay mixtures; silty or clayey sands, sand/clay or sand/silt mixtures	Class III	GM GC SM SC	Gravel and Sand (<10% fines)	93%

2.02 MANUFACTURERS

- A. All pipe shall be produced in a plant of recognized reputation and regularly engaged in the production of pipe conforming to the specified standards. The pipe and fittings shall be marked with the manufacturer's name or trademark, size, class and date of manufacture. All pipe of the same type supplied for the work shall be produced by the same manufacturer.
- B. HDPE pipe and fittings shall be 6-inch SMOOTHWALL pipe manufactured by ADS or approved equal.

PART 3 – EXECUTION

3.01 INSPECTION

- A. In the presence of the Engineer, inspect each length of pipe and fittings delivered to the property for flaws, cracks, dimensional tolerances and compliance with the referenced standards. Provide the Engineer with suitable templates or calipers for checking pipe dimensions. Only lengths of pipe and fittings accepted by the Engineer and so marked shall be installed in the Work.

3.02 INSTALLATION

- A. Trenching, bedding and backfilling shall be as specified in Section 02200 - Earthwork and Section 2.1 (C) Backfill Material of this Specification. Under no condition shall pipe be laid in water or when trench conditions or weather are unsuitable for such work.
- B. All pipes and fittings shall be handled carefully in loading and unloading. Lift by hoists and lower on skidways in such a manner as to avoid shock. Derricks, ropes or other suitable equipment shall be used for lowering the pipe into the trench. Pipe and fittings shall not be dropped or dumped.
- C. Inspect each pipe and fitting before it is lowered into the trench. The interior of the pipe and all joint surfaces shall be thoroughly cleaned and shall thereafter be maintained clean. Securely plug open ends of pipe whenever pipe laying is not in progress.
- D. Pipe and fittings shall be selected so that there will be as small a deviation as possible at the joints and so that inverts present a smooth surface. All joints shall be installed, made up and inspected in accordance with approved printed instructions of the manufacturer. Pipe and fittings which do not fit together to form a tight joint will be rejected.
- E. Cutting of reinforced concrete pipe will be permitted only at connections to structures and be accomplished by abrasive saws. Cutting of other pipe materials shall be done only with mechanical cutters and in accordance with the manufacturer's recommendations.
- F. Lay pipe accurately to the lines and grades shown on the drawings or as directed by the Engineer.

SECTION 02710 – STORM DRAINS AND ROOF DRAINS

- G. If an adequate foundation for the pipe is not available at the desired depth, additional excavation shall be required and the foundation brought to desired grade with suitable granular material.
- H. Rock outcroppings, very soft soils such as muck, and other similar materials not providing proper foundation support shall be removed/replaced with suitable granular material.
- I. Bedding material directly under the pipe invert shall be left in native condition and not compacted. Pipe shall be placed on the bedding, and then backfilled under the pipe haunches before further backfill is placed.
- J. Class I materials may be dumped around pipe. Voids shall be eliminated by knifing under and around the pipe or by other approved technique.
- K. Non-cohesive sand, sand/gravel mixes and other Class II and III materials, if used as for pipe backfill, shall be compacted to 85-percent and 90-percent standard Proctor density, respectively.
- L. Inorganic silts, and gravelly, sandy, or silty clays, and other Class IV materials (not shown in Table 1) shall not be used for pipe backfill.
- M. Any section of the pipe that is found defective in material, alignment, grade, joints, or otherwise, shall be satisfactorily corrected by the Contractor at no additional cost to the Owner.

3.03 FIELD QUALITY CONTROL

- A. Testing: All labor, materials, measuring devices and water necessary to perform the required tests shall be furnished at the expense of the Contractor. All tests shall be performed in the presence of the Engineer.
- B. Exfiltration and Infiltration Tests:
 - 1. The pipe shall be tested for leakage by exfiltration and/or infiltration tests after installation and backfilling. Exfiltration or infiltration shall not exceed 100-gallons per inch of pipe diameter per mile per day. If the leakage is greater than that volume specified, the Contractor shall locate and repair or replace defective joints or pipes at no additional cost to the Owner until the leakage is within the specified allowance.
 - 2. Exfiltration tests shall be performed on all pipe where the groundwater elevation is 1-foot or less above the crown of the pipe. Exfiltration tests shall impose a head of at least 2-feet on the pipe at the maximum elevation of the length to be tested. An allowance of an additional 10-percent of gallonage shall be permitted for each additional 2-feet of head over the initial 2-feet minimum. Infiltration tests shall be performed for all other pipe where the groundwater table is greater than 1-foot above the crown of the pipe.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope:
 - 1. Provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish and install hot mix-hot laid bituminous paving.
 - 2. Pavement damaged by the Contractor outside the removal limits shown on the Drawings shall be removed and replaced, as directed by the Engineer.
 - 3. The Work includes permanent and temporary pavements comprised of one or more of the following:
 - a. Aggregate base course.
 - b. Tack coats.
 - c. Binder course.
 - d. Top course.
 - e. Pavement marking.
 - 4. Temporary pavement shall be placed as necessary.
 - 5. In order to prevent damage to the permanent pavement by the Contractor's operations, all permanent pavement materials, including the aggregate base course, shall not be installed until approved in writing by the Engineer. The finished course of paving shall not be installed until all buildings, structures, equipment, piping and outside facilities are substantially completed and at a time approved by the Engineer.
- B. Related Sections:
 - 1. Section 02050, Demolition, Removals and Modifications.
 - 2. Section 02200, Earthwork.
 - 3. Section 02529, Concrete Curbs, Gutters and Sidewalks.

1.02 QUALITY ASSURANCE

- A. Plant Inspection: All bituminous mixes will be subject to inspection, testing and approval by the Owner. The Contractor and plant personnel shall furnish all necessary assistance and cooperation.
- B. Laboratory Approval: Laboratory approval of the sources of supply of the fine aggregates, coarse aggregates, mineral filler, bituminous materials, liquefiers and any other materials used in the mix shall be obtained and submitted by the Contractor. No delivery or mixed materials shall be made from any bituminous mixing plant until the source of supply are approved.
- C. Testing Services:
 - 1. General: Testing of materials and of compaction requirements for compliance with technical requirements of the Specifications shall be the duty of the testing laboratory provided by the Owner.
 - 2. Testing Services: The testing laboratory will:
 - a. Test the Contractor's proposed materials in the laboratory and field for compliance with the Specifications.
 - b. Perform field density tests to assure that the specified compaction of surface and base course materials has been obtained.
 - c. Report all test results to the Engineer and the Contractor.
 - 3. Authority and Duties of Testing Laboratory: Technicians representing the testing laboratory will inspect the materials in the field and perform compaction tests, and will report their findings to the Engineer and the Contractor. When the materials furnished or work performed by the Contractor fails to fulfill Specifications requirements, the technician will direct the attention of the Engineer and the Contractor to such failure.
 - a. The technician will not act as foreman or perform other duties for the Contractor. Work will be checked as it progresses, but failure to detect any defective work or materials shall not in any way prevent later rejection when such defect is discovered, nor will it obligate the Engineer for final acceptance. Technicians are not authorized

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to revoke alter, relax, enlarge, or release any requirements of the Specifications, nor to approve or accept any portion of the Work.

4. Responsibilities and Duties of the Contractor: The use of testing services shall in no way relieve the Contractor of his responsibility to furnish materials and construction in full compliance with the Drawings and Specifications. To facilitate testing services, the Contractor shall:
 - a. Secure and deliver to the Engineer and the testing laboratory representative samples of the materials he proposes to use and which are required to be tested.
 - b. Furnish such casual labor as is necessary to obtain and handle samples at the project or at other sources of material.
 - c. Advise the testing laboratory and the Engineer sufficiently in advance of operations to allow for completion of quality tests and for the assignment of personnel.
- D. Reference Standards: Comply with the applicable provisions and recommendations of the following, unless otherwise shown or specified.
 1. Standard Specifications and Drawings (including addenda) of the County of Nassau Department of Public Works for Construction of Highway and Bridges, herein referred to as the County Standard Specification.
 - a. Bituminous concrete shall conform to the County Standard Specification, Part Three, Section B.

1.03 SUBMITTALS

- A. Samples: Submit for approval the following:
 1. At least two weeks prior to the date of anticipated use, submit to the Owner for approval, a representative sample of materials for the following:
 - a. Aggregate base course.
 - b. Binder course.
 - c. Top course.
 - d. Other materials as requested by the Engineer.
 2. Indicate in writing of the location and source of each sample.
- B. Shop Drawings: Submit for approval the following:
 1. Job mix formula proposed, giving complete data on materials, including source, location, percentages, temperatures, date of last testing, and all other pertinent data.

1.04 JOB CONDITIONS

- A. Weather Limitations:
 1. Permanent paving materials, including the aggregate base course, shall be placed only when the air temperature is 40 degrees Fahrenheit and rising or warmer and the surface on which the paving is to be laid is 40 degrees Fahrenheit or higher. All temperatures are to be measured in the shade.
 2. Bituminous pavement for temporary uses, that are not and will not become part of a permanent pavement, will not be subject to the above regulations in regard to weather limitations. No pavement, however, shall be laid on a frozen subgrade.
- B. Grade Control: Establish and maintain the required lines and grades, including crown and cross-slope for each course during construction operations.

PART 2 – PRODUCTS

2.01 PAVEMENT THICKNESS

- A. In-place compacted material thickness shall not be less than shown on the Drawings.

2.02 MATERIALS

- A. Materials shall conform to the following:
 1. Subgrade shall be virgin material or select fill conforming to the requirements of Section 02200, Earthwork.
 2. Base Courses:

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- a. Aggregate for permanent pavement base course shall consist of crushed stone conforming to the requirements of the County Standard Specification and the following gradation:

Screen Size	% Passing
1-1/2-in	100
1-in	90-100
1/2-in	65-85
3/8-in	55-75
#4	10-55
#8	30-45
#16	22-36
#30	16-27
#50	12-19
#100	7-13
#200	3-8

- b. Aggregate for temporary access road base course shall consist of limestone screenings. Stone screenings shall be limestone and may be crusher run provided 100 percent passes a 1/2-inch screen, 15 percent to 35 percent passes a #20 screen and 5 percent passes a #200 screen. Screenings need not be washed- provided they contain no clay, loam or other deleterious material. Screenings shall be from stone that passes the abrasion and soundness tests described under the County Standard Material Specification M4 Coarse Aggregate.
3. Pavement:
- a. Permanent: Provide a two course wearing surface for permanent pavement, consisting of a binder course and a top course. Binder course shall conform to the County Standard for Bituminous Concrete Binder Course. Top course shall conform to the County Standard for Bituminous Concrete Type 1A (Flat Process) Top Courses.
- b. Temporary: Provide a one course-wearing surface for temporary pavement, consisting of a top course as specified above.
4. Tack Coat: Tack coat shall be an asphalt emulsion conforming to the County Standard Material Specification M5 Bituminous Materials, Material Designation RS-1.
5. Pavement Markings: Pavement markings shall be installed at locations shown on the Drawings. Pavement markings shall be white, thermoplastic reflectorized type conforming to Section 727-01 of the New York State Department of Transportation, Design and Construction Division, Standard Specifications, Construction and Materials, latest revision.

PART 3 - EXECUTION

3.01 GENERAL

- A. Installation of all pavement materials and pavement markings shall be performed by experienced personnel.
- B. Preparing the mixtures, paving equipment, placing the mixes, and compacting the mixes shall be in accordance with the County Standard Specification.
1. Preparing the mixtures includes the plant equipment, stockpiling, heating, aggregate processing, mixing of aggregate and bituminous material, and transportation to job site.
 2. Paving equipment includes bituminous pavers, rolling equipment and hand tools.
 3. Placing the mixes includes paver-placing, hand placing, spreading, tamping and jointing.
 4. Compacting the mixes includes breakdown rolling, second rolling and finish rolling.
- C. Regardless of the type of temporary or permanent restoration involved, insure that all castings are set flush with the road surface. There shall be no placement of bituminous concrete top course until:

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1. Curbs, gutter aprons, driveway aprons, surface inlets, catch basins, and manholes have been constructed to their final elevation.
 2. Defective areas of the binder course have been repaired.
- D. Provide final surfaces of uniform texture, conforming to required grades and cross sections.
- E. Repair holes from test specimens as specified for patching defective work.
- F. Provide all labor, equipment and materials required to provide a drainage system for temporary access roads to facilities under construction.

3.02 SUBGRADE PREPARATION

- A. Permanent Pavement: Preparation of the permanent pavement subgrade including compaction shall be completed for the full width of the roadway.
1. Fine grade earth subgrade and compact with self-powered rollers of sufficient size to provide a firm, unyielding surface to receive the aggregate base course. Remove and replace all un-suitable subgrade material as directed by the Engineer.
 2. Where the subgrade is constructed by excavation of the existing grade, the top 6-inches of the subgrade shall be compacted to at least 95 percent of maximum density at optimum moisture content as determined in ASTM D 698.
 3. When the subgrade is constructed on fill:
 - a. Existing grade shall be made smooth and compacted per Section 3.2.A.2.
 - b. Subgrade shall be brought to the appropriate lines and grades utilizing select backfill placed in accordance with the applicable requirements of Section 02200, Earthwork.
 4. Existing grades prior to placement of subbase or backfill shall be established such that when materials for construction are placed no rutting or displacement will occur.
- B. Temporary Pavement: Subgrade shall be compacted with a ten-ton roller or other approved method.
- C. No materials, temporary or permanent, shall be placed on subgrades which are muddy or have water thereon.

3.03 PERMANENT PAVEMENT BASE COURSE INSTALLATION

- A. Construct base course to thickness shown on Drawings in equal layers not more than three inches (compacted) thick. If subgrade material is worked into the base material during compaction or finishing operations, remove the aggregate over this area and replace with new aggregate.
- B. Compact each layer with a power driven roller weighing not less than ten tons in an approved manner with the aid of water. Before mixing and spreading the base material, the moisture content shall be both sufficient to prevent segregation into pockets of fine and coarse material, and to permit satisfactory compaction. Add water as required.
- C. After compaction, the top surface of this course shall not extend above, nor more than 1/2-inch below true grade and surface at any location. Depressions shall be filled with additional aggregate material and the surface rerolled. Base course shall be maintained by the Contractor within the 1/2-inch tolerance until the pavement course is installed.

3.04 LIMESTONE SCREENINGS INSTALLATION

- A. Construct limestone screenings course to not less than 4-inch thickness.
- B. Screenings shall be spread evenly and thoroughly rolled with an approved three-wheel roller, weighing not less than 10 tons, until thorough consolidation is obtained. Depressions shall be filled with screenings, and the process of rolling and filling shall continue until a thoroughly compacted uniform surface, satisfactory to the Engineer, is produced. No segregation of large or fine materials will be permitted, but the screenings shall be sprinkled with water at times and in the amounts necessary to provide consolidation.

3.05 PAVEMENT INSTALLATION

- A. Contact surfaces of all curbs, gutters, castings and adjacent pavement edges shall be painted with a layer of tack coat before placing or repairing the pavement course.

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- B. Bituminous concrete shall be constructed to thicknesses as shown on the Drawings and rolled with 12 ton self-powered two-axle or three-axle tandem or three-wheel roller to a density of 94 percent of maximum.
- C. Pavement shall be uniform in appearance, free of bumps and hollows, worked to drain, and free of bleeding.
- D. Trim the existing pavement with pneumatic chisels of all loose edges and broom and tack coat all edges prior to placing the transition pavement.
- E. In placing and compacting abutting courses of bituminous concrete pavements, joint heating devices shall be used on all joints (transverse, longitudinal and existing). See the County Standard Specification for additional information.
- F. Bituminous pavement shall match in thickness the existing pavement and shall butt with the pavement in a smooth, even transition.
- G. Test bituminous pavement for conformity with the specified crown and grade immediately after initial compression. Correct variations by the removal or additional of materials and by continuous rolling.
- H. The finished surface shall not vary more than 1/4-inch when tested with a 16-foot straightedge applied parallel with, or at right angles to, the centerline.
- I. After final rolling, again test the smoothness of the course. Correct humps or depressions exceeding the specified tolerances or that retain water on the surface by removing the defective work and re-placing with new material.

3.06 TEMPORARY PAVEMENT OVER TRENCHES

- A. Bituminous concrete plant mix to be utilized for temporary pavement over trenches, as required, shall conform to the requirements for the top course Type 1A plant mix conforming to the Referenced Specifications.
- B. Trenches for utility work within existing paved areas shall receive temporary pavement. Temporary pavement shall be furnished, installed and maintained by Contractor. The Owner shall determine the limits of temporary pavement to be installed over these trenches.
- C. After the trench has been properly backfilled, excavation shall be made over the trench area and the sub-grade compacted by rolling with a ten ton roller or other approved methods, so as to permit the placing of a one and one-half inch (1-1/2") compacted thickness of bituminous concrete. The sub-grade shall not be in a muddy or frozen condition and shall be smooth and parallel to the desired surface of the finished pavement. Compaction of this 1-1/2 inch minimum thickness bituminous concrete shall be as specified herein.

3.07 PATCHING

- A. Remove and replace all defective areas in temporary and permanent pavements. Cutout such areas and fill with fresh Type 1A bituminous concrete top course as specified in the County Standard Specification. Compact to the required density.

3.08 CLEANING AND PROTECTION

- A. After completion of paving operations, clean surfaces of excess or spilled bituminous materials and all foreign matter.
- B. Protect newly finished pavement until it has become properly hardened by cooling.
- C. During the paving operation cover openings of drainage structures in the area of paving.

3.09 MAINTENANCE AND ACCEPTANCE

- A. Maintain all paved surfaces until the roads and parking areas have been accepted. Paved areas will not be accepted until after the Contractor has completed all phases of the work, including all necessary transportation, hauling and severe usage of the paved areas. The Engineer shall be the sole judge in this matter.

END OF SECTION

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SECTION 02831 – CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Chain link fences and gates.

1.02 REFERENCES

- A. ANSI/ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. ANSI/ASTM F567 - Installation of Chain Link Fence.
- C. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated Welded and Seamless.
- D. ASTM A116 - Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric.
- E. ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- F. ASTM A392 - Zinc-Coated Steel Chain Link Fence Fabric.
- G. ASTM C150 - Portland Cement.
- H. ANSI/ASTM F668 – PVC Coated Steel Chain Link Fence Fabric.
- I. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.

1.03 SYSTEM DESCRIPTION

- A. Line Post Spacing: As indicated on Contract Drawings and if not indicated, intervals shall not exceed 10 feet.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.
- C. Manufacturer's Installation Instructions: Indicate installation requirements and post foundation anchor bolt templates.
- D. Provide name and qualifications of the installer of chain link fences and gates.
- E. Shop drawings: Show details necessary to install chain link fences.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with ANSI/ASTM F567.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with a minimum 3 years documented experience.
- B. The installer shall have a minimum of 3 years of experience as an installer of chain link fences.

1.07 FIELD MEASUREMENTS

- A. The Contractor's surveyor shall layout all fence post locations where fence is to be installed along a property line.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. ANCHOR FENCE, INC.
- B. AMERICAN FENCE CORPORATION.

2.02 MATERIALS

- A. Framing: ASTM F1083; Schedule 40 steel pipe, standard weight, one piece without joints.
- B. Fabric Wire: ASTM A392; Zinc-coated No. 9 steel wire fabric with 2-inch squares. (9 gauge I.D. / 6 gauge O.D.).
- C. Concrete: ASTM C150, Type 1; minimum 4,000 psi strength at 28 days; 3 inch slump; 5 to 7 percent air entrainment.

2.03 COMPONENTS

- A. Line Posts: 2-1/2 inch outside diameter; 3.65 pounds per linear foot.
- B. Corner and Terminal Posts: 3 inch outside diameter, 5.79 pounds per linear foot.
- C. Gate Posts: 4 inch outside diameter; 9.11 pounds per linear foot.
- D. Top and Brace Rail: 1-5/8 inch outside diameter, plain end, sleeve coupled; 2.27 pounds per linear foot.
- E. Gate Frame: 2 inch outside diameter; welded corner construction.
- F. Fabric: 2 inch diamond mesh interwoven wire, 9 gauge thick I.D. (6 gauge O.D), top selvage twisted tight, bottom selvage knuckle end closed.
- G. Tension Wire: 6 gauge thick steel, single strand.
- H. Tie Wire: Aluminum alloy steel wire, 9 gauge ASTM A491.

2.04 ACCESSORIES

- A. Caps: Cast steel galvanized or malleable iron galvanized; sized to post diameter, set screw retainer.
- B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; galvanized steel.
- C. Gate Hardware: Fork latch with gravity drop; center gate stop and drop rod; two 180-degree gate hinges per leaf and hardware for padlock.
- D. Diagonal Truss Rod with Turnbuckle: ASTM A153 galvanized steel.
- E. Grounding Rod: ANSI/ASTM A123 steel rod.

2.05 FINISHES

- A. Components and Fabric: Galvanized to ANSI/ASTM A123; 2.0 oz/sq ft coating.
- B. Hardware: Galvanized to ASTM A153, 2.0-oz/sq ft coating.
- C. Accessories: Same finish as framing and fabric.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install framework, fabric, accessories and gates in accordance with ANSI/ASTM F567 and manufacturer's instructions.
- B. Set all posts plumb in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.
- C. Install forms for concrete curbing and earth retaining walls for installation after the curbs or walls are constructed.
- D. Set all posts plumb in concrete footings.
- E. Post Footing Depth Below Finish Grade: 42 inches.
- F. Diameter of line post footings: 12 inches; all other footings: 18-inch diameter.
- G. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail, one bay from end and gate posts.
- H. Install diagonal truss rod from the center of the gate or corner post to the bottom of the adjacent line post. Provide top rail through line post tops and splice with 6-inch long rail sleeves.
- I. Install brace rail on corner gate leaves.
- J. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less. Position bottom of fabric 2 inches above finished grade.
- K. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches on centers. Attach fabric to end, corner and gate posts with tension bars and tension bar clips.
- L. Install bottom tension wire stretched taut between terminal posts.

SECTION 02831 – CHAIN LINK FENCES AND GATES

- M. Do not swing gate from building wall; provide gate posts. Install gate with fabric and barbed wire overhang to match fence. Install 3 hinges per leaf, latch, catches and drop bolt.
- N. Install concrete center drop to footing depth and drop rod retainers at center of double gate openings.
- O. Install 8-foot long grounding rod bonded to fence post.

3.02 TOLERANCES

- A. Maximum Variation from Plumb: 1/4 inch.
- B. Maximum Offset from True Position: 1 inch.
- C. Components shall not infringe adjacent property lines.

END OF SECTION

SECTION 02831 – CHAIN LINK FENCES AND GATES

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SECTION 03100 – CONCRETE FORMING

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Scope:
 - 1. Provide labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install concrete forming. The Work also includes:
 - a. Designing forming systems in accordance with requirements of ACI 301 and ACI 350.5 and the Contract Documents.
 - b. Providing forming to accommodate the Work under this and other Sections and building into forming items such as sleeves, anchorage devices, inserts, pipe embedments, reinforcing, and all other items to be embedded in concrete for which placement is not specifically provided under other Sections.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before concrete forming Work.
 - 2. Coordinate forming Specifications with requirements for finished surfaces specified in Section 03300, Cast-In-Place Concrete.
- C. Related Sections:
 - 1. Section 03251, Concrete Accessories.
 - 2. Section 03300, Cast-In-Place Concrete.

1.02 REFERENCES

- A. Standards referenced in this Section include:
 - 1. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials and Commentary.
 - 2. ACI 301 - Specifications for Structural Concrete.
 - 3. ACI 350.5 - Specifications for Environmental Concrete Structures.
 - 4. ASTM C805/C805M - Test Method for Rebound Number of Hardened Concrete.
 - 5. ASTM C1074 - Practice for Estimating Concrete Strength by the Maturity Method.
 - 6. NIST PS 1 - Structural Plywood.

1.03 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Professional Engineer:
 - a. Retain a licensed professional engineer registered to practice in same state as the Site. Licensed design engineer shall have at least five years experience designing formwork and falsework of the type required.
 - b. Responsibilities include:
 - 1) Reviewing formwork and falsework performance and design criteria stated in the Contract Documents.
 - 2) Preparing written requests for clarifications or interpretations of performance or design criteria for submittal to Engineer by Contractor.
 - 3) Preparing or supervising preparation of design calculations verifying compliance of formwork and falsework with requirements of the Contract Documents.
 - 4) Signing and sealing calculations.
 - 5) Certifying that:
 - (a) Design of formwork and falsework was performed in accordance with performance and design criteria stated in the Contract Documents, and
 - (b) Design conforms to Laws and Regulations, and to prevailing standards of practice.
 - (c) In place falsework, prior to concrete placement, complies with the intent of the forming design and complies with the Contract Documents.
- B. Mock-Ups for Concrete Finishes: Provide forming for mock-ups as required for finish work shown and specified for the Work. Place embedded materials in mock-up. Construct forms

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using facing materials such as form liners, where required, to provide specified finishes and to the requirements specified in Section 03300, Cast-In-Place Concrete. Obtain Engineer's acceptance of each mock-up prior to starting forming for the Work. Do not remove mock-up(s) until directed by Engineer.

1.04 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Samples:
 - a. Plywood form material used for smooth form finish, four inches square minimum.
 - b. Controlled permeability forming liner material, eight inches square, minimum.
- B. Informational Submittals: Submit the following:
 - 1. Shop Drawings: Submit Shop Drawings showing and indicating general construction of individual forms, including:
 - a. Jointing.
 - b. Special formed joints or reveals.
 - c. Location, pattern, and details of form tie placement, removal, and repair procedures.
 - d. Location and details for temporary openings.
 - e. Void-form layout drawings and details of installation.
 - f. Other items that would visually affect the finished concrete.
 - 2. Design of Temporary Measures: Design of formwork and falsework is Contractor's responsibility. Submit the following:
 - a. Falsework layout drawings with the seal and signature of Contractor's licensed design engineer. Layout drawings shall show bracing details, waler arrangements, location of shores, joint forming details, and details at connections to previously placed concrete. Engineer's review will be for general conformance to the requirements of the Contract Documents and ACI 301 and ACI 350.5, as indicated for delegated design in the General Conditions.
 - b. Design calculations for formwork and falsework, when requested by Engineer.
 - c. Certification letter from Contractor's licensed design engineer stating that in-place falsework was inspected and complies with the intent of the falsework design.
 - 3. Product Data: Manufacturer's data for proprietary materials, including form coatings, manufactured form systems, ties and accessories.
 - 4. Manufacturer's Instructions: Installation instructions for proprietary materials, including form coatings, manufactured form systems, ties and accessories.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery and Storage:
 - 1. Upon delivery to the Site, place materials in area protected from weather.
 - 2. Store materials in accordance with manufacturer's recommendations.
 - 3. Store materials above ground on framework or blocking. Cover wood for forms and other accessory materials with protective, waterproof covering. Provide for adequate air circulation or ventilation under cover.
- B. Handle materials in accordance with the manufacturers' recommendations. Do not damage materials during handling.

PART 2 – PRODUCTS

2.01 SYSTEM PERFORMANCE

- A. Design Criteria:
 - 1. Design, erect, support, brace and maintain forming in accordance with ACI 301 and ACI 350.5 so that forming safely supports vertical and lateral loads that might be applied, until such loads can be supported by the concrete structure. Carry vertical and lateral loads to ground by forming system or in-place construction that has attained adequate strength for the purpose. Construct forming so that concrete members and structures are of correct size, shape, alignment, elevation, and position.

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2. Design forms and falsework to include values of live load, dead load, weight of moving equipment operated on forming, concrete mix, height of concrete drop, vibrator frequency, ambient temperature, foundation pressures, stresses, lateral stability, and other factors pertinent to safety of structure during construction.
3. Provide shores and struts with positive means of adjustment capable of taking up forming settlement during concrete placing operations, using wedges or jacks, or a combination thereof. Provide trussed supports when adequate foundations for shores and struts cannot be secured.
4. Support form facing materials by structural members spaced sufficiently close to prevent beyond tolerance deflection, in accordance with ACI 117. Fit forms placed in successive units for continuous surfaces to accurate alignment, free from irregularities and within allowable tolerances. For long-span members without intermediate supports, provide camber in forming as required for anticipated deflections resulting from weight and pressure of fresh concrete and construction loads.
5. Design and construct forming to be readily removable without impact, shock or damage to concrete surfaces and adjacent materials.
6. Provide forming sufficiently tight to prevent leakage of cement paste during concrete placing. Solidly butt joints and provide backup material at joints as required to prevent leakage and fins.

2.02 FORM MATERIALS

- A. Forms for Smooth Finish Concrete:
 1. Unless otherwise shown or indicated in the Contract Documents, construct forming for smooth concrete surfaces with plywood, metal, metal-framed plywood-faced, or other panel type materials acceptable to Engineer, to provide continuous, straight, smooth as-cast surfaces with no wood grain or other surface texture imparted by forming. Provide in largest practical sizes to minimize number of joints and to conform to joint system shown or specified in the Contract Documents. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection.
- B. Forms for Standard Finish Concrete:
 1. Form concrete surfaces designated to have standard formed finish with plywood, lumber, metal, or other acceptable material. Provide lumber that is dressed on at least two edges and one side.
- C. Forms for Architecturally Finished Concrete:
 1. Form finish concrete surfaces with units of face design, size, arrangement, and configuration as shown or as required to comply with approved Project job mock-up.
 2. Form Material: Overlaid plywood in accordance with NIST PS 1. Provide B-B high density overlaid concrete form, Class I.
- D. Form Ties:
 1. Provide factory-fabricated metal form ties, designed to prevent form deflection, and to prevent spalling of concrete surfaces upon removal.
 2. Unless otherwise shown or indicated in the Contract Documents, provide ties so that portion of tie remaining within concrete after removal of exterior parts of tie is at least 1.5 inches from the outer concrete surface. Unless otherwise shown or indicated in the Contract Documents, provide form ties that will leave a hole no larger than one-inch diameter in concrete surface.
 3. Ties shall have waterstops on exterior, below-grade walls, and walls subject to hydrostatic pressure.
 4. Ties shall leave a uniform, circular hole when forms are removed.
 5. Do not use removable ties unless accepted by Engineer. Removable ties are not allowed on exterior below-grade walls or walls subject to hydrostatic pressure. If removable ties are accepted, submit hole repair details for Engineer approval.
 6. Wire ties are not allowed.

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7. Do not use reinforcing bars shown by the Drawings as part of the form tie system unless approved by Engineer.
 8. Provide stainless steel form ties for areas with architectural finish. When used, tiebreak back point shall be at least one inch from outer concrete surface.
- E. Form Coatings:
1. Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatment of concrete surfaces requiring bond or adhesion, nor impede wetting of surfaces to be cured with water or curing compounds. For concrete surfaces that will be in contact with potable water or water that will be treated to become potable, form coating shall be a mineral oil base coating.
- F. Void-Forms:
1. Void (carton) forms shall be corrugated fiberboard used for creating a void space beneath grade beams and slabs on grade.
 2. Manufacturer: Provide void-forms by one of the following:
 - a. Savway Carton Forms
 - b. Sheplers
 - c. SureVoid Products
 - d. Or equal
 3. Void-forms shall have moisture-resistant treated paper faces, be laminated with waterproof adhesive, and be biodegradable. Void-forms shall have interior fabrication of uniform braced cellular configuration and shall be capable of sustaining minimum working load of 1,000 psf for minimum of ten days after concrete placement.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Examine substrate and conditions under which the Work will be performed and notify Engineer in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.02 FORM CONSTRUCTION

- A. Construct forms in accordance with ACI 301 and ACI 350.5; to the exact sizes, shapes, lines, and dimensions shown; as required to obtain accurate alignment, location, and grades; to tolerances specified; and to obtain level and plumb work in finish structures. Provide for openings, offsets, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required. Use selected materials to obtain required finishes. Finish shall be in accordance with approved mock-up or sample panel, when specified.
- B. Allowable Tolerances:
1. Construct forming to provide completed concrete surfaces complying with tolerances specified in ACI 117 and as follows:
 - a. Architectural finish forming, and where shown or indicated on the Drawings, shall be Class A surface, 1/8-inch offset.
 - b. Other surfaces exposed to view shall be Class B surface, 1/4-inch offset. Exposed to view shall include surfaces of liquid containing structures when liquid and media, if present, are removed.
 - c. Other surfaces shall be Class C surface, 1/2-inch offset.
 2. Tolerances apply to form offsets and to irregularities within the formed surface when measured with a straightedge over a five-foot distance.
- C. Install forming and accessories for facilities in accordance with manufacturer's instructions, Laws and Regulations, and the Contract Documents.
- D. Fabricate forms for easy removal without damaging concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where the slope is too steep to place concrete with bottom forms only. Kerf

SECTION 03100 – CONCRETE FORMING

wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and assure ease of removal.

- E. Provide temporary openings where interior area of forming is inaccessible for cleanout, for inspection before concrete placement, and for placing concrete. Brace temporary closures and set tightly to forms to prevent loss of cement paste. Locate temporary openings on forms in locations as inconspicuous as possible, consistent with requirements of the Work. Form intersecting planes of openings to provide true, clean-cut corners, with edge grain of plywood not exposed as form for concrete.
- F. Falsework:
 - 1. Erect falsework and support, brace, and maintain falsework to safely support vertical, lateral, and asymmetrical loads applied until such loads can be supported by in-place concrete structures. Construct falsework so that adjustments can be made for take-up and settlement.
 - 2. Provide wedges, jacks or camber strips to facilitate vertical adjustments. Carefully inspect falsework and formwork during and after concrete placement operations to determine abnormal deflection or signs of failure; make necessary adjustments to produce finished Work of required dimensions.
- G. Forms for Smooth Finish Concrete:
 - 1. Do not use metal cover plates for patching holes or defects in forms.
 - 2. Provide sharp, clean corners at intersecting planes, without visible edges or offsets. Back joints with extra studs or girts to maintain true, square intersections.
 - 3. Use extra studs, walers, and bracing to prevent bowing of forms between studs and to avoid bowed appearance in concrete. Do not use narrow strips of form material that will produce bow.
 - 4. Assemble forms so they may be readily removed without damage to exposed concrete surfaces.
 - 5. Form molding shapes, recesses, rustication joints and projections with smooth-finish materials, and install in forms with sealed joints to prevent displacement.
- H. Corner Treatment:
 - 1. Form exposed corners of beams, walls, foundations, bases and columns to produce smooth, solid, unbroken lines, except as otherwise shown or indicated in the Contract Documents. Chamfer exposed corners.
 - 2. Form chamfers with 3/4-inch by 3/4-inch strips, unless otherwise shown or indicated in the Contract Documents, accurately formed and surfaced to produce uniformly straight lines and tight edge joints. Use rigid PVC chamfers for architecturally formed concrete. Extend terminal edges to required limit and miter chamfer strips at changes in direction.
 - 3. Reentrant or internal and unexposed corners may be formed either square or chamfered.
- I. Joints: For joint treatment, comply with Section 03251, Concrete Accessories. Locate joints as shown and specified.
- J. Openings and Built-In Work:
 - 1. Provide openings in concrete forming shown or required under other Sections. Refer to Paragraph 1.1.B of this Section for coordination requirements.
 - 2. Accurately place and securely support items to be built into forms.
- K. Sealing Forming:
 - 1. Forming joints shall be tight-fitting or otherwise sealed to prevent loss of cement paste.
 - 2. Provide forming resting against concrete surfaces with compressible gasket material between the concrete and edge of form, to fill irregularities and create tight seal.
- L. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before concrete is placed. Retighten forms immediately after placing concrete, as required to eliminate cement paste leaks.
- M. Tie Hole Repair: Repair tie holes in accordance with Section 03300, Cast-In-Place Concrete.

3.03 FORM COATINGS

- A. Coat form contact surfaces with non-staining form-coating compound before installing reinforcing materials. Do not allow excess form coating material to accumulate in forms or come into contact with surfaces that will be bonded to fresh concrete. Apply in compliance with manufacturer's instructions.
- B. Coat steel forms with non-staining, rust-preventative form oil, or otherwise protect against rusting. Do not use rust-stained steel forming.

3.04 INSTALLATION OF EMBEDDED ITEMS

- A. Set and build into forming anchorage devices and other embedded items, shown, specified, or required under other Sections. Refer to Paragraph 1.1.B of this Section for coordination requirements. Use necessary setting drawings, diagrams, instructions, and directions.
- B. Edge Forms and Screeds Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units to support screeds.

3.05 VOID-FORMS

- A. Install void-forms where shown or indicated in the Contract Documents, to the thickness indicated, in accordance with manufacturer's recommendations.
- B. Where void-form is shown or indicated in the Contract Documents, place void-form to grades and elevations shown over an even, well-compacted subgrade to form continuous void space under entire extent of slab, mat, or grade beam.
- C. For structural slab applications, place 1/8-inch thick masonite or plywood sheet over void-form. Place void-forms in largest pieces practical and secure in place.
- D. Properly surround and void around upper portion of drilled piers at intersection of slab, grade beam or pier cap using premanufactured, non-field cut sealed void-form with curved, radial, vertical edge adjacent to drilled pier.
- E. Void-forms shall remain dry and undamaged prior to concrete placement. Replace damaged pieces prior to placing concrete. Seal all joints and exposed ends to prevent concrete leakage into void space.

3.06 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Before placing concrete, check ties, tie cones, tie waterstops, embedded items, form coatings, forming stability, alignment, and tolerances. Make corrections and adjustments to ensure forming complies with intent of the forming design, proper stability of forming systems, and accurate size and location of concrete members.
 - 2. During concrete placing, check forming and related supports to ensure that forms are not displaced and that completed Work will be within specified tolerances.
 - 3. If forms are unsatisfactory, either before or during concrete placing, stop or postpone placing of concrete until defects are corrected as required by Contractor's or Supplier's professional engineer and accepted by Engineer.

3.07 REMOVAL OF FORMS

- A. Determination of time between placing concrete and removing forms and shoring is Contractor's responsibility. Requirements specified in this Section are minimum times and requirements intended to ensure that concrete will support its own weight, and do not consider additional effects of the construction. Account for additional effects of the construction when determining time for removing forming. Time for removing of forms is subject to Engineer's acceptance.
- B. Comply with requirements of ACI 301 and ACI 350.5, except as indicated in the Contract Documents.
- C. Removal of Forms for Walls, Columns, Sides of Beams and Girders, and Slab and Foundation Edges:

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1. Comply with requirements of Table 03100-A of this Section:

3.08 TABLE 03100-A, REMOVAL OF FORMS

COMPONENT	AVERAGE DAILY AMBIENT AIR TEMPERATURE (DEG F)				MIN. CONCRETE COMPRESSIVE STRENGTH FOR FORM REMOVAL
	OVER 70 F	60 F TO 70 F	50 F TO 60 F	BELOW 50 F	
WALLS	ONE DAY	TWO DAYS	THREE DAYS		750 PSI
COLUMNS	TWO DAYS	THREE DAYS	FOUR DAYS	SEE PARA- GRAPH	1000 PSI
SIDE OF BEAMS AND GIRDERS	ONE DAY	ONE DAY	TWO DAYS	3.8.C.2 OF THIS SECTION	500 PSI
SLAB AND FOUNDATION EDGES	ONE DAY	ONE DAY	TWO DAYS	N	500 PSI

- A. When average daily ambient air temperature is below 50 degrees F, do not remove forms until concrete attains minimum compressive strength indicated in Table 03100-A for form removal, and comply with Paragraph 3.8.C.3.b of this Section.
- B. Concrete Strength Requirements for Form Removal:
 1. For other than beams and elevated slabs, do not remove forms until concrete attains minimum concrete compressive strength indicated in Table 03100-A for form removal.
 2. For beams and elevated slabs, do not remove supporting forms or shoring until concrete attains minimum of 90 percent of its specified compressive strength.
- C. Alternative Criteria for Removing Forms for Walls, Columns, Sides of Beams and Girders, and Slab and Foundation Edges: Contractor has the option of submitting an alternative removal of forms table, together with supporting data, for Engineer's acceptance. Supporting data shall include representative field data for each different placement ambient temperature condition and minimum of three tests per temperature condition to ensure that accurate correlation between concrete strength and placement temperature is obtained.
- D. Determination of In-place Concrete Strength:
 1. Determine compressive strength of in-place concrete by compression test specimens cured at the Site under the same conditions of temperature and moisture as the concrete member under consideration.
 2. Alternately, determine compressive strength of in-place concrete by maturity factor procedure in accordance with ASTM C1074 and approved by Engineer. Location of embedded thermistors or thermocouples shall be as approved by Engineer.
- E. Leave form facing material in place for minimum of four days after concrete placement, unless otherwise approved by Engineer.
- F. Continue curing, including bottom surfaces of slabs and beams, after form removal in accordance with Section 03300, Cast-In-Place Concrete.

3.09 PERMANENT SHORES

- A. Provide permanent shores in accordance with ACI 301 and ACI 350.5.
- B. Reshores are not allowed.

3.10 RE-USE OF FORMS

- A. Clean and repair surfaces of forms to be re-used in the construction. Do not use split, frayed, delaminated, or otherwise damaged form facing material. Apply form coating compound material to concrete contact surfaces as specified for forming.

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- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joints to avoid offsets. Do not use “patched” forms for exposed concrete surfaces. Form surfaces are subject to Engineer’s approval.

END OF SECTION

SECTION 03200 – CONCRETE REINFORCING

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Scope:
 - 1. Provide labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install concrete reinforcing.
 - 2. Extent of concrete reinforcing is shown and indicated in the Contract Documents.
 - 3. Work includes fabrication and placement of reinforcing including bars, ties, and supports, and welded wire fabric for concrete, encasements, and fireproofing.
- B. Related Sections:
 - 1. Section 02604 – Utility Structures.
 - 2. Section 03251 - Concrete Accessories.
 - 3. Section 05051 - Anchor Systems.

1.02 REFERENCES

- A. Standards referenced in this Section include:
 - 1. ACI 301 - Specifications for Structural Concrete.
 - 2. ACI 350.5 - Specifications for Environmental Concrete Structures.
 - 3. ASTM A615 - Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - 4. ASTM A706 - Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
 - 5. ASTM A767 - Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
 - 6. ASTM A775 - Specification for Epoxy-Coated Steel Reinforcing Bars.
 - 7. ASTM E329 - Specification for Agencies Engaged in Construction Inspection and/or Testing.
 - 8. Concrete Reinforcing Steel Institute (CRSI), CRSI 1MSP, Manual of Standard Practice.
 - 9. ASTM E488 - Test Methods for Strength of Anchors in Concrete and Masonry Elements.
 - 10. ICC Evaluation Service (ES) AC 308 - Acceptance Criteria for Post-Installed Anchors in Concrete Elements.

1.03 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Testing Laboratory: Shall meet requirements of ASTM E329 and shall have experience in the testing welded splices of reinforcing steel and tension testing of reinforcing bars set in adhesive in hardened concrete.
 - 2. Installer of Adhesive Dowels: Shall be experienced and certified by manufacturer of adhesive as possessing necessary training for installing manufacturer's products. Distributors or manufacturer's representatives shall not provide product training unless qualified as certified trainers by anchor manufacturer.

1.04 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Drawings for fabricating, bending, and placing concrete reinforcing. Comply with ACI 301 and ACI 350.5.
 - b. For walls, show elevations at minimum scale of 1/4-inch to one foot.
 - 1) Elevations shall show all openings and reference details that identify additional reinforcing required around each opening.
 - 2) Elevations shall denote each wall intersection and reference a detail that identifies additional reinforcing required at wall intersection. As an alternate to providing separate details for each wall intersection, provide overall plan detailing only the additional wall intersection reinforcing for each wall intersection.

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- c. For slabs and mats, show top and bottom reinforcing on separate plan views.
Plans shall show all openings and shall reference details that identify additional reinforcing around each opening.
- d. Show bar schedules, stirrup spacing, diagrams of bent bars, location of bar splices, length of lap splices, arrangements, and assemblies, as required for fabricating and placing concrete reinforcing unless otherwise noted.
- e. Splices shall be kept to a minimum. For slabs and beams, when splices are required, locate splices in bottom bars within 1/3 span from supports and for top bars locate splices in the middle 1/3 of the span.
- f. Drawings detailing location of all construction and expansion joints, as required under Section 03251, Concrete Accessories, shall be submitted and approved before Shop Drawings for reinforcing are submitted.
- g. Drawings detailing location, spacing, edge distance, and embedment depth of adhesive dowels. Adhesive system shall be submitted and approved before Shop Drawings with adhesive dowels are submitted.
- 2. Product Data:
 - a. Manufacturer's product data for adhesive, if not submitted under other Sections.
 - b. Adhesive manufacturer's test data and ICC ES report to verify specified capacity of adhesive dowels.
- B. Informational Submittals: Submit the following:
 - 1. Certificates:
 - a. Steel manufacturer's certificates of mill analysis, tensile, and bend tests for reinforcing steel.
 - b. Certification of welders and weld procedures for splices.
 - c. Adhesive manufacturer's certification verifying that installer is qualified and using proper installation procedures.
 - 2. Manufacturer's Instructions: Installation instructions for adhesive systems.
 - 3. Field Quality Control Submittals:
 - a. Reports of all field quality control testing, where applicable.
 - b. Results of required inspection of welded splices of reinforcing bars.
 - c. Results of required tensile testing of adhesive dowels. Include size and location of bars tested.
 - 4. Special Procedure Submittals: Description of reinforcing weld locations and weld procedures.

1.05 DELIVERY, HANDLING, AND STORAGE

- A. Deliver concrete reinforcing products to Site bundled, tagged, and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings on approved Shop Drawings.
- B. Store concrete reinforcing products to prevent damage and accumulation of dirt and excessive rust. Store on heavy wood blocking so that reinforcing does not come into contact with the ground.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Reinforcing Bars: Shall be deformed in accordance with ASTM A615, and as follows:
 - 1. Provide Grade 60 for all bars, unless indicated otherwise.
- B. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting and fastening reinforcing in place.
 - 1. Use wire bar type supports complying with CRSI 1 MSP recommendations, except as specified in this Section. Do not use wood, brick, or other unacceptable materials.
 - 2. For slabs on grade, use precast concrete blocks, four inches square in plan, with embedded tie wire as specified by CRSI 1 MSP. Precast concrete blocks shall have same or higher compressive strength as specified for concrete in which they are located.

SECTION 03200 – CONCRETE REINFORCING

3. For concrete surfaces where legs of supports are in contact with forms, provide supports complying with CRSI 1 MSP as follows:
 - a. At formed surfaces in contact with soil, weather, or liquid, or located above liquid, supports shall be CRSI Class 1 for maximum protection. Plastic coating on legs shall extend at least 0.5-inch upward from form surface. At surfaces not exposed to view or liquid, precast concrete blocks, three inches square in plan, with embedded tie wire shall be permitted. Precast concrete blocks shall have same or higher compressive strength as specified for concrete in which they are located.
 - b. At interior dry surfaces (not located above liquid), supports shall be either Class 1 or Class 2 for moderate protection.
 - c. At formed surfaces with an architectural finish, use stainless steel protected legs (Type B).
 4. Over waterproof membranes, use precast concrete chairs.
 5. For epoxy-coated reinforcing, use wire reinforcing supports coated with dielectric material including epoxy or another polymer for minimum distance of two inches from point of contact with epoxy-coated reinforcement.
- C. Adhesive Dowels:
1. Dowels: Dowel reinforcing bars shall be deformed in accordance with ASTM A615, Grade 60.
 2. Adhesive: Requirements for adhesive are specified under requirements for concrete adhesive anchors in Section 05051, Anchor Systems.

2.02 FABRICATION

- A. General: Fabricate reinforcing bars to conform to required shapes and dimensions, with fabrication tolerances complying with ACI 301 and ACI 350.5. In case of fabricating errors, do not re-bend or straighten reinforcing in manner that injures or weakens material.
- B. Unacceptable Materials: Reinforcing with one or more of the following defects is not allowed:
1. Bar lengths, bends, and other dimensions exceeding specified fabrication tolerances.
 2. Bends or kinks not shown on approved Shop Drawings.
 3. Bars that do not meet or exceed their ASTM specification requirements when hand-wire-brushed, with respect to cross section, nominal weight, or average height of deformations.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Examine the substrate and conditions under which concrete reinforcing is to be placed and notify Engineer in writing of unsatisfactory conditions. Do not proceed with Work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Comply with applicable requirements of Laws and Regulations, applicable standards, and ACI 301 and ACI 350.5 for details and methods of reinforcing placement and supports.
- B. Clean reinforcing to remove loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.
- C. Position, support, and secure reinforcing against displacement during formwork construction and concrete placing. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.
1. Place reinforcing to obtain minimum concrete coverages specified in the Contract Documents. Arrange, space, and securely tie bars and bar supports together with 16-gage wire to hold reinforcing accurately in position during concrete placing. Set wire ties so that twisted ends are directed away from exposed concrete surfaces.
 2. Prior to placing concrete, using surveyor's level or string line, demonstrate to Engineer that specified cover of reinforcing has been attained.
 3. Do not secure reinforcing steel to forms with wire, nails, or other ferrous metal. Metal supports subject to corrosion shall not touch formed or exposed concrete surfaces.

SECTION 03200 – CONCRETE REINFORCING

- D. Allowable Placing Tolerances: Comply with ACI 301 and ACI 350.5, except as specified in this Section:
 - 1. Concrete surfaces in contact with liquid shall have minimum of two inches of concrete over reinforcing steel.
- E. Provide sufficient number of supports of strength required to carry reinforcing. Do not place reinforcing bars more than two inches beyond last leg of continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.
- F. Lap Splices: Provide standard reinforcing splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements shown for minimum lap of spliced bars as shown on the Drawings.
- G. Adhesive Dowels:
 - 1. Comply with manufacturer's written installation instructions and requirements of this Section.
 - 2. Drill holes to adhesive system manufacturer's recommended drill bit diameter and to specified depth. Drill holes in hammering and rotation mode with carbide-tipped drill bits complying with tolerances indicated in ANSI B212.15. Core-drilled holes shall not be permitted.
 - 3. Before setting adhesive dowel, hole shall be made free of dust and debris by method recommended by adhesive system manufacturer. Brush the hole with adhesive system manufacturer-approved brush and blow hole clean with clean, dry, oil-free compressed air to remove dust and loose particles. Hole shall be dry as defined by adhesive system manufacturer.
 - 4. Before injecting adhesive, obtain Engineer's concurrence that hole is dry and free of oil and other contaminants.
 - 5. Prior to injecting adhesive into the drilled hole, dispense to an appropriate location for waste an initial amount of adhesive from the mixing nozzle until adhesive is a uniform color, indicating that product is properly mixed.
 - 6. Inject adhesive into hole through injection system-mixing nozzle and extension tubes (as required) placed to bottom of hole. Withdraw nozzle's discharge end as adhesive is placed while keeping nozzle immersed to prevent formation of air pockets. Fill hole to depth that ensures that excess material is expelled from hole during dowel placing.
 - 7. Twist dowel during insertion into partially-filled hole to ensure full wetting of rod surface with adhesive. Insert rod slowly to avoid developing air pockets.
 - 8. Provide adequate curing in accordance to adhesive system manufacturer's requirements prior to continuing with adjoining or adjacent Work that could impose or impart load on the dowels. Do not begin adjoining or adjacent Work until dowels are successfully tested or when approved by Engineer.
 - 9. Limitations:
 - a. Installation Temperature: Comply with manufacturer's instructions for installation temperature requirements. Provide temporary protection and other measures, such as heated enclosures, necessary to ensure that base material temperature complies with requirements of adhesive systems manufacturer during installation and adhesive system curing.
 - b. Oversized Holes: Advise Engineer immediately if size of drilled hole is larger than recommended by adhesive system manufacturer. Cost of corrective measures, including but not limited to redesign of dowels due to decreased capacities, shall be paid by Contractor.

3.03 FIELD QUALITY CONTROL

- A. Site Inspections and Tests:
 - 1. General:
 - a. Do not place concrete until reinforcing is inspected, and permission for placing concrete is granted by Engineer. Concrete placed in violation of this provision will be rejected.

SECTION 03200 – CONCRETE REINFORCING

- b. Do not close up formwork for walls and other vertical members until reinforcing is inspected, and permission for placing concrete is granted by Engineer. Concrete placed in violation of this provision will be rejected.
 - c. Correct defective Work by removing and replacing or correcting, as required by Engineer.
 - d. Contractor shall pay cost of corrections and subsequent testing required to confirm integrity of post-installed anchors.
 - e. Owner's testing laboratory will submit test results to Contractor and Engineer within 24 hours of completion of test.
- 2. Site Tests:
 - a. Owner will employ testing laboratory to perform field quality testing of adhesive dowels at the Site.
 - 1) Testing shall comply with ASTM E488.
 - 2) Test at least ten percent of each type of adhesive dowel. If one or more dowels fail the test, Contractor shall pay cost to test all dowels of same diameter and type installed on the same day as the failed dowel.
 - 3) Test dowels to 60 percent of specified yield strength. Engineer will direct which dowels are to be tested.
 - 4) Apply test loads with hydraulic ram.
 - 5) Displacement of dowels shall not exceed $D/10$, where D is nominal diameter of dowel.
 - 3. Inspection of Welded Splices: Owner will employ testing laboratory to perform field quality control testing of welded splices. All welded splices shall be visually inspected. Radiographically test minimum of five percent of butt splice welds. Repair defective welds so that welds are completely sound.
- B. Manufacturer's Services: Provide qualified adhesive manufacturer's representative at the Site during initial installation of adhesive dowel systems to train installing personnel in proper selection and installation procedures. Manufacturer's representative shall observe to verify that installer demonstrates proper installation procedures for adhesive dowels and adhesive material. Each installer shall be certified in writing by manufacturer as qualified to install adhesive anchors.

END OF SECTION

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SECTION 03251 – CONCRETE ACCESSORIES

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Scope:
 - 1. Provide labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install concrete accessories.
- B. Related Sections:
 - 1. Section 03100, Concrete Forming.
 - 2. Section 03600, Grouting.
 - 3. Section 07920, Joint Sealants.

1.02 REFERENCES

- A. Standards referenced in this Section are:
 - 1. ACI 301 - Specifications for Structural Concrete.
 - 2. ACI 350.5 - Specifications for Environmental Concrete Structures.
 - 3. ASTM D1752 - Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
 - 4. CRD-C572 - U.S. Army Corps of Engineers Specifications for Polyvinyl- Chloride Waterstop.

1.03 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Layout of construction and expansion joint locations. Submit and obtain approval prior to submitting concrete reinforcement Shop Drawings.
 - b. For construction and expansion joints that require waterstops, submit layout of locations showing waterstop details. Indicate waterstop type, waterstop joint conditions, and details on how joint conditions will be handled.
 - c. Detail for joining PVC to steel waterstops.
 - d. Layout of all control joint locations.
 - 2. Samples:
 - a. Submit Sample, at least six inches long each, of each type of waterstop proposed for use.
 - b. Submit Sample of foam rubber and cork expansion joint fillers.
 - c. Submit Sample of each type of prefabricated PVC waterstop joint.
- B. Informational Submittals: Submit the following:
 - 1. Manufacturer's Instructions: Manufacturer's specifications and installation instructions for materials required.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Transportation and Handling of Products:
 - 1. Deliver materials to Site to ensure uninterrupted progress of the Work.
 - 2. Comply with Section 01600, Delivery, Storage and Handling.
- B. Storage and Protection:
 - 1. Store concrete joint materials on platforms or in enclosures or covered to prevent contact with ground and exposure to weather and direct sunlight. Comply with manufacturer's storage and protection requirements.
 - 2. Comply with Section 01600, Delivery, Storage and Handling.

PART 2 – PRODUCTS

2.01 WATERSTOPS

- A. Polyvinyl Chloride (PVC):
 - 1. Material Requirements:
 - a. Waterstops shall be extruded from elastomeric PVC compound containing plasticizers, resins, stabilizers, and other materials necessary to meet requirements

SECTION 03251 – CONCRETE ACCESSORIES

- of the Contract Documents and requirements of CRD-C572. Do not use reclaimed or scrap material.
- b. Tensile strength of finished waterstop: 1,400 psi, minimum.
- c. Ultimate elongation of finished waterstop: 280 percent, minimum.
- d. Minimum thickness shall be 3/8-inch over entire width of waterstop.
- e. Provide waterstops with minimum of seven ribs equally spaced at each end on each side. First rib shall be at the edge. Ribs shall be a minimum of 1/8-inch in height.
- f. Provide waterstops with hog rings or factory-installed grommets anchored to exterior ribs to facilitate tying waterstop in position.
- 2. Split waterstops are not allowed.
- 3. Construction Joints: Waterstops shall be flatstrip ribbed type, six-inch minimum width, unless otherwise shown or indicated in the Contract Documents.
- 4. Expansion Joints: Waterstops shall be centerbulb ribbed type, nine-inch minimum width, unless otherwise shown or indicated in the Contract Documents. Centerbulb shall have minimum outside diameter of 7/8-inch.
- 5. Product and Manufacturer: Provide one of the following:
 - a. W.R. Meadows, Inc.
 - b. Durajoint Concrete Accessories.
 - c. Greenstreak Plastic Products Company.
 - d. Paul Murphy Plastics Company.
 - e. Vinylex Corporation.
 - f. Or equal.
- B. Hydrophilic Waterstop Materials:
 - 1. General Material Properties:
 - a. Bentonite-free, and expandable by minimum of 80 percent of dry volume in presence of water to form watertight joint seal without damaging concrete in which material is cast. Provide only where shown or indicated in the Contract Documents.
 - b. Material shall be composed of resins and polymers that absorb water and cause an increase in volume in completely reversible and repeatable process. Waterstop material shall be dimensionally stable after repeated wet-dry cycles with no deterioration of swelling potential.
 - c. Select materials that are recommended by manufacturer for type of liquid to be contained.
 - 2. Hydrophilic Rubber Waterstop:
 - a. Minimum cross sectional dimensions shall be 3/16-inch by 3/4-inch.
 - b. Product and Manufacturer: Provide one of the following:
 - 1) Duroseal Gasket, by BBZ USA, Inc.
 - 2) Adeka Ultraseal MC-2010M, by Asahi Denka Kogyo K.K.
 - 3) Hydrotite, by Greenstreak Plastic Products Company.
 - 4) Or equal.
 - 3. Hydrophilic Sealant:
 - a. Hydrophilic sealant shall adhere firmly to concrete, metal, and PVC in dry or damp condition. When cured sealant shall be elastic indefinitely.
 - b. Product and Manufacturer: Provide one of the following:
 - 1) Duroseal Paste, by BBZ USA, Inc.
 - 2) Adeka Ultraseal P-201, by Asahi Denka Kogyo K.K.
 - 3) Hydrotite, by Greenstreak Plastic Products Company.
 - 4) SikaSwell S, by Sika Corporation.
 - 5) Or equal.
- C. Injection Hose Waterstop System:
 - 1. Injection Hose Waterstop:
 - a. Injection hose shall consist of PVC or neoprene central core of sufficient strength to resist weight of minimum of 25 vertical feet of fresh concrete placed upon it. Provide injection openings closely spaced in minimum of three locations equally spaced

SECTION 03251 – CONCRETE ACCESSORIES

around perimeter of hose. Seal openings with strips of closed cell foam of consistency to act as one-way valves preventing entrance of cement paste while allowing free flow of injection material, pumped through hose, into the concrete joint surface.

- b. Injection hose system shall be appropriate for injection of hydrophilic injection resin. Hose shall allow for vacuuming operations and repeated use. Construction of hose shall permit free discharge of specified injected grout into concrete without backwash, for entire length of hose.
 - c. Injection hose system shall be complete with hold-down clips, connection tubes, fittings, and injection connections designed to be mounted flush with concrete surface and sealed to allow future injections. All system components shall be provided by same manufacturer.
 - d. Product and Manufacturer: Provide one of the following:
 - 1) Fuko Injection System, by BBZ USA, Inc.
 - 2) SikaSwell Hose, by Sika Corporation.
 - 3) Or equal.
2. Hydrophilic Injection Resin:
- a. Hydrophilic injection resin shall be acrylate-ester based. Viscosity shall be less than 50 centipoises (cps). Resin shall be water soluble in its uncured state, solvent-free, and non-water reactive. In cured state, resin shall form solid, hydrophilic, flexible material resistant to permanent water pressure, and shall not attack bitumen, joint sealants, and concrete.
 - b. Product and Manufacturer: Provide one of the following:
 - 1) Duroseal Inject 1K/2K, by BBZ USA, Inc.
 - 2) Sika Injection 29, by Sika Corporation.
 - 3) Or equal.

2.02 PREFORMED EXPANSION JOINT FILLER

- A. Provide preformed expansion joint filler complying with ASTM D1752, Type I (sponge rubber) or Type II (cork).

2.03 CONCRETE CONSTRUCTION JOINT ROUGHENER

- A. Provide water-soluble non-flammable, surface-retardant roughener.
- B. Product and Manufacturer: Provide one of the following for the types of joints specified:
 1. Rugasol-S, by Sika Corporation for horizontal joints only.
 2. Concrete Surface Retarder-Formula S, by Euclid Chemical Company, for horizontal joints only.
 3. Concrete Surface Retarder-Formula F, by Euclid Chemical Company, for vertical joints only.
 4. TK-6100 Concrete Form Surface Retarder, by TK Products.
 5. Or equal.

2.04 EPOXY BONDING AGENT

- A. Provide a two-component epoxy-resin bonding agent.
- B. Product and Manufacturer: Provide one of the following:
 1. Sikadur 32 Hi-Mod LPL, by Sika Corporation.
 2. Eucopoxy LPL, by the Euclid Chemical Company.
 3. Resi-Bond J-58, by Dayton Superior.
 4. Or equal.

2.05 EPOXY-CEMENT BONDING AGENT

- A. Provide three component epoxy resin-cement blended formulated as bonding agent.
- B. Product and Manufacturer: Provide one of the following:
 1. Sika Armatec 110 EpoCem, as manufactured by Sika Corporation.
 2. Duralprep A.C., as manufactured by the Euclid Chemical Company.

SECTION 03251 – CONCRETE ACCESSORIES

3. Emaco P24, as manufactured by MBT/ChemRex.
4. Or equal.

2.06 JOINT SEALANT AND ACCESSORIES

- A. For joint sealants and accessories used on isolation joints, control joints, and expansion joints, refer to Section 07920, Joint Sealants.

2.07 CONCRETE BOND BREAKERS

- A. Provide asphalt-saturated rag felt building paper, not less in weight than commercially known as 15 pound felt building paper, which weighs 15 pounds per 100 square feet.

2.08 STAIR NOSING

- A. Non-skid Stair Nosing: Cast in place, Ecoglo Model S2-N30, black, inserts attached or approved equal.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Examine substrate and conditions under which the Work shall be performed and notify Engineer in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.02 CONSTRUCTION JOINTS

- A. Comply with requirements of ACI 301, ACI 350.5 and the Contract Documents.
- B. Locate and install construction joints as shown or indicated on the Drawings. Where not shown or indicated, locate joints to not impair strength of the structure; position joints at points of minimum shear. Location of joints shall be approved by Engineer. In addition to joints shown or indicated on the Drawings, locate construction joints as follows:
 1. In foundation mats, locate joints at a maximum spacing of 50 feet. Joints shall be located within middle third of element span, unless otherwise shown or indicated on the Drawings. Element span shall be considered distance between piles or, as determined by Engineer, distance between bearing elements, such as columns, exterior walls and interior walls. Place concrete in strip pattern, unless otherwise shown or indicated on the Drawings.
 2. In walls, locate joints at a maximum spacing of 40 feet. Locate joints away from wall intersections a minimum of one-quarter of the clear span distance between wall intersections measured horizontally.
 3. In structural slabs and beams, joints shall be located within middle third of element span and shall be located in compliance with ACI 301 and ACI 350.5, unless otherwise shown or indicated on the Drawings.
 4. In slabs on grade, locate joints at a maximum spacing of 40 feet. Place concrete in strip pattern, unless otherwise shown or indicated on the Drawings.
- C. Horizontal Joints:
 1. Roughen concrete at interface of construction joints by abrasive blasting, hydroblasting, or using surface retardants and water jets to expose aggregate and remove accumulated concrete on projecting rebar immediately subsequent to form stripping, unless otherwise approved by Engineer. Do not allow surface retardants to contact waterstop. Protect waterstop from blasting. Immediately before placing fresh concrete, thoroughly clean existing contact surface using stiff brush or other tools and stream of pressurized water. Surface shall be clean and wet, and free from pools of water at time of placing fresh concrete.
 2. Remove laitance, waste mortar, and other substances that may prevent complete adhesion. Where joint roughening was performed more than seven days prior to concrete placing or where dirt or other bond reducing contaminants are on surface, perform additional light abrasive blasting or hydroblasting to remove laitance and bond-reducing materials just prior to concrete placement.

SECTION 03251 – CONCRETE ACCESSORIES

3. Provide over contact surface of concrete a six-inch layer of Construction Joint Grout as specified in Section 03600, Grouting. Place fresh concrete before grout has attained its initial set. Placement of grout may be omitted if concrete mix has slump increased to at least six inches by addition of high range water reducer.
- D. Vertical Joints:
 1. Apply roughener to the form in thin, even film by brush, spray, or roller in accordance with manufacturer's instructions. Do not allow roughener onto waterstop. Clean off any roughener that contacts the waterstop. After roughener is dry, concrete may be placed.
 2. When concrete has been placed, remove joint surface forms as early as necessary to allow for removal of surface retarded concrete. Forms covering member surfaces shall remain in place as required under Section 03100, Concrete Forming. Wash loosened material off with high-pressure water spray to obtain roughened surface subject to approval by Engineer. Alternately, surface shall be roughened by abrasive blasting or hydroblasting to expose aggregate. Outer one-inch of each side of joint face shall be masked and protected from blasting to avoid damaging member surface. Protect waterstop from blasting.

3.03 EXPANSION JOINTS

- A. Comply with requirements of ACI 301, ACI 350.5, and this Section.
- B. Locate and install expansion joints as shown and indicated in the Contract Documents. Install joint filler in accordance with manufacturer's instructions. Install sealants as specified in this Section.

3.04 CONTROL JOINTS

- A. Provide control joints in non-water bearing slabs on grade as shown or indicated on the Drawings. Where control joints are not shown or indicated on the Drawings, space control joints at 24 to 36 times thickness of slab in both directions. Locate control joints only at places approved by Engineer.
- B. A groove, with depth of at least 25 percent of the member thickness, shall be tooled, formed, or saw-cut in concrete. Groove shall be filled with joint sealant material in accordance with Section 07920, Joint Sealants.
- C. Where control joint is formed by sawcutting, make sawcut in presence of Engineer immediately after concrete has set sufficiently to support the saw and be cut without damage to concrete. Keep concrete continually moist during cutting. Joints shall be 1/8-inch (+/- 1/32-inch) wide.
- D. Control joints may be formed with tool or by inserting joint forming strip. After concrete has achieved design strength, remove upper portion of joint forming strip and fill void with sealant.

3.05 ISOLATION JOINTS

- A. Provide isolation joint where sidewalk or other slab on grade abuts a concrete structure and slab on grade is not shown doweled into that structure. Form isolation joint by 1/2-inch joint filler with upper 1/2-inch of joint filled with sealant.

3.06 WATERSTOPS

- A. General:
 1. Comply with ACI 301, ACI 350.5, and this Section. Make joints in accordance with manufacturer's instructions.
 2. Provide PVC waterstops, except where otherwise shown or indicated on the Drawings.
 3. Provide waterstops in all joints where concrete construction is below grade or intended to retain liquid. Install waterstop to the higher of: at least 12 inches above grade, or 12 inches above overflow liquid level in tanks.
 4. Waterstops shall be fully continuous for extent of joint and with waterstops in intersecting joints. Maintain waterstop continuity at transitions between waterstops in joints at different levels and orientations.
 5. In vertical joints in walls that are free at the top, waterstops shall extend no closer than six inches from top of wall.

SECTION 03251 – CONCRETE ACCESSORIES

6. In placing concrete around horizontal waterstops, with waterstop flat face in horizontal plane, work the concrete under waterstops by hand to avoid forming air and rock pockets.
- B. Polyvinyl Chloride Waterstop:
1. Waterstops shall be positively held from displacement during concrete placing. Tie waterstops to reinforcement or other rigid supports at maximum spacing of 18 inches so that waterstop is securely and rigidly supported in proper position during concrete placing. Continuously inspect waterstops during concrete placing to ensure proper positioning.
 2. Perform splicing in waterstops by heat sealing adjacent waterstop sections in accordance with manufacturer's printed recommendations. The following is required:
 - a. Material shall not be damaged by heat sealing.
 - b. Splices shall have tensile strength of not less than 60 percent of unspliced material's tensile strength.
 - c. Maintain the continuity of waterstop ribs and of its tubular center axis.
 3. Only butt-type joints of ends of two identical waterstop sections shall be made while material is in forms.
 4. Prefabricated PVC Waterstop Joint:
 - a. Joints with waterstops involving more than two ends to be jointed together, and joints that involve an angle cut, alignment change, or joining of two dissimilar waterstop sections, shall be prefabricated by Contractor or manufacturer prior to placing in the forms.
 - b. Prefabricated joints shall have minimum of 2.0 feet of waterstop material beyond joint in each direction.
 - c. Install prefabricated joint assembly in the forms and butt-weld each two-foot end to a straight-run portion of waterstop in place in the forms.
 5. Where centerbulb waterstop intersects and is jointed with non-centerbulb waterstop, seal end of centerbulb using additional PVC material as required.
 6. Symmetrical halves of waterstops shall be equally divided between concrete placements at joints and centered within joint width, unless shown or indicated otherwise in the Contract Documents. Place centerbulb waterstops in expansion joints so that centerbulb is centered on joint filler material.
 7. When waterstop is installed in the forms or embedded in first concrete placement and waterstop remains exposed to atmosphere for more than four days, implement suitable precautions to shade and protect exposed waterstop from direct rays of sun during entire exposure, until exposed portion of waterstop is embedded in concrete.
 8. Protect waterstop placed in joints intended for future concrete placement from direct rays of the sun by temporary means until permanent cover is installed, so that waterstop is not exposed to direct rays of the sun for more than four days total.
- C. Hydrophilic Rubber Waterstop and Sealant:
1. Where a hydrophilic rubber waterstop or sealant is required in accordance with the Contract Documents, or where approved by Engineer, install waterstop or sealant in accordance with manufacturer's instructions and recommendations; except, as modified in the Contract Documents.
 2. When requested by Engineer, provide manufacturer's technical assistance at the Site.
 3. Locate waterstop or sealant as near as possible to center of joint. Waterstop or sealant shall be continuous around entire joint. Minimum distance from edge of waterstop to face of the member shall be three inches.
 4. Where hydrophilic rubber waterstop is used in combination with PVC waterstop, hydrophilic rubber waterstop shall overlap PVC waterstop for minimum of six inches. Fill contact surface between hydrophilic rubber waterstop and PVC waterstop with hydrophilic sealant.
 5. Where wet curing methods are used, apply hydrophilic rubber waterstop and sealant after curing water is removed and just prior to closing up of the forms for concrete placement. Protect hydrophilic rubber waterstop and sealant from direct rays of sun and from becoming wet prior to concrete placement. If material becomes wet and expands, allow

SECTION 03251 – CONCRETE ACCESSORIES

material to dry until material has returned to original cross sectional dimensions before placing concrete.

6. Install hydrophilic rubber waterstop in bed of hydrophilic sealant, before skinning and curing begins, so that irregularities in concrete surface are completely filled and waterstop is bonded to sealant. After sealant has cured, install concrete nails, with washers of a diameter equal to waterstop width, to secure waterstop to concrete at maximum spacing of 1.5 feet.
 7. Prior to installing hydrophilic sealant, wire brush or sandblast the concrete surface to remove laitance and other materials that may interfere with bonding. Metal and PVC surfaces to receive sealant shall be cleaned of paint and materials that may interfere with bond. When sealant alone is shown or indicated in the Contract Documents, place sealant placed in built-up bead which has a triangular cross section with each side of triangle at least 3/4-inch long, unless otherwise indicated in the Contract Documents. Do not place concrete until sealant has cured as recommended by sealant manufacturer.
- D. Injection Hose Waterstop:
1. Provide injection hose waterstop where shown or indicated on the Drawings.
 2. Install injection hose in maximum lengths recommended by manufacturer, but not greater than 40 feet.
 3. Clean concrete surface of debris prior to installing injection hose. Install injection hose on two-inch wide strip of unroughened concrete at center of member width in direct contact with concrete. Clamp hose into position with anchor clips set into concrete spaced no more than 10 inches on centers.
 4. Where injection hose is used in combination with PVC waterstop, hose shall overlap PVC waterstop for minimum of six inches and shall be less than two inches away from PVC waterstop.
 5. Provide each end of injection hose with solid injector hoses mounted to formwork using a fitting. Provide fitting with cover that seals hose from cement paste and serves as a removable and reinstallable cover for future reinjections. Mount fittings on dry side of member, unless shown otherwise on the Drawings.
 6. Hose system shall not be injected until authorization is given by Engineer. When authorized, hose system shall be injected with hydrophilic resin in conformance with manufacturer's recommendations. Injection shall be by an applicator authorized by injection system manufacturer.
 7. Injection system manufacturer shall provide necessary supervision to satisfy Engineer that application conforms strictly to manufacturer's recommendations.
 8. Prior to resin injection, flush hose system with water. At end of injection operation, clean the hose system in accordance with manufacturer's recommendations to facilitate future injections. Plug and cover injection and vent ends of system, leaving system ready for future reinjections.

3.07 BONDING AGENT

- A. Use epoxy bonding agent for bonding of fresh concrete to concrete that has been in place for at least 60 days, and for bonding to existing concrete.
- B. Use epoxy-cement bonding agent for the following:
 1. Bonding toppings and concrete fill to concrete that has been in place for at least 60 days, and for bonding to existing concrete.
 2. For locations where bonding agent is required and concrete cannot be placed within open time period of epoxy bonding agent.
 3. Bonding of horizontal construction joints where joints are required in accordance with the Drawings or approved by Engineer for foundation mats that are five feet thick or greater.
- C. Use cement-water slurry as bonding agent for toppings and concrete fill to concrete that has been in place for less than 60 days. Cement water slurry shall be worked into surface with stiff bristle broom and place the concrete before cement-water slurry dries.

SECTION 03251 – CONCRETE ACCESSORIES

- D. Handle and store bonding agent in accordance with manufacturer's printed instructions and safety precautions.
- E. Mix bonding agent in accordance with manufacturer's instructions.
- F. Before placing fresh concrete, thoroughly roughen and clean hardened concrete surfaces and coat with bonding agent not less than 1/16-inch thick. Place fresh concrete while bonding agent is still tacky (within its open time), without removing in-place bonding agent coat, and as directed by manufacturer.

3.08 BEARING PAD INSTALLATION

- A. Neoprene Bearing Pad: Install with water insensitive adhesive in accordance with manufacturer's instructions.

END OF SECTION

SECTION 03 3000
CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Scope:
 - 1. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install cast-in-place concrete.
 - 2. Concrete shall be in accordance with requirements of ACI 301 and ACI 350.5 unless otherwise specified.
 - 3. The Work includes providing concrete consisting of portland cement, fine and coarse aggregate, water, and approved admixtures; combined, mixed, transported, placed, finished, and cured.
 - 4. The Work also includes: Providing openings in concrete to accommodate the Work under this and other Sections, and building into the concrete all items such as sleeves, frames, anchorage devices, inserts, and all other items to be embedded in concrete Work.
- B. Coordination: Review installation procedures under other Sections and coordinate installation of items to be installed in the concrete Work.
- C. Classifications of Concrete:
 - 1. Class "A" concrete includes the following: All concrete, unless otherwise shown or indicated.
 - 2. Class "AF" concrete may be used in lieu of Class "A" concrete for the following: Walls and foundations thicker than 16 inches.
 - 3. Class "AS" concrete shall be provided, where shown or indicated, for slabs not exposed to freezing and thawing where troweled finish is required.
 - 4. Class "B" concrete shall be placed without forms or with simple forms, with little or no reinforcing, and includes the following, unless otherwise shown or indicated:
 - a. Concrete fill within structures.
 - b. Duct banks.
 - c. Unreinforced encasements.
 - d. Curbs and gutters.
 - e. Sidewalks.
 - f. Thrust blocks.
 - g. Class "C" concrete shall be provided where shown or indicated for slabs that require enhanced durability against wear.
 - h. Class "D" concrete shall be unreinforced and used where required as concrete fill under foundations, filling abandoned piping, and where "lean concrete" or "mudmat" is shown or indicated in the Contract Documents.
- D. Related Sections:
 - 1. Section 03251 - Concrete Accessories.
 - 2. Section 03600 - Grouting.

1.02 REFERENCES

- A. Standards referenced in this Section include:
 - 1. AASHTO M 182 - Specification for Burlap Cloth Made From Jute or Kenaf and Cotton Materials.
 - 2. AASHTO TP23 - Test Method for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying.
 - 3. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials and Commentary.
 - 4. ACI 301 - Specifications for Structural Concrete.
 - 5. ACI 305.1 - Specification for Hot Weather Concreting.
 - 6. ACI 306.1 - Standard Specification for Cold Weather Concreting.
 - 7. ACI 308.1 - Specification for Curing Concrete.

8. ACI 318 - Building Code Requirements for Structural Concrete and Commentary.
9. ACI 350/350R - Code Requirements for Environmental Engineering Concrete Structures and Commentary.
10. ACI 350.5 - Specifications for Environmental Concrete Structures.
11. ASTM C31/C31M - Practice for Making and Curing Concrete Test Specimens in the Field.
12. ASTM C33 - Specification for Concrete Aggregates.
13. ASTM C39/C39M - Test Method for Compressive Strength of Cylindrical Concrete Specimens.
14. ASTM C42/C42M - Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
15. ASTM C94/C94M - Specification for Ready-Mixed Concrete.
16. ASTM C109/C109M - Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
17. ASTM C138/C138M - Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
18. ASTM C143/C143M - Test Method for Slump of Hydraulic- Cement Concrete.
19. ASTM C150 - Specification for Portland Cement.
20. ASTM C157/C157M - Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
21. ASTM C171 - Specification for Sheet Materials for Curing Concrete.
22. ASTM C172 - Practice for Sampling Freshly Mixed Concrete.
23. ASTM C231 - Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
24. ASTM C260 - Specification for Air-Entraining Admixtures for Concrete.
25. ASTM C309 - Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
26. ASTM C494/C494M - Specification for Chemical Admixtures for Concrete.
27. ASTM C618 - Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
28. ASTM C882/C882M - Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
29. ASTM C989 - Specification for Slag Cement for Use in Concrete and Mortars.
30. ASTM C1017 - Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
31. ASTM C1064/C1064M - Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
32. ASTM C1077 - Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
33. ASTM C1240 - Specification for Silica Fume Used in Cementitious Mixtures.
34. ASTM C1260 - Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).
35. ASTM C1293 - Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction.
36. ASTM C1567 - Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction.
37. ASTM D1042 - Test Method for Linear Dimensional Changes of Plastics Caused by Exposure to Heat and Moisture.
38. ASTM D3574 - Test Methods for Flexible Cellular Materials—Slab, Bonded, and Molded Urethane Foams.
39. ASTM E96/E96M - Test Methods for Water Vapor Transmission of Materials
40. ASTM E329 - Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
41. ASTM E1643 - Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

42. ASTM E1745 - Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
43. NRMCA - National Ready Mixed Concrete Association.

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Concrete Testing Laboratory:
 - a. Employ independent testing laboratory experienced in design and testing of concrete materials and mixes to perform material evaluation tests and to design concrete mixes.
 - 1) Testing agency shall be in accordance with ASTM E329 and ASTM C1077.
 - 2) Testing laboratory shall have been inspected and passed within previous two years by Cement and Concrete Reference Laboratory (CCRL) of NIST for testing concrete aggregates, and for preparing and testing concrete trial batches with or without admixtures. Testing laboratory shall provide documentation indicating how deficiencies, if any, in most recent CCRL inspection report were corrected.
 - 3) Selection of testing laboratory is subject to Owner's acceptance.
 - 4) Submit written description of proposed concrete testing laboratory giving qualifications of personnel, laboratory facilities, and equipment, and other information requested by Engineer.
 - b. Batch Plant: NRMCA Program for Certification of Ready-Mixed Concrete Production Facilities or approved equivalent program.
 - c. Mix Designer: Person responsible for developing concrete mixture proportions certified as NRMCA Concrete Technologist Level 2 or DOT certified mix designer in jurisdiction of the Work. Requirement may be waived if individual is Contractor's Licensed Professional Engineer.
 - d. Flatwork Finisher: Unless otherwise permitted, at least one person on finishing crew shall be certified as an ACI Flatwork Finisher, or equivalent.
 - e. Water Reducing Admixture Manufacturer:
 - 1) Water-reducing admixtures shall be manufactured under strict quality control in facilities operated under a quality assurance program.
 - 2) Manufacturer shall maintain a concrete testing laboratory approved by CCRL at NIST.
 - 3) Manufacturer shall be capable of providing services of qualified field service representatives at the Site.

B. Laboratory Trial Batch:

1. Each concrete mix design specified shall be verified by laboratory trial batch, unless indicated otherwise.
2. For classes of concrete that require air-entrainment, test the trial batch at highest percentage of air allowed for that class of concrete.
3. Perform the following testing on each trial batch:
 - a. Aggregate gradation for fine and coarse aggregates.
 - b. Fly ash testing to verify meeting specified properties, unless fly ash Supplier submits certification by an independent testing laboratory.
 - c. Slump.
 - d. Air content.
 - e. Compressive strength based on three cylinders each tested at seven days and at 28 days.
 - f. Shrinkage test in accordance with this Section, for Class "A" concrete and Class "AF" concrete.
 - g. Submit for each trial batch the following information:
 - 1) Project identification name and number (if applicable).
 - 2) Date of test report.
 - 3) Complete identification of aggregate source of supply.
 - 4) Tests of aggregates for compliance with the Contract Documents.

- 5) Scale weight of each aggregate.
- 6) Absorbed water in each aggregate.
- 7) Brand, type, and composition of cementitious materials.
- 8) Brand, type, and amount of each admixture.
- 9) Amounts of water used in trial mixes.
- 10) Proportions of each material per cubic yard.
- 11) Gross weight and yield per cubic yard of trial mixtures.
- 12) Measured slump.
- 13) Measured air content.
- 14) Compressive strength developed at seven days and 28 days, from not less than three test cylinders cast for each seven day and 28 day test, and for each design mix.
- 15) Shrinkage test results where required and as specified in this Section. Report results and averages for original length and at zero, seven, 14, 21, and 28 days of drying.

C. Shrinkage Test:

1. Perform drying shrinkage tests for trial batch as specified in this Section.
2. Drying shrinkage specimens shall be four-inch by four-inch by 11-inch prisms with effective gage length of ten inches; fabricated, cured, dried, and measured in accordance with ASTM C157 modified as follows: remove specimens from molds at an age of 23 hours, plus-or-minus one hour, after trial batching; shall be placed immediately in water at 70 degrees F plus-or-minus three degrees F for at least 30 minutes; and shall be measured within 30 minutes thereafter to determine original length and then submerged in saturated lime water at 73 degrees F plus-or-minus three degrees F. Measurement to determine expansion expressed as percentage of original length shall be made at age of seven days. Length at age of seven days shall be base length for drying shrinkage calculations (zero days drying age). Immediately afterward store specimens in humidity-controlled room maintained at 73 degrees F plus-or-minus three degrees F, and 50 percent (plus-or-minus four percent) relative humidity for remainder of test. Obtain measurements to determine shrinkage expressed as percentage of base length and report measurements separately for seven, 14, 21, and 28 days of drying after seven days of moist curing.
3. Determine drying shrinkage deformation of each specimen as the difference between base length (at zero days drying age) and length after drying at each test age. Determine average drying shrinkage deformation of specimens to nearest 0.0001-inch at each test age. If drying shrinkage of a specimen departs from average of that test age by more than 0.0004-inch, results obtained from that specimen shall be disregarded. Report results of shrinkage test to nearest 0.001 percent of shrinkage. Compression test specimens shall be taken in each case from same concrete used for preparing drying shrinkage specimens. Tests shall be considered part of normal compression tests for the Work. Allowable shrinkage limitations shall be as specified in Part 2 of this Section.

D. Component Supply and Compatibility: Provide a certificate of compatibility for all admixture materials.

E. Sample Panels:

1. Provide Sample panels of wall finishes, each at least 12 inches by 12 inches by three inches thick. Revise Sample panels to produce acceptable finished concrete surfaces.
 - a. Provide additional Sample panels as required if original results are unsatisfactory as determined by Engineer.
 - b. Continuity of color and texture for exposed concrete surfaces is important. Maintain such controls and procedures, in addition to those specified, as necessary to provide continuous match of concrete Work with approved Samples.

F. Mock-up Panels:

1. Provide mock-up panels representative of specified finished surfaces after sample form panels are approved, at locations on the Site directed by Engineer. Form, reinforce, mix,

cast, cure, and finish mock-up panels using selected materials and construction methods proposed for the Work. Provide mock-up panels as follows:

- a. Wall section of L-shaped panels, approximately four feet high by three feet each side by eight inches thick and set on an 18-inch wide by eight-inch thick base, unless other-wise shown or indicated. Form faces to represent each specified formed surface finish. Include not less than two form ties, two form panel intersections, one vertical construction joint, and one horizontal construction joint. Construction joints are in Section 03251, Concrete Accessories.
- b. Column section, approximately four feet high and not less than 12-inch diameter for round sections, and not less than 12 inches in the least dimension for rectangular sections, for each specified formed finish, unless otherwise shown or indicated. Set column sections on a six-inch thick concrete base extending eight inches beyond column. Chamfer exposed edges of rectangular Sample columns.
- c. Slab-on-grade section, approximately four feet square and minimum of four inches thick for each applied finish, with at least one construction joint and one expansion joint, if used.
- d. Pan-formed section using at least two pan form units. Set units to illustrate method of blending exposed pan joints.
- e. Reinforce mock-up panels as required to prevent cracking and to be structurally stable or as shown or indicated; reinforcing steel shall not be less than 0.25 percent of the gross concrete cross section in each direction.
- f. Protect mock-up panels from damage and do not remove approved mock-up panels without written Engineer's permission. When directed by Engineer, demolish mock-up panels and remove from the Site.

G. Existing Example Panels:

1. Engineer will identify sections of existing concrete that will serve as reference examples of acceptable concrete finishes.
2. If appropriate existing concrete members that adequately define required finishes do not exist, provide Sample panels as specified in this Article.

H. Designated Finish Sample Areas:

1. Engineer will identify areas of concrete members, to serve as reference examples of acceptable concrete finishes, from first members constructed for each finish.
2. At each area so designated, complete the finish as specified.
3. Where specified concrete finish is not obtained, repair the member to provide an acceptable finish. Adjust construction techniques to produce the required finish.
4. Clearly mark each Sample area with name of specified finish to cause no damage to finish.
5. Protect Sample areas from damage and maintain access to view Sample areas.

1.04 THERMAL CONTROL PLAN

- 1.05 A THERMAL CONTROL PLAN SHALL BE DEVELOPED FOR ALL CONCRETE PLACEMENTS IN EXCESS OF 30 INCHES IN THICKNESS.**
- 1.06 PRIOR TO START OF CONCRETE PLACEMENT, TEST CONCRETE PLACEMENTS A MINIMUM OF 6 FEET BY 6 FEET BY EACH THICKNESS EXCEEDING 30 INCHES SHALL BE PREPARED. THE TEST PLACEMENTS SHALL HAVE THERMISTERS OR THERMOCOUPLES EMBEDDED AT THE MID-POINT AND WITHIN 2 INCHES OF THE EXPOSED SURFACE. TEMPERATURE READINGS SHALL BE TAKEN AT NO LESS THAN 30-MINUTE INTERVALS UNTIL THE PEAK INTERNAL TEMPERATURE IS REACHED. A TIME-TEMPERATURE PLOT OF THE INTERNAL, SURFACE AND AMBIENT AIR TEMPERATURE SHALL BE PREPARED. THE TEMPERATURE OF THE CONCRETE AS IT IS BEING PLACED IN THE TEST PLACEMENT SHALL BE RECORDED. THE TEMPERATURE RISE FROM PLACEMENT TEMPERATURE TO MAXIMUM INTERNAL TEMPERATURE SHALL BE DETERMINED.**
- 1.07 IF INTERNAL PEAK TEMPERATURE EXCEEDS 155 DEGREES F, ONE OR MORE OF THE FOLLOWING ACTIONS SHALL BE TAKEN:**
- 1.08 CONCRETE PLACEMENT TEMPERATURE SHALL BE REDUCED BY COOLING MIX INGREDIENTS SO THAT THE PEAK TEMPERATURE DOES NOT REACH 155 DEGREES F.**
- 1.09 THE CONCRETE MIX DESIGN SHALL BE ADJUSTED TO USE SUPPLEMENTAL CEMENTITIOUS MATERIALS IN QUANTITIES THAT WILL REDUCE HEAT OF HYDRATION.**
- 1.10 A LOWER HEAT OF HYDRATION PORTLAND CEMENT SHALL BE USED.**
- 1.11 MEANS TO PROVIDE INTERNAL COOLING OF THE CONCRETE SHALL BE DESIGNED AND SUBMITTED FOR APPROVAL.**
- 1.12 THE THERMAL CONTROL PLAN SHALL PROVIDE HOW THE THERMAL GRADIENT FROM THE INTERIOR TO EXTERIOR OF THE CONCRETE SHALL BE KEPT WITHIN THE FOLLOWING LIMITS: 35 DEGREES F FOR THE FIRST FIVE DAYS AFTER PLACING, 45 DEGREES F DURING SIX TO TEN DAYS AFTER PLACING, AND 60 DEGREES F AFTER 10 DAYS AFTER PLACING.**

A. Concrete Coordination Conference:

- 1. Conduct concrete coordination conference to review detailed requirements of Contractor's proposed concrete design mixes, to discuss procedures for producing proper concrete construction, and to clarify roles of the parties involved. Organize and schedule the conference and prepare and distribute to all parties attending conference minutes of the conference.**
- 2. Conduct concrete coordination conference no later than 14 days after the date the Contract Times commence running. Conference shall be held at mutually agreed upon date and time; conference shall be held at the Site unless otherwise mutually agreed upon. Notify all parties to attend concrete coordination conference not less than five days prior to scheduled date of conference.**
- 3. Additional structure specific concrete construction conferences shall be held as required by the Engineer.**
- 4. All parties involved in the concrete Work shall attend concrete coordination conference including, but not limited to, the following:**
 - a. Contractor.**
 - b. Field testing services representative.**
 - c. Concrete Subcontractor (if any).**
 - d. Reinforcing steel Subcontractor (if any) and reinforcing steel Supplier and detailer.**
 - e. Concrete Supplier.**
 - f. Admixture manufacturer's representative.**
 - g. Engineer.**
 - h. Resident Project Representative (if any).**

1.13 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Mix Design:
 - a. List of concrete materials and proportions for the proposed concrete mix designs. Include data sheets, test results, certifications, and mill reports to qualify the materials proposed for use in the mix designs. Do not start laboratory trial batch testing until this submittal is approved by Engineer.
 - b. Laboratory Trial Batch Reports: Submit laboratory test reports for concrete cylinders, materials, and mix design tests.
 - c. Submit to Engineer laboratory trial batch test results for proposed mixes at least 15 days prior to start of Work. Do not begin concrete production until associated laboratory trial batch test submittal has been found in compliance with specifications by Engineer.
 - d. Test results per ASTM C33 confirming meets limit on deleterious material in fine aggregate.
 - e. Test results per ASTM C1260, ASTM C1293, and ASTM C1567 to determine potential for alkali-silica reactivity.
 - f. Certificate of compatibility of combined admixtures.
 - g. Certification of mix designer.

1.14 CONCRETE SUPPLY:

- A. Ready-mixed Concrete: Submit the following information.
 - 1. NRMCA plant certification.
 - 2. Physical capacity of mixing plant.
 - 3. Trucking facilities available.
 - 4. Estimated average amount of the specified concrete that can be produced and delivered to the Site during a normal, eight-hour day, excluding output to other customers.
 - a. Product Data:
 - 1) Manufacturers' specifications with application and installation instructions for proprietary materials and items, including admixtures and bonding agents.
 - b. Samples:
 - 1) Submit Samples of materials as specified and as requested by Engineer. Include with each sample names of product and supplier, and description.

1.15 THERMAL CONTROL PLAN:

1.16 SUBMIT PLAN FOR CONTROLLING INTERNAL TEMPERATURE AND TEMPERATURE GRADIENTS WITHIN SPECIFIED LIMITS.

1.17 CURING AND PROTECTION PLANS:

1.18 SUBMIT DETAILED PLAN FOR CURING AND PROTECTION OF CONCRETE PLACED AND CURED IN COLD WEATHER.

1.19 SUBMIT DETAILED PLAN FOR CURING AND PROTECTION OF CONCRETE PLACED AND CURED IN AMBIENT TEMPERATURES OVER 80 DEGREES F.

- A. Informational Submittals: Submit the following:
 - 1. Certifications:
 - a. Notarized certification of conformance to reference standards used in this Section, when required by Engineer.
 - b. Flatwork finisher certification.
 - c. Delivery Tickets: Copies of all delivery tickets for each load of concrete delivered to or mixed at the Site submitted prior to unloading. Each delivery tickets shall contain the information in accordance with ASTM C94 requirements of sections 14.2.1 through 14.2.10 along with project identification name and number (if any), date, mix type, mix time, quantity and amount of water initially withheld and introduced on site.
 - d. Submit copy of water-reducing admixtures manufacturer's quality assurance handbook to document program existence.

- e. Minutes of the Concrete Coordination Conference and other subsequent structure specific concrete construction conferences.

1.20 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Transportation, Delivery, and Handling:
 - 1. Materials used for concrete shall be clean and free from foreign matter during transportation and handling, and kept separate until measured and placed into concrete mixer.
 - 2. Implement suitable measures during hauling, piling, and handling to ensure that segregation of coarse and fine aggregate particles does not occur and grading is not affected.
- B. Storage: For storage, provide bins or platforms with hard, clean surfaces.

PART 2 – PRODUCTS

2.01 CEMENTITIOUS MATERIALS

- A. Cement:
 - 1. Portland cement shall be Type II(MH) ASTM C150. Type I or Type II may be used in lieu of Type II (MH) when approved by Engineer.
 - 2. Portland cement shall be produced by one manufacturer. Alternate cement sources may be used provided that mix design has been approved and acceptable trial batch verifying performance has been made.
 - 3. Do not use cement that has deteriorated because of improper storage or handling.
- B. Fly Ash:
 - 1. Fly ash, when used, shall conform to the requirements of ASTM C618 Class F, except as follows:
 - a. The loss on ignition shall be a maximum of four percent.
 - b. The maximum percent of sulfur trioxide (SO₃) shall be 4.0.
 - c. Fly ash shall be considered to be a cementitious material.
 - d. Laboratory trial batches shall be tested to determine compliance with strength requirements, times of setting, slump, slump loss, and shrinkage characteristics.
- C. Slag Cement:
 - 1. Slag Cement, when used, shall conform to ASTM C989, Grade 120.
 - 2. Slag cement is considered a cementitious material.
 - 3. Perform laboratory tests on trial batches to determine compliance with strength requirements, times of setting, slump, slump loss, and shrinkage characteristics.
- D. Silica Fume: Silica fume shall be dry compacted or slurry form and shall conform to ASTM C1240. Silica fume is considered a cementitious material. Application rate, when specified, shall be seven percent by weight of cement, unless indicated otherwise.
- E. For all classes of concrete, when Type II (MH) Cement is used, fly ash or slag cement may be used within the following percentages by weight. When Type II Cement is used, fly ash or slag cement shall be used within the following percentages by weight. When Type I Cement is used, in lieu of Type II (MH) Cement, fly ash or slag cement shall be used such that total tricalcium aluminate content (C3A) of the resulting cementitious material is not greater than eight percent.
 - 1. When fly ash is used, material shall have minimum of 20 percent and maximum of 25 percent of total weight of cementitious material.
 - 2. When slag cement is used, material shall have minimum of 40 percent and maximum of 50 percent of total weight of cementitious material.

2.02 AGGREGATES

- A. General:
 - 1. Aggregates shall conform to ASTM C33, Class Designation 4S, and as specified in this Section.

2. Do not use aggregates containing soluble salts or other substances, such as iron sulfides, pyrite, marcasite, ochre, or other materials, that can cause stains on exposed concrete surfaces.
 3. Aggregates shall be tested to determine potential for alkali-silica reactivity.
- B. Fine Aggregate:
1. Provide clean, sharp, natural sand free of loam, clay, lumps, and other deleterious substances.
 2. Dune sand, bank run sand, and manufactured sand are unacceptable.
- C. Coarse Aggregate:
1. Provide clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter, as follows:
 - a. Crushed stone, processed from natural rock or stone.
 - b. Washed gravel, either natural or crushed. Slag, pit gravel, and bank run gravel are unacceptable.

2.03 WATER

- A. Water used in producing and curing concrete shall be clean and free of injurious quantities of oils, acids, alkalis, organic materials, and other substances that may be deleterious to concrete and steel.

2.04 CONCRETE ADMIXTURES

- A. Provide admixtures in accordance with product manufacturer's published instructions. Admixtures shall be compatible with each other. Admixtures shall not contain thiocyanates, shall not contain more than 0.05 percent chloride ion, and shall be non-toxic in the concrete mix after 30 days. Do not use admixtures that have not been incorporated and tested in the accepted mixes, unless otherwise approved by Engineer.
- B. Air Entraining Admixtures: ASTM C260. Air entraining admixture shall be vinsol resin or vinsol rosin-based.
- C. Water-Reducing Admixture: ASTM C494, Type A or D. Proportion Class "A", Class "AF", Class "AS", and Class "B" concrete with non-air entraining, water-reducing, aqueous solution of modified organic polymer.
- D. High Range Water-Reducing Admixture (HRWR): ASTM C494, Type F or G. Use high range water-reducing admixture in the concrete classifications so specified or indicated. Use of HRWR admixture is allowed at Contractor's option in all other classifications of concrete. Specific admixture formulation shall be as recommended by admixture manufacturer for Project conditions.
1. Plasticizing Admixtures: ASTM C1017, Type I or Type II. Use plasticizing admixture as an alternate to high range water-reducing admixture. Specific admixture formulation shall be as recommended by admixture manufacturer for Project conditions.
- E. Set Control Admixtures: In accordance with ASTM C494. Use the following as required:
1. Type B, Retarding.
 2. Type C, Accelerating.
 3. Type D, Water reducing and Retarding.
 4. Type E, Water reducing and Accelerating.
 5. Type G, Water-reducing, high range, and retarding admixtures.
- F. Calcium Chloride: Do not use calcium chloride.
- G. Shrinkage Reducing Admixture: Shrinkage reducing admixture may be used in mix design when necessary to conform to specified shrinkage limitations, provided that specified strength requirements are complied with and there is no reduction in sulfate resistance in the concrete and no increase in concrete permeability.
- H. Corrosion-Inhibiting Admixtures:

1. Corrosion-inhibiting admixture shall be calcium nitrite solution containing minimum of 30 percent calcium nitrite. Admixture shall be added at dosage rate of five gallons per cubic yard of concrete.
2. Product and Manufacturer: Provide one of the following:
 - a. DCI or DCI-S, by Grace Construction Products.
 - b. Rheocrete CNI, by Master Builders, Inc.
 - c. Eucon CIA, by Euclid Chemical Company.
 - d. Or equal.
 - e. Adjust quantity of mix water to account for water portion of calcium nitrite solution.
 - f. Provide retarding admixtures as required, if set time is accelerated.

2.05 PROPORTIONING AND DESIGN OF MIXES

A. Prepare concrete design mixes in accordance with Table 03300-A:

2.06 TABLE 03300-A

2.07 CONCRETE DESIGN MIX CRITERIA

CONCRETE CLASS	COARSE AGGREGATE ⁽¹⁾		MINIMUM CEMENTITIOUS ⁽⁵⁾ (LBS/CU YD)	MAX. W/CM ⁽⁴⁾	SLUMP ⁽²⁾	AIR ⁽⁶⁾ (%)	MIN. COMP STRENGTH ⁽³⁾ (PSI)
	SIZE A	SIZE B					
CLASS "A"	NO. 57	NO. 8	535	0.42	4" MAX.	6 +/- 1.5	4,500
CLASS "AF"	NO. 467	NO. 8	517	0.42	4" MAX.	5 +/- 1.5	4,500
CLASS "AS"	NO. 57	NO. 8	535	0.42	4" MAX.	-	4,500
CLASS "B"	NO. 57 OR NO. 67		517	0.50	4" MAX.	6 +/- 1.5	3,000
CLASS "C"	N. 57 OR NO. 67		564	0.40	4" MAX.	3 MAX.	5,000
CLASS "D"	ANY ASTM C33		NO REQUIREMENTS				2,000

- A. Notes Applicable to Table 03300-A:
- B. Coarse aggregate size numbers refer to ASTM C33. Where Size A and B are designated in Table 03300-A, it is intended that the smaller Size B aggregate is to be added, replacing a portion of the coarse or fine aggregate, in the minimum amount necessary to make a workable and pumpable mix with sand content not exceeding 41 percent of total aggregate.
 - C. Slumps indicated are prior to addition of high range water reducing admixture or plasticizing admixture.
 - D. Mix designs shall be made for all but Class "D", which does not require trial batch, so that the compressive strength achieved for laboratory trial batches will not be less than 125 percent of specified design strength.
 - E. Quantity of water to be used in the determination of water-cementitious materials (W/CM) ratio shall include free water on aggregates in excess of SSD and water portion of admixtures.

2.08 MINIMUM CEMENTITIOUS CONTENT SHALL BE ADJUSTED IN ACCORDANCE WITH THE REQUIREMENTS OF TABLE 5.2.2.1 OF ACI 350.5 AND TABLE 4.2.2.1 OF ACI 301 IF SMALLER MAXIMUM COARSE AGGREGATE SIZE IS USED.

2.09 REQUIRED AIR CONTENT LISTED SHALL BE ADJUSTED IN ACCORDANCE WITH THE REQUIREMENTS OF TABLE 5.2.2.4 OF ACI 350.5 AND TABLE 4.2.2.7.B.1 OF ACI 301 FOR SEVERE EXPOSURE IF A DIFFERENT MAXIMUM COARSE AGGREGATE SIZE IS USED.

- A. Lightweight Concrete: Not used.
- B. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, Site conditions, weather, test results, or other circumstances warrant; at no additional cost to Owner and as approved by Engineer. Before using adjusted concrete mixes, laboratory test data and strength results shall be submitted to and approved by Engineer.
- C. Admixtures:
 - 1. Use air-entraining admixture in concrete, unless otherwise shown or indicated. Add air-entraining admixture at admixture manufacturer's prescribed rate to produce concrete at point of placement having air content within prescribed limits.
 - 2. Use water-reducing or high-range water-reducing admixtures in all Class "A" and Class "AF" concrete.
 - 3. Use amounts of admixtures recommended by admixture manufacturer for climatic conditions prevailing at the Site at time of placing. Adjust quantities and types of admixtures as required to maintain quality.
- D. Slump Limits with High-Range Water Reducer: Slump shall not exceed four inches prior to adding high-range water reducer and shall not exceed eight inches, measured at point of placement, after adding high-range water reducer.
- E. Shrinkage Limitation:
 - 1. Concrete shrinkage for specimens cast in laboratory from trial batch with total water of 30.2 gallons per cubic yard or less, as measured at 21-day drying age and at 28-day drying age shall not exceed 0.039 percent and 0.045 percent, respectively. For trial batch with total water of 32.7 gallons per cubic yard or greater respective limits shall not exceed 0.035 percent and 0.040 percent. Limits in between shall be linear interpolated. Use mix design for construction that complies with trial batch shrinkage requirements. Shrinkage limitations apply to Class "A" concrete and Class "AF" concrete.
 - 2. Trial Batch Does Not Comply with Shrinkage Limitation:
 - a. If trial batch results do not comply with shrinkage limitation specified in the Contract Documents, redesign the mix to reduce shrinkage.
 - b. After mix has been repeatedly redesigned and Engineer is satisfied that all reasonable means to provide concrete mix that complies with shrinkage requirement have been exercised; and mix design still fails to comply with shrinkage limitation in the Contract Documents, Engineer reserves the right to accept the higher-shrinkage mix, provided that the quantity of shrinkage reinforcing in structures is increased.
 - c. "Reasonable means" will be construed as reducing the total water content to a maximum of 27 gallons per cubic yard, having the large aggregate blended so that eight percent to 18 percent of combined aggregate is retained on each sieve, using an alternate aggregate source, and a combination of these means.
 - d. Basis for shrinkage reinforcing increase will be proportional to amount that shrinkage value is over the specified shrinkage limitation and will be determined by Engineer. The cost of providing additional shrinkage reinforcement will be paid by the Owner.

2.10 BONDING AGENT

- A. Provide epoxy and epoxy-cement bonding agents in accordance with Section 03251, Concrete Accessories.

2.11 CONCRETE CURING MATERIALS

- A. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 10 ounces per square yard and complying with AASHTO M 182, Class 3.
- B. Curing Mats: Shall be heavy carpets or cotton mats, quilted at four inches on centers, and weighing minimum of 12 ounces per square yard when dry.
- C. Moisture-Retaining Cover: Provide one of the following, complying with ASTM C171:
 - 1. Waterproof paper.
 - 2. Polyethylene film.
 - 3. White burlap polyethylene sheet.
- D. Liquid Curing Compound: ASTM C309 Type 1-D (water retention requirements):
 - 1. Provide fugitive dye.
 - 2. Curing compound shall be applied by roller or power sprayer.

2.12 FINISHING AIDS

- A. Evaporation Retardant:
 - 1. Product and Manufacturer: Provide one of the following:
 - a. Confilm, by Master Builders.
 - b. Eucobar, by Euclid Chemical Company.
 - c. SikaFilm, by Sika Corporation.
 - d. Or equal.

2.13 VAPOR RETARDER

- A. Vapor Retarder:
 - 1. Vapor retarder membrane shall comply with the following.
 - a. Water Vapor Transmission Rate, ASTM E96: 0.04 perms or lower.
 - b. Water Vapor Retarder, ASTM E1745: Meets or exceeds Class C.
 - c. Thickness of Retarder (plastic), ACI 302 1R: Not less than 10 mils.
 - d. Products and Manufacturers: Provide one of the following:
 - 1) Stego Wrap 10-mil Vapor Retarder, by Stego Industries LLC.
 - 2) Griffolyn 10-mil, by Reef Industries.
 - 3) Moistop Ultra, by Fortifiber Industries.
 - 4) Or equal.
- B. Accessories:
 - 1. Provide accessories by same manufacturer as vapor retarder.
 - 2. Seam Tape:
 - a. Tape shall have water vapor transmission rate (ASTM E96) of 0.3 perms or lower.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Stego Tape by Stego Industries LLC.
 - 2) Griffolyn Fab Tape by Reef Industries.
 - 3) Moistop Tape by Fortifiber Industries.
 - 4) Or equal.
 - c. Vapor Proofing Mastic: Mastic shall have a water vapor transmission rate ASTM E96, 0.3 perms or lower.
 - d. Pipe Boots: Construct pipe boots from vapor barrier material, pressure sensitive tape, mastic, or a combination thereof, in accordance with manufacturer's recommendations.

2.14 SOURCE QUALITY CONTROL

- A. Concrete materials may require testing, as directed by Engineer, at any time during the Work if concrete quality is in question. Provide access to material stockpiles and facilities at all times. Tests shall be done at no expense to Owner.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Examine the substrate and conditions under which the Work will be performed and notify Engineer in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.02 CONCRETE MIXING

- A. General:
 - 1. Concrete may be produced at batch plants or by the ready-mixed process. Batch plants shall comply with recommendations of ACI 301 and have sufficient capacity to produce concrete of qualities required and in quantities required to comply with the accepted Progress Schedule. All plant facilities are subject to acceptance of Engineer.
 - 2. Mixing:
 - a. Mix concrete with a rotating type batch machine, except where hand mixing of very small quantities is approved by Engineer.
 - b. Remove hardened accumulations of cement and concrete from drum and blades to ensure proper mixing action.
 - c. Replace mixer blades upon loss of ten percent of mixer blades' original height.
- B. Site Mixing:
 - 1. When Site mixing of concrete is approved by Engineer mix all materials for concrete in a drum-type batch mixer.
 - a. For mixers of one cubic yard or smaller capacity, continue mixing at least 1.5 minutes but not more than five minutes after all ingredients are in the mixer, before any part of batch is released.
 - b. For mixers of capacity larger than one cubic yard, increase minimum 1.5 minutes of mixing time by 15 seconds for each additional cubic yard or fraction thereof.
 - c. Do not exceed mixer manufacturer's published rating of the mixer, or mixer nameplate capacity, for total volume of materials used per batch.
 - d. Equip mixer with automatic controls for proportioning materials and proper, measured quantities.
 - e. Do not exceed 45 minutes total elapsed time between intermingling of damp aggregates and cement to discharge of completed mix.
- C. Ready-Mix Concrete:
 - 1. Comply with ASTM C94 and the Contract Documents.
 - a. Plant Equipment and Facilities: Conform to requirements of NRMCA certification.
 - b. Mix concrete in revolving-type truck mixers that are in good condition and produce thoroughly-mixed concrete conforming to the Contract Documents.
 - c. Do not exceed rated capacity of mixer.
 - d. Mix concrete for minimum of two minutes after arrival at the Site, or as recommended by mixer manufacturer.
 - e. Do not allow drum to mix while in transit.
 - f. Mix at proper speed until concrete is discharged from mixer.
 - g. Maintain adequate facilities at the Site for continuous delivery of concrete at required rates.
 - h. Provide access to mixing plant for Engineer upon request.
 - i. When silica fume is used in dry compacted form, comply with the following mix requirements and ensure full dispersion:
 - 1) For all types of mixing equipment, increase mix times by 40 percent over minimum mix time required to achieve mix uniformity defined in ASTM C94.
 - 2) For truck-mixed and central-mixed concrete, maximum allowable batch size shall be 80 percent of maximum in accordance with ASTM C94.

- D. Maintain equipment in proper operating condition, with drums cleaned before charging each batch. Schedule rates of delivery to prevent delay of placing concrete after mixing, or holding dry-mixed materials too long in mixer before the adding water and admixtures.

3.03 TRANSPORTING CONCRETE

- A. Transport and place concrete not more than 90 minutes after water has been added to the dry ingredients.
- B. Avoid spilling and separation of concrete mixture during transportation.
- C. Do not place concrete in which the ingredients have separated.
- D. Do not retemper partially set concrete.
- E. Use suitable equipment for transporting concrete from mixer to forms.

3.04 PREPARATION FOR CONCRETING

- A. Notify Engineer a minimum of 24 hours in advance of placing concrete to allow for inspection of form work, joints, waterstops, reinforcement, embedded items, and vapor retarders. The section to be placed shall be fully prepared for concrete placement at the time of notice. Confirm inspection status with Engineer a minimum of 4 hours prior to concrete placement. Do not begin placing concrete until Work is in conformance with the Contract Documents.
- B. Subgrade surfaces shall be thoroughly wetted by sprinkling, prior to the placing of concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. The surface shall be free from standing water, mud, and debris at the time of placing concrete.
- C. Reinforcing steel and embedded items shall be completely cleaned of mortar, loose rust, form release compounds, dirt, or other substances which would interfere with proper bonding with concrete. Protective coatings on embedded aluminum items shall continuously cover the surface to be in contact with concrete. Defects in the coating shall be repaired.
- D. Do not place concrete until flow of water entering space to be filled with concrete has been properly stopped 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 water to rise on concrete surfaces until concrete has attained its initial set. Do not allow water to flow over concrete surface in manner and or velocity that will injure concrete surface finish. Provide temporary pumping or other dewatering operations for removing water as required.
- E. Prepare joint surfaces in accordance with Section 03251, Concrete Accessories.
- F. Installation of Vapor Retarder:
 - 1. Provide vapor retarder under slabs-on-grade and outside walls to receive resilient floor finishes, carpet, ceramic and slate tile, chemical resistant coatings, and where shown or indicated on the Drawings.
 - 2. Install in accordance with manufacturer's instructions, ASTM E1643, and the following:
 - a. Unroll vapor retarder with longest dimension parallel with direction of the pour.
 - b. Lap vapor retarder over footings and seal to foundation walls.
 - c. Overlap vapor retarder joints by six inches and seal with vapor retarder manufacturer's tape.
 - d. Seal penetrations, including pipes, in accordance with vapor retarder manufacturer's instructions.
 - e. Penetration of vapor retarder is not allowed except for reinforcing steel and permanent utilities.
 - f. Repair damaged areas of vapor retarder by providing, for each damaged area, patch of vapor retarder material and overlapping damaged area with the patch by six inches on each side, and securely and continuously taping all four sides of patch to undamaged vapor retarder.
- G. Form release agent shall be compatible with form liner material.

3.05 CONCRETE PLACEMENT

A. General:

1. Place concrete continuously, so that no concrete will be placed on concrete that has hardened sufficiently to cause formation of seams or planes of weakness within the section. If section cannot be placed continuously, provide construction joints in accordance with Section 03251, Concrete Accessories.
2. Deposit concrete as nearly as practical in its final location to avoid segregation due to rehandling or flowing. Do not subject concrete to action that may cause segregation.
3. Screed concrete that is to receive other construction to proper level to avoid excessive skimming or grouting.
4. Do not use concrete that becomes non-plastic and unworkable, or does not conform to required quality limits, or that has been contaminated by foreign materials. Do not use retempered concrete. Remove rejected concrete from the Site and dispose of it in conformance with Laws and Regulations.
5. Do not place concrete until forms, bracing, reinforcing, and embedded items are each in final position and secure.
6. Do not place footings in freezing weather unless adequate precautions are taken against frost action.
7. Do not place footings, piers or pile caps on frozen soil.
8. Unless otherwise instructed, place concrete only when Engineer is present.
9. Allow minimum of three days between adjoining concrete placements. At expansion joints, allow minimum of one day between adjoining concrete placements.

B. Bonding for Next Concrete Pour:

1. Prepare for bonding of fresh concrete to concrete that has set but is not fully cured, as follows:
 - a. Thoroughly wet the surface, but allow no free-standing water.
 - b. For horizontal surfaces place a six-inch layer of Construction Joint Grout, as specified in Section 03600, Grouting, over the hardened concrete surface.
 - c. Place fresh concrete before the grout has attained its initial set.
 - d. Accomplish bonding of fresh concrete to fully cured, hardened, existing concrete by using a bonding agent as specified in Section 03251, Concrete Accessories.

C. Concrete Conveying:

1. Handle concrete from point of delivery at the Site, transfer to concrete conveying equipment, and transfer to locations of final deposit as rapidly as practical by methods that prevent segregation and loss of concrete mix materials.
2. Provide mechanical equipment for conveying concrete to ensure continuous flow of concrete at delivery end of conveyor. Provide runways for wheeled concrete conveying equipment from concrete delivery point to locations of final deposit. Keep interior surfaces of conveying equipment, including chutes, free of hardened concrete, debris, water, snow, ice, and other deleterious materials.
3. Do not use chutes for distributing concrete, unless accepted by Engineer.
4. Pumping concrete is allowed, however do not use aluminum pipe for conveying concrete.

D. Placing Concrete into Forms:

1. Deposit concrete in forms in horizontal layers not deeper than 18 inches each and in manner that avoids inclined construction joints. Where placement consists of several layers, place concrete at such rate that concrete being integrated with fresh concrete while still plastic.
2. Do not allow concrete to free-fall within the form from height exceeding four feet. Where high-range water reducer is used to extend slump to at least six inches, maximum allowable free-fall of concrete is six feet. Use "elephant trunks" to prevent free-fall and excessive splashing of concrete on forms and reinforcing. Discontinue free-falls greater than four feet if there is evidence of segregation.
3. Remove temporary spreaders in forms when concrete placing has reached elevation of such spreaders.

4. Consolidate concrete placed in forms by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidating concrete in accordance with requirements of ACI 301. Vibration of forms and reinforcing is not allowed unless otherwise accepted by Engineer.
 5. Where height of concrete placement in walls exceeds 14 feet, provide temporary windows in formwork to facilitate vibration. Properly close temporary windows when height of concrete approaches windows. Determine location, size, and spacing of temporary windows to suit equipment used.
 6. Do not use vibrators to transport concrete inside of forms. Insert and withdraw vibrators vertically at uniformly-spaced locations not farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate the layer of concrete and at least six inches into the preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit the duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcing and other embedded items without causing segregation of concrete mix.
 7. Do not place concrete in beam and slab forms until concrete previously placed in columns and walls is no longer plastic.
 8. Prevent voids in the concrete. Force concrete under pipes, sleeves, openings, and inserts from one side until visible from the other side.
- E. Placing Concrete Slabs:
1. Deposit and consolidate concrete slabs in continuous operation, within limits of construction joints, until placing of a slab panel or section is completed.
 2. Consolidate concrete during placing operations using mechanical vibrating equipment, so that concrete is thoroughly worked around reinforcing and other embedded items and into corners.
 3. Consolidate concrete placed in beams and girders of supported slabs, and against bulkheads of slabs on ground, as specified in this Article for formed concrete structures.
 4. Bring slab surfaces to correct elevation and level. Smooth the surface, leaving surface free of humps or hollows. Do not sprinkle water on surface while concrete is plastic. Do not disturb slab surfaces prior to commencing concrete finishing.
 5. Where slabs are placed in conditions of high temperature or wind that could lead to formation of plastic shrinkage cracks, provide evaporation retardant applied in accordance with retardant manufacturer's recommendations.
- F. Quality of Concrete Work:
1. Concrete shall be solid, compact, and smooth, and free of laitance, cracks, and cold joints.
 2. Concrete for liquid-retaining structures, and concrete in contact with earth, water, or exposed directly to the elements shall be watertight.
 3. Cut out and properly replace to extent directed by Engineer, or repair to satisfaction of Engineer, defects as defined in 3.12. Thin patches or plastering are unacceptable.
 4. Leaks through concrete that exhibit flowing water, and cracks, holes, or other defective concrete in areas of potential leakage, shall be repaired and made watertight.
 5. Repair, removal, and replacement of defective concrete as directed by Engineer shall be at no additional cost to Owner.
- G. Cold Weather Placing:
1. Protect concrete Work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures, in compliance with ACI 306.1 and the Contract Documents.
 2. When air temperature has fallen to or may be expected to fall below 40 degrees F, provide adequate means to maintain temperature in area where concrete is being placed between 50 degrees F and 70 degrees F for at least seven days after placing. Provide temporary housings or coverings including tarpaulins or plastic film. Maintain temporary heating and protection as necessary so that ambient temperature does not fall more than 30 degrees F in the 24 hours following the seven-day period. Avoid rapid dry-out of concrete due to overheating, and avoid thermal shock due to sudden cooling or heating.

3. When air temperature has fallen to or is expected to fall below 40 degrees F, uniformly heat water and aggregates before mixing for concrete as required to obtain concrete mixture temperature not less than 55 degrees F and not more than 85 degrees F at point of placement.
 4. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. Before placing concrete, verify that forms, reinforcing, and adjacent concrete surfaces are entirely free of frost, snow, and ice.
 5. Do not use salt or other materials containing antifreeze agents. Do not use chemical accelerators or set-control admixtures unless approved by Engineer and tested in mix design proposed for use.
- H. Hot Weather Placing:
1. When hot weather conditions exist that would impair the quality and strength of concrete, place concrete in compliance with ACI 305.1 and the Contract Documents.
 2. When ambient air temperature is at or above 90 degrees F and rising, cool ingredients before mixing concrete to maintain concrete temperature at time of placement below 80 degrees F. When ambient air temperature is at or above 90 degrees F and falling, cool the ingredients before mixing concrete to maintain concrete temperature at time of placement below 85 degrees F. In no case shall the concrete temperature at time of placement exceed 90 degrees F.
 3. Mixing water may be chilled, or chopped ice may be used to control concrete temperature provided the water equivalent of ice is calculated in total amount of mixing water. If required, reduce the time from addition of mix water to placement, or use set-retarding admixture.
 4. Cover reinforcing materials with water-soaked burlap if ambient air temperature becomes too hot, so that reinforcing material temperature does not exceed ambient air temperature immediately before embedment of reinforcing in concrete.
 5. Wet forms thoroughly before placing concrete.
 6. Do not place concrete at temperature that causes difficulty from loss of slump, flash set, or cold joints.
 7. Obtain Engineer's approval of substitute methods and materials proposed for use.

3.06 FINISHING OF FORMED SURFACES

- A. Standard Form Finish:
1. Standard form finish shall be basically smooth and even, but is allowed to have texture imparted by the form material used. Repair defects in accordance with the Contract Documents.
 2. Use standard form finish for the following:
 - a. Exterior vertical surfaces from foundation up to one foot below grade.
 - b. Vertical surfaces not exposed to view.
 - c. Other areas shown or indicated.
- B. Smooth Form Finish:
1. Produce smooth form finish by selecting form materials that will impart smooth, hard, uniform texture. Arrange panels in orderly and symmetrical manner with minimum of seams. Repair and patch defective areas in accordance with the Contract Documents.
 2. Use smooth form finish for the following:
 - a. Exterior surfaces exposed to view.
 - b. Surfaces to be covered with coating material. Coating material may be applied directly to concrete or may be a covering bonded to concrete such as waterproofing, dampproofing, painting, or other similar system.
 - c. Interior vertical surfaces of liquid-containers.
 - d. Interior and exterior exposed beams and undersides of slabs.
 - e. Surfaces to receive abrasive blasted finish.
 - f. Surfaces to receive smooth rubbed or grout cleaned finish.
 - g. Other areas shown or indicated.

- C. Grout Cleaned Finish:
1. Provide grout cleaned finish to concrete surfaces that have received smooth form finish and where defects have been repaired, as follows:
 - a. Combine one part portland cement to 1.5 parts fine sand by volume, and mix with water to consistency of thick paint. Blend standard portland cement and white portland cement, in proportions determined by trial patches, so that final color of dry grout will closely match adjacent concrete surfaces.
 - b. Thoroughly wet concrete surface and apply grout uniformly by brushing or spraying immediately to wetted surfaces. Scrub surface with cork float or stone to coat surface and fill surface holes. Remove excess grout by scraping, followed by rubbing with clean burlap to remove visible grout film. Keep grout damp during setting period by using fog spray on surface for at least 36 hours after final rubbing. Complete each area the same day the area is started, with limits of each area being natural breaks in the finished surface.
 - c. Use grout cleaned finish for the following:
 - 1) Interior exposed walls and other vertical surfaces.
 - 2) Exterior exposed walls and other vertical surfaces down to one foot below grade.
 - 3) Interior and exterior horizontal surfaces.
 - 4) Interior exposed vertical surfaces of liquid-containing structures down to one foot below normal operating liquid level.
 - 5) Other areas shown.
- D. Abrasive Blasted Finish:
1. Provide abrasive blasted finish where shown or indicated.
 2. Where abrasive blasted finish is required, apply finish to smooth formed finish after end of curing period, with defects repaired, to match approved finish provided on mock-up or Sample panel, as applicable.
 3. Heavy Abrasive Blasted Finish: Abrasive blast to uniformly expose coarse aggregate.
 4. Light Abrasive Blasted Finish: Abrasive blast to uniformly expose fine aggregate.
- E. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise shown or indicated.

3.07 SLAB FINISHES

- A. Float Finish:
1. After placing concrete slabs, do not work the surface further until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently. Check and level the surface plane to tolerance not exceeding 1/4-inch in ten feet when tested with a ten-foot straightedge placed on surface at not less than two different angles. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to uniform, smooth, granular texture.
 2. Use float finish for the following:
 - a. Interior exposed horizontal surfaces of liquid-containing structures, except those to receive grout topping.
 - b. Exterior below-grade horizontal surfaces.
 - c. Surfaces to receive additional finishes, except as shown or indicated.
- B. Trowel Finish:
1. After floating, begin first trowel finish operation using power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over the surface.
 2. Consolidate concrete surface by the final hand troweling operation. Finish shall be free of trowel marks, uniform in texture and appearance, and with surface plane tolerance not exceeding 1/8-inch in ten feet when tested with a ten foot straight edge. Grind smooth surface defects that would otherwise project through applied floor covering system.
 3. Use trowel finish for the following:

- a. Interior exposed slabs, unless otherwise shown or indicated.
 - b. Slabs that receive one of the following: resilient flooring, carpeting, or ceramic tile.
- C. Non-Slip Broom Finish:
 - 1. Immediately after float finishing, slightly roughen concrete surface by brooming in direction perpendicular to main traffic route. Use fine fiber-bristle broom, unless otherwise directed by Engineer. Coordinate required final finish with Engineer before applying finish.
 - 2. Use non-slip broom finish for the following:
 - a. Exterior exposed horizontal surfaces subject to lightweight foot traffic.
 - b. Interior and exterior concrete steps and ramps.
- D. Scratched Finish:
 - 1. After providing float finish, roughen concrete surface with rake before concrete's final set. Amplitude of surface shall be minimum of 1/4-inch.
 - 2. Provide scratched finish for the following:
 - a. Horizontal surfaces that will receive grout topping or concrete equipment pad.
 - b. Surfaces so indicated on the Drawings or elsewhere in the Contract Documents.

3.08 CONCRETE CURING AND PROTECTION

- A. General:
 - 1. Protect freshly placed concrete from premature drying, excessive cold or hot temperatures, and maintain without drying at relatively constant temperature for period necessary for hydration of cement and proper hardening of concrete.
 - 2. Start curing after placing and finishing concrete, as soon as free moisture has disappeared from concrete surface. Keep surface continuously moist during entire curing period. Cure for a minimum of 10 days and in accordance with requirements of ACI 301 and ACI 308.1. For concrete sections over 30-inches thick, the curing period shall be for a minimum of 14 days. Avoid rapid drying at end of final curing period.
 - 3. For curing, use water that is free of impurities that could etch or discolor exposed concrete surfaces.
 - 4. Confine water for curing to area being cured.
- B. Curing Methods: Curing methods are specified below. Curing methods to be used on each type of concrete surface are specified elsewhere in this Article.
 - 1. Water Curing. Cure by one of the following methods:
 - a. Keep concrete surface continuously wet.
 - b. Ponding or immersion.
 - c. Continuous water-fog spray.
 - d. Covering concrete surface with curing mats, thoroughly saturating mats with water, and keeping mats continuously wet with sprinklers or porous hoses. Place curing mats to cover concrete surfaces and edges with four-inch horizontal lap over adjacent mats; provide eight-inch lap over adjacent mats at vertical surfaces. If necessary, weigh down curing cover to maintain contact with concrete surface.
 - e. Form Curing. Cure by one of the following methods:
 - 1) Forms shall be maintained and loosened during curing period.
 - 2) Immediately after forms are loosened or removed, continue with the required curing method as applicable, for remainder of curing period.
 - 3) Where wood forms are kept in place, apply water to keep forms wet.
 - f. Moisture Retaining Cover Curing. Cure as follows: Cover concrete surfaces with the required moisture retaining cover for curing concrete, placed in widest practical width with sides and ends lapped at least three inches and sealed using waterproof tape or adhesive. Immediately repair holes or tears during curing period using cover material and waterproof tape.
 - g. Liquid Compound Curing. Cure as follows:
 - 1) Unless otherwise approved by Engineer, provide water curing or form curing. Request to use liquid curing compound will be considered by Engineer on case-by-case basis. Construction joints, formed surfaces prior to receiving

specified form finish, and concrete to receive surface treatment where surface treatment will be bonded to concrete surface (such as, but not limited to grout fill, coatings, lining, water repellent, painting, resilient flooring, terrazzo flooring, ceramic tile, quarry tile, chemical resistant coatings, or other applications) shall be water-cured or form-cured.

- 2) In liquid-retaining structures, provide water curing or form curing, unless other curing method is approved by Engineer. Requests to use liquid curing compound will be considered by Engineer on case-by-case basis. Request shall provide valid construction reason or safety reason for using liquid compound curing including reason why other curing methods are not viable.
- 3) Apply curing compounds immediately after final finishing or after terminating water curing. Apply curing compound in continuous operation by power spray equipment in accordance with curing compound manufacturer's directions. If areas are subjected to rainfall within three hours after completing curing compound application, area shall be recoated. Maintain coating continuity and repair areas damaged during curing period.
- 4) When liquid curing compound is used, apply first coat of liquid curing compound at compound manufacturer's recommended coverage rate, and subsequently apply second coat at identical rate, thus providing twice the curing compound manufacturer's recommended coverage.
- 5) At end of curing period, remove liquid curing compound where required.

C. Formed Surfaces: Use the following curing methods:

1. Walls That Will Retain Liquid or That are Under Ground Surface:
 - a. If forms are wood, form curing is allowed for entire curing period. If forms are steel, form curing is allowed for maximum of three days after which forms shall be removed so that concrete is free of the forms for remainder of the curing process.
 - b. Immediately after the forms are loosened or removed, continue with water curing for remainder of curing period.
 - c. When wall surface will not receive surface treatment and when allowed by Engineer, use of liquid curing compound is allowed. Before using liquid compound curing, use water curing or form curing for at least the first three days of curing.
 - d. Formed Slab Underside and Beam Surfaces Where Will Retain Liquid:
 - 1) Form curing is allowed for the full curing period.
 - 2) Immediately after forms are loosened or removed, continue with water curing for remainder of curing period.
 - 3) When slab surface will not receive surface treatment and when allowed by Engineer, use of liquid curing compound is allowed.
 - e. Vertical Joint Surfaces and Surfaces to Receive Surface Treatment:
 - 1) Form curing is allowed for entire curing period.
 - 2) Immediately after forms are loosened or removed, continue with water curing for remainder of curing period.
 - f. Cure other formed surfaces using an appropriate curing method specified in the Contract Documents.

D. Unformed Surfaces: Treat with one of the following curing methods:

1. Slabs and Mats That Will Retain Liquid or are Below Ground Surface:
 - a. Water curing.
 - b. Moisture-retaining cover curing when allowed by Engineer.
 - c. When slab or mat surface will not receive surface treatment and when allowed by Engineer, use of liquid curing compound is allowed. Before using liquid compound curing, use water curing or form curing for at least the first three days of curing.
 - d. Construction Joint Surfaces and Slab and Mat Surfaces to Receive Surface Treatment.
 - 1) Water curing.
 - 2) Moisture-retaining cover curing.

- e. Cure other formed surfaces using an appropriate curing method specified in the Contract Documents.
- E. Temperature of Concrete During Curing:
 - 1. When ambient temperature is 40 degrees F or less, continuously maintain concrete temperature between 50 degrees F and 70 degrees F throughout curing period. When necessary, before concrete placing provide for temporary heating, covering, insulation, or housing as required to continuously maintain specified temperatures and moisture conditions throughout concrete curing period. Provide cold weather protection in accordance with requirements of ACI 306.1.
 - 2. When the ambient temperature is 80 degrees F and above, or during other climatic conditions that would cause too-rapid drying of concrete, before starting concrete placing, provide wind breaks and shading as required, and fog spraying, wet sprinkling, or moisture retaining coverings as required. Continuously protect concrete throughout concrete curing period. Provide hot weather protection in accordance with requirements of ACI 305.1, unless otherwise specified.
 - 3. Maintain concrete temperature as uniformly as possible, and protect from rapid ambient temperature changes. Avoid concrete temperature changes that exceed five degrees F in one hour and 50 degrees F in 24-hour period.
- F. Protection: During curing period, protect concrete from damaging mechanical disturbances including load stresses, heavy shock, excessive vibration, and damage by rain and flowing water. Protect finished concrete surfaces from damage by subsequent construction operations.

3.09 CONCRETE INSTALLATION TOLERANCES

- A. Installation Tolerances:
 - 1. Concrete placement tolerances, unless otherwise specified in the Contract Documents, shall be in accordance with ACI 117.
 - 2. Notify Engineer in writing when concrete placement does not conform with required tolerances, as soon as the condition is known to Contractor.
 - 3. When concrete installation does not conform to required tolerances, do not repair or correct by grinding unless specified in the Contract Documents or approved by Engineer in writing.
 - 4. Verification Measurements:
 - a. If surfaces where tolerances are in question, obtain measurements to verify conformance with tolerances in manner acceptable to Engineer.
 - b. If surfaces tolerances are in question, cost of obtaining measurements shall be at no additional cost to the Owner.
 - c. Before obtaining measurements, obtain Engineer's acceptance of method proposed for obtaining measurements.
 - d. After obtaining measurements, submit measurements to Engineer.
 - e. Submit with verification measurements submittal proposed method to rectify out-of-tolerance concrete. Do not start repair Work without obtaining Engineer's approval.

3.10 FIELD QUALITY CONTROL

- A. Field Testing Services:
 - 1. Owner will employ testing laboratory to perform field quality control testing for concrete. Engineer will direct the testing requirements.
 - 2. Testing laboratory will make standard compression test cylinders and entrained air tests as specified in this Article, under observation of Engineer or Resident Project Representative.
 - 3. Testing laboratory will provide all labor, material, and equipment required for sampling and testing concrete, including: scale, glass tray, cones, rods, molds, air tester, thermometer, and other incidentals required.
 - 4. Provide all curing and necessary cylinder storage facilities in accordance with ASTM C31.
- B. Quality Control Testing During Construction:

1. Perform sampling and testing for field quality control during placement of concrete, as follows:
 - a. Sampling Fresh Concrete: ASTM C172.
 - b. Slump: ASTM C143; one test for each concrete load at point of discharge.
 - c. Concrete Temperature: ASTM C1064; one for every two concrete loads at point of discharge, and when a change in the concrete is observed. Test each load when time from batching to placement exceeds 75 minutes.
 - d. Air Content: ASTM C231; one for every two concrete load at point of discharge, and when a change in the concrete is observed.
 - e. Unit Weight: ASTM C138; one for every two concrete loads at point of discharge, and when a change in the concrete is observed.
 - f. Compression Test Specimens:
 - 1) In accordance with ASTM C31; make one set of compression cylinders for each 50 cubic yards of concrete, or fraction thereof, of each mix design placed each day. Each set shall be four standard cylinders, unless otherwise directed by Engineer.
 - 2) Cast, store, and cure specimens in accordance with ASTM C31.
 - 3) Test and record the following when cylinders are cast: slump, concrete temperature, air content, and unit weight.
 - 4) Compressive Strength Tests:
 - (a) In accordance with ASTM C39; one specimen tested at seven days, and two specimens tested at 28 days. Test fourth cylinder if needed to verify test results. If 4-inch by 8-inch cylinders are used, three specimens shall be tested at 28 days.
 - (b) Adjust mix design if test results are unsatisfactory and resubmit for approval.
 - (c) Concrete that does not comply with strength requirements will be considered as defective Work.
 - 5) Water/Cementitious Materials Ratio: Perform one test from each sample from which compression test specimens are taken, in accordance with AASHTO TP23.
 - 6) Within 24 hours of completion of test, testing laboratory will submit certified copy of test results to Contractor and Engineer.
- C. Evaluation of Field Quality Control Tests:
 1. Do not use concrete delivered to final point of placement having slump, concrete temperature, total air content or unit weight outside specified values.
 2. Water/Cementitious Materials Ratio:
 - a. When water content testing indicates water/cementitious materials ratio to exceed specified requirements by greater than 0.02, remaining batches required to complete concrete placement shall have water content decreased in the mix and water reducing admixture dosage increased as required to bring subsequently-batched concrete within specified water/cementitious materials ratio.
 - b. Perform additional testing to verify compliance with specified water/cementitious materials ratio.
 - c. Do not resume concrete production for further concrete placement until Contractor has identified cause of excess water in the mix and revised batching procedures, or adjusted the mix design (and obtained Engineer's associated approval) to bring water/cementitious materials ratio into conformance with the Contract Documents.
 - d. Compressive Strength:
 - 1) Compressive strength tests for laboratory-cured cylinders will be acceptable if the averages of all sets of three consecutive compressive strength tests results equal or exceed specified 28-day design compressive strength of the associated type or class of concrete, and no individual strength test falls below required compressive strength by more than 500 psi.
 - 2) Questionable Field Conditions During Concrete Placement:

- (a) Where questionable field conditions exist during concrete placement or immediately thereafter, strength tests of specimens cured under field conditions will be required by Engineer to check adequacy of curing and protecting of concrete placed. Specimens shall be molded at the same time and from the same samples as laboratory-cured specimens.
 - (b) Provide improved means and procedures for protecting concrete when 28-day compressive strength of field-cured cylinders is less than 85 percent of companion laboratory cured cylinders.
 - (c) When laboratory-cured cylinder strengths are appreciably higher than minimum required compressive strength, field-cured cylinder strengths need not exceed minimum required compressive strength by greater than 500 psi even though the 85 percent criterion may not be met.
 - (d) If individual tests of laboratory-cured specimens produce strengths more than 500 psi below the required minimum compressive strength, or if tests of field-cured cylinders indicate deficiencies in protection and curing, provide additional measures to ensure that load-bearing capacity of the structure is not jeopardized or impaired. If likelihood of low-strength concrete is confirmed and evaluations indicate load-bearing capacity may have been reduced, perform tests of cores from the concrete in question at Contractor's expense.
 - 3) If compressive strength tests fail to indicate compliance with minimum requirements of the Contract Documents, concrete represented by such tests will be considered defective.
- D. Testing Concrete Structure for Strength:
 - 1. When there is evidence that strength of in-place concrete does not comply with the Contract Documents, employ the services of concrete testing laboratory to obtain cores from hardened concrete for compressive strength determination. Cores and tests shall comply with ASTM C42 and the following:
 - a. Obtain at least three representative cores from each concrete member or suspect area of concrete at locations directed by Engineer.
 - b. Strength of concrete for each series of cores will be acceptable if average compressive strength is at least 85 percent of specified compressive strength and no single core is less than 75 percent of required 28-day required concrete compressive strength.
 - c. Testing laboratory shall submit test results to Engineer on same day that tests are completed. Include in test reports Project name and number (if any), date of sampling and testing, Contractor name, name of concrete testing laboratory, exact location of test core in the Work, type or class of concrete represented by core sample, nominal maximum size aggregate, design compressive strength, compression breaking strength, and type of break (corrected for length-diameter ratio), direction of applied load to core with respect to horizontal plane of concrete as placed, and moisture condition of the core at time of testing.
 - d. Fill core holes solid with non-shrink grout in accordance with Section 03600, Grouting, and finish to match adjacent concrete surfaces.
 - e. If results of core tests are unacceptable or if it is impractical to obtain cores, perform static load test and evaluations complying with ACI 318 and ACI 350, as directed by Engineer.
- E. Concrete Tolerance Verification Measurements: Refer to Article 3.9 of this Section.
- F. Supplier's Services: Water-Reducing Admixture Manufacturer: Furnish services of qualified concrete technician employed by admixture manufacturer to assist in proportioning concrete for optimum use of admixture. Concrete technician shall advise on proper addition of admixture to concrete and on adjustment of concrete mix proportions to meet changing conditions at the Site.

3.11 MISCELLANEOUS CONCRETE ITEMS

- A. Temporary Openings:
 - 1. Openings in concrete walls and slabs required for passage of Work are allowed only upon approval of Engineer.
 - 2. Temporary openings made in concrete shall be provided with waterstop in below-ground or liquid-retaining members and structures. Reinforcement going through and around the opening shall be made continuous to provide continuity and shall be approved by the Engineer.
 - 3. Temporary openings that remain in concrete structures shall be filled with the same class of concrete as the adjoining construction, after the Work causing need for temporary opening is complete, unless otherwise shown or directed by Engineer. Mix, place, and cure concrete as specified in this Section to blend with in-place construction. Provide miscellaneous concrete filling shown or required to complete the Work.
- B. Bases or Pads for Piping, Panels, and Equipment:
 - 1. Unless specifically shown or indicated otherwise, provide concrete bases or pads for equipment, floor-mounted panels, and floor-mounted supports for piping and similar construction. Provide all concrete pad and base Work not specifically included under other Sections.
 - 2. Dimensions and Elevations:
 - a. Coordinate and construct bases and pads to dimensions shown or indicated, or as required to comply with equipment, panel, or piping manufacturer's requirements and elevations indicated on the Drawing.
 - b. Unless otherwise shown or indicated, place concrete bases for equipment up to one-inch below the equipment manufacturer's base or mounting plate.
 - c. Where specific dimensions or elevations are not shown or indicated, bases and pads shall be six inches thick and extend three inches outside dimensions of the equipment, panel, or supports.
 - d. Finish: Bases and pads outside of areas to receive non-shrink grout shall have smooth trowel finish, unless special finish such as terrazzo, ceramic tile, quarry tile, or heavy-duty concrete topping is required. In such cases, provide appropriate concrete finish. Surfaces of bases and pads to receive non-shrink grout shall have broom finish.
- C. Curbs:
 - 1. Provide monolithic finish to interior curbs by stripping forms while concrete is still green followed by steel-troweling surfaces to hard, dense finish with corners, intersections, and terminations slightly rounded.
 - 2. Exterior curbs shall have rubbed finish for vertical surfaces and broomed finish for top surfaces.

3.12 REPAIR OF CONCRETE PLACED UNDER THIS CONTRACT

- A. Repair of Formed Surfaces:
 - 1. Repair the following defects in all formed finishes:
 - a. Spalls, air bubbles, rock pockets, form depressions, and other defects that are more than 1/4-inch in depth.
 - b. Holes from tie rods and other form tie systems.
 - c. Fins, offsets, and other projections that extend more than 1/4-inch beyond designated concrete member surface.
 - d. Structural cracks, as defined by Engineer.
 - e. Non-structural cracks greater than 0.010-inch wide as defined by Engineer. In liquid-retaining structures, elevated slabs subject to the elements or washdowns, below-grade members, and cracks that evidence leakage. Where it is not possible to verify whether a crack is leaking, repair the crack.
 - f. Repair the following defects in smooth-finish surfaces, in addition to those listed above in this Section:

- 1) Spalls, air bubbles, rock pockets, form depressions, and other defects that extend to more than 1/2-inch in width in any direction, no matter how deep.
 - 2) Spalls, air bubbles, rock pockets, form depressions, and other defects of any size that exceed three in number in a 12-inch by 12-inch area, or 12 in number in a three-foot by three-foot area.
 - 3) Fins, offsets, and other projections shall be completely removed and smoothed.
 - 4) Scratches and gouges in concrete surface.
 - 5) Texture and color irregularities. In liquid-retaining surfaces, texture and color irregularities need not be repaired when greater than 12 inches below minimum normal operating liquid surface elevation, except where such defects are indicative of reduced durability.
 - g. Where smooth rubbed or grout cleaned finish is specified, minor surface defects repairable by the finishing process need not be repaired prior to finish application, when approved by Engineer.
- B. Method of Repair of Formed Surfaces:
1. Immediately after removing forms, repair and patch defective areas with cement mortar or concrete repair mortar as directed by Engineer. Make repairs made to liquid-retaining structures and below-grade surfaces with repair mortar only. Repair form tie holes in liquid-retaining or below-grade surfaces with non-shrink grout in accordance with Section 03600, Grouting.
 2. Honeycombs, Rock Pockets, and Holes Left by Tie Rods and Bolts:
 - a. Cut out honeycomb, rock pockets, voids, and holes left by tie rods and bolts, down to solid concrete but, in no case, to depth less than one-inch for cement mortar and 1/2-inch for repair mortar. Make edges of cuts perpendicular to concrete surface.
 - b. Before placing cement mortar, thoroughly clean and brush-coat area to be patched with specified bonding agent.
 - c. When using concrete repair mortar, use of bonding agent is optional; prepare the surface and place mortar in accordance with mortar manufacturer's recommendations.
 - d. Repairs at exposed-to-view surfaces shall match the color of surrounding concrete, except color matching is not required for interior surfaces of liquid-retaining surfaces up to one foot below typical minimum liquid level. Impart texture to repaired surfaces to match texture of existing adjacent surfaces. Provide test areas at inconspicuous locations to verify mixture, texture, and color match before proceeding with patching.
 - e. Compact mortar in place and strike off slightly higher than the surrounding surface.
 - f. Structural Cracks: Pressure-grout structural cracks using injectable epoxy installed using pressurized system. Apply in accordance with epoxy manufacturer's directions and recommendations.
 - g. Non-structural Cracks: Shall be pressure-grouted using hydrophobic or hydrophilic resin. Install in accordance with resin manufacturer's directions and recommendations.
 - h. Determination of the crack type shall be made by the Engineer.
 - i. Holes Through Concrete:
 - 1) Using plunger-type gun or other suitable device, fill holes extending through concrete from least-exposed face, using flush stop held at exposed face; completely fill the hole with specified repair material.
 - 2) At below-grade and liquid-containing members, fill holes with concrete repair mortar and use color-matched cement mortar for outer two inches at exposed-to-view surfaces.
 - j. Where powerwashing or scrubbing is not adequate, abrasive blast exposed- to-view surfaces that require removal of stains, grout accumulations, sealing compounds, and other substances marring the surfaces. Use sand finer than No. 30 and air pressure from 15 to 25 psi.
- C. Repair of Unformed Surfaces:

1. Test unformed surfaces, such as monolithic slabs, for smoothness and to verify surface plane to specified tolerances for each surface and finish. Correct low and high areas in accordance with this Section.
 2. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using template having the required slope. Correct high and low areas in accordance with this Section.
 3. Repair finish of unformed surfaces containing defects that adversely affect concrete durability. Surface defects include crazing, cracks in excess of 0.01-inch wide, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.
 4. Repair structural cracks in all structures and non-structural cracks in liquid-retaining structures. In liquid-retaining structures, where dry face of concrete member can be observed, repair all cracks evidencing any rate of water flow through crack. Where dry face of member cannot be observed, repair all cracks.
- D. Methods of Repair of Unformed Surfaces:
1. Correct high areas in unformed surfaces by grinding, after concrete has cured sufficiently so that repairs can be made without damage to adjacent areas.
 2. Correct low areas in unformed surfaces, during or immediately after completion of surface finishing, by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Where repairs are required and concrete has already set, sawcut around perimeter of area to be repaired to depth of 1/2-inch and remove concrete so that minimum thickness of repair is 1/2-inch. Apply specified concrete repair mortar in accordance with repair mortar manufacturer's directions and recommendations.
 3. Repair defective areas, except random cracks and single holes not exceeding one-inch diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts, and expose reinforcing steel with at least 3/4-inch clearance all around. Minimum thickness of repair shall be 1.5 inches. Dampen concrete surfaces in contact with patching concrete and brush with specified bonding agent. Place patching concrete while bonding agent is tacky. Mix patching concrete of same materials and proportions to provide concrete of same classification as original, adjacent concrete. Place, compact, and finish as required to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.
 4. Repair isolated, random, non-structural cracks (in members that are not below grade or liquid-retaining), and single holes not greater than one-inch diameter, by dry-pack method. Groove top of cracks, and cut out holes to sound concrete, and clean repair area of dust, dirt, and loose particles. Dampen all cleaned concrete surfaces and brush with the specified bonding agent. Place dry-pack before cement grout takes its initial set. Mix dry-pack, consisting of one part portland cement to 2.5 parts fine aggregate passing No. 16 mesh sieve, using only enough water as required for handling and placing. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched areas continuously moist for at least 72 hours.
 5. Structural cracks shall be pressure-grouted using injectable epoxy. Apply in accordance with epoxy manufacturer's directions and recommendations.
 6. Non-structural cracks in below-grade and liquid-retaining structures shall be pressure-grouted using hydrophilic resin. Apply in accordance with resin manufacturer's directions and recommendations.
 7. Determination of crack type will be by Engineer.
 8. Ensure that surface is acceptable for flooring material to be installed in accordance with flooring manufacturer's recommendations.
- E. Other Methods of Repair:
1. Repair methods not specified in this Section may be used when approved by Engineer.

END OF SECTION 03 3000

SECTION 03350 – CONCRETE FINISHES

PART 1- GENERAL

1.01 DESCRIPTION

- A. Furnish all materials, labor, and equipment required to provide finishes of all concrete surfaces specified herein and shown on the Drawings.

1.02 RELATED SPECIFICATIONS

- A. Section 03100 – Concrete Forming
- B. Section 03300 – Cast-in-Place Concrete
- C. Section 03600 – Grouting

1.03 PAYMENT

- A. PAYMENT FOR WORK FURNISHED AND INSTALLED UNDER THIS SECTION SHALL BE INCLUDED IN THE LUMP SUM PRICE BID FOR THE CONTRACT, AS DESCRIBED IN SECTION 01150 – MEASUREMENT AND PAYMENT.

1.04 REFERENCES

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. ACI 301 – Specifications for Structural Concrete for Buildings
 - 2. ACI 318 – Building Code Requirements for Structural Concrete

1.05 SUBMITTALS

- A. Submit the following in accordance with Section 01300 – Submittals.
 - 1. Manufacturer's literature on all products specified herein.

PART 2- PRODUCTS

2.01 CONCRETE FLOOR SEALER

- A. Floor sealer: Diamond Clear VOX or Super Diamond Clear VOX by the Euclid Chemical Company, Sonneborn Kure N Seal 30 by BASF Construction Chemicals.

2.02 NON-METALLIC FLOOR HARDENER

- A. The specified non-metallic mineral aggregate hardener shall be formulated, processed, and packaged under stringent quality control at the manufacturer's owned and controlled factory. The hardener shall be a factory-blended mixture of specifically processed graded mineral aggregate, selected Portland cement, and necessary plasticizing agents. The hardener shall be light reflective. Acceptable products shall be "Surflex" by the Euclid Chemical Company, Quartzplate FF Light Reflective" by L&M Construction Chemicals and "Mastercon" by BASF.

PART 3 – EXECUTION

3.01 FINISHES ON FORMED CONCRETE SURFACES

- A. After removal of forms, the finishes described below shall be applied in accordance with Article 3.5 - Concrete Finish Schedule. Unless the finish schedule specifies otherwise, all surfaces shall receive at least a Type I finish. The Engineer shall be the sole judge of acceptability of all concrete finish work.
 - 1. Type I - Rough: All fins, burrs, offsets, marks and all other projections left by the forms shall be removed. Projections, depressions, etc. below finished grade required to be removed will only be those greater than ¼-inch. All holes left by removal of ends of ties, and all other holes, depressions, bugholes, air/blow holes or voids shall be filled solid with cement grout after first being thoroughly wetted and then struck off flush. The only holes below grade to be filled will be tie holes and any other holes larger than ¼-inch in any dimension. Honeycombs shall be chipped back to solid concrete and repaired as directed by the Engineer. All holes shall be filled with tools, such as sponge floats and trowels, that will permit packing the hole solidly with cement grout. Cement grout shall consist of one part cement to three parts sand, epoxy bonding agent (for tie holes only) and the amount

SECTION 03350 – CONCRETE FINISHES

- of mixing water shall be as little as consistent with the requirements of handling and placing. Color of cement grout shall match the adjacent wall surface.
2. Type II - Grout Cleaned: Where this finish is required, it shall be applied after completion of Type I finish. After the concrete has been predampened, a slurry consisting of one part cement (including an appropriate quantity of white cement in order to produce a color matching the surrounding concrete) and 1-1/2 parts sand passing the No. 16 sieve, by damp loose volume, shall be spread over the surface with clean burlap pads or sponge rubber floats. Mix proportions shall be submitted to the Engineer after a sample of the work is established and accepted. Any surplus shall be removed by scraping and then rubbing with clean burlap.
 3. Type III - Smooth Form Finish: Concrete shall be cast against forms constructed of plywood not less than 5/8 inch thick, or of boards lined with tempered hardboard not less than 3/16 inch thick, or other approved materials. Form material shall not have torn grain, worn edges, patches of holes from previous use, or other defects which would impair the texture of the concrete surface. Form material shall utilize sheets as large as practicable in an orderly and symmetric configuration. Other aspects of the finish shall conform to the requirements of the rough form finish.
 4. Type IV - Smooth Rubbed: Where this finish is required, it shall be applied after the completion of the Type III finish. No rubbing shall be done before the concrete is thoroughly hardened and the mortar used for patching is firmly set. A smooth, uniform surface shall be obtained by wetting the surface and rubbing it with a carborundum stone to eliminate irregularities. Unless the nature of the irregularities requires it, the general surface of the concrete shall not be cut into. Corners and edges shall be slightly rounded by the use of the carborundum stone. Brush finishing or painting with grout or neat cement will not be permitted. A 100 square foot example shall be established at the beginning of the project to establish acceptability.

3.02 SLAB AND FLOOR FINISHES

- A. The finishes described below shall be applied to floors, slabs, flow channels and top of walls in accordance with Article 3.5 - Concrete Finish Schedule. The Engineer shall be the sole judge of acceptability of all such finish work.
 1. Type "A" - Screeded: This finish shall be obtained by placing screeds at frequent intervals and striking off to the surface elevation required. When a Type "F" finish is subsequently to be applied, the surface of the screeded concrete shall be roughened with a concrete rake to 1/2" minimum deep grooves prior to final set.
 2. Type "B" - Wood or Magnesium Floated: This finish shall be obtained after completion of a Type "A" finish by working a previously screeded surface with a wood or magnesium float or until the desired texture is reached. Floating shall begin when the water sheen has disappeared and when the concrete has sufficiently hardened so that a person's foot leaves only a slight imprint. If wet spots occur, water shall be removed with a squeegee. Care shall be taken to prevent the formation of laitance and excess water on the finished surface. All edges shall be edged with an 1/8-inch tool as directed by the Engineer. The finished surface shall be true, even, and free from blemishes and any other irregularities.
 3. Type "C" - Cork Floated: This finish shall be similar to Type "B" but slightly smoother than that obtained with a wood float. It shall be obtained by power or band floating with cork floats.
 4. Type "D" - Steel Troweled: This finish shall be obtained after completion of a Type "B" finish. When the concrete has hardened sufficiently to prevent excess fine material from working to the surface, the surface shall be compacted and smoothed with not less than two thorough and complete steel troweling operations. In areas which are to receive vapor barriers and applied roofing, the applicable Specification Sections and Contract Drawings shall be reviewed for the required finishes and degree of flatness. All edges shall be edged with a 1/8-inch tool as directed by the Engineer. The finish shall be brought to a smooth, dense surface, free from defects and blemishes.
 5. Type "E" - Broom or Belt: This finish shall provide the surface with a transverse scored texture by drawing a broom or burlap belt across the surface immediately after completion

SECTION 03350 – CONCRETE FINISHES

of a Type "B" finish. All edges shall be edged with a 1/8-inch tool as directed by the Engineer.

6. Type "G" Hardened Finish: This finish shall be applied after completion of a Type "B" or Type "C" finish and prior to application of a Type "D" finish. Hardeners shall be applied in strict accordance with the manufacturer's requirements. Hardeners shall be applied using a mechanical spreader. The hardener shall be applied in two shakes with the first shake comprising 2/3 of the total amount. Type "D" finish shall be applied following completion of application of the hardener.
7. Non-metallic floor hardener shall be applied at the rate of 1.5 pounds/ft.2 and shall increase floor light reflection a minimum of 60%.
8. Type "H" - Non-Slip Finish: This finish shall be provided by applying a non-slip flooring aggregate concurrently with the application of a Type "E" finish. Application procedure shall be in accordance with manufacturer's instructions. Finish shall be applied where specifically required on the Contract Drawings or specified herein.

3.03 CONCRETE SEALERS

- A. Apply concrete sealers where specifically required on the Contract Drawings or specified herein.
- B. Apply sealers after installation of all equipment, piping, etc. and after completion of any other related construction activities. Application of sealers shall be in strict accordance with manufacturer's requirements.
- C. Sealers shall be applied to all floor slabs not painted and not intended to be immersed.
- D. All other floor slabs to receive sealer shall be sealed with concrete floor sealer.

3.04 FINISHES ON EQUIPMENT PADS

- A. Formed surfaces of equipment pads shall receive a Type III finish.
- B. Top surfaces of equipment pads, except those surfaces subsequently required to receive grout and support equipment bases, shall receive a Type "D" finish, unless otherwise noted. Surfaces which will later receive grout shall, before the concrete takes its final set, be made rough by removing the sand and cement that accumulates on the top to the extent that the aggregate will be exposed with irregular indentations in the surface up to 1/2 inch deep.

3.05 CONCRETE FINISH SCHEDULE

ITEM	TYPE OF FINISH
EXTERIOR EXPOSED CONCRETE WALLS, CEILINGS, BEAMS, MANHOLES, HAND HOLES, MISCELLANEOUS STRUCTURES AND COLUMNS (INCLUDING TOP OF WALL) TO ONE FOOT BELOW GRADE. ALL OTHER EXPOSED CONCRETE SURFACES NOT SPECIFIED ELSEWHERE	II
EXPOSED EXTERIOR CONCRETE PIERS	IV
ALL INTERIOR FINISH FLOORS OF BUILDINGS AND STRUCTURES.	G
ROOF SLABS	D
EXTERIOR CONCRETE SIDEWALKS, STEPS, RAMPS, DECKS, SLABS ON GRADE AND LANDINGS EXPOSED TO WEATHER	H

END OF SECTION

++ NO TEXT ON THIS PAGE ++

SECTION 03370 – CONCRETE CURING

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Protect all freshly deposited concrete from premature drying and from the weather elements. The concrete shall be maintained with minimal moisture loss at a relatively constant temperature for a period of time necessary for the hydration of the cement and proper hardening of the concrete in accordance with the requirements specified herein.

1.02 RELATED SECTIONS

- A. Section 03100 – Concrete Formwork
- B. Section 03300 – Cast-In-Place Concrete
- C. Section 03350 – Concrete Finishes

1.03 PAYMENT

- A. Payment for work furnished and installed under this Section shall be included in the lump sum price bid for the Contract, as described in Section 01150 – Measurement and Payment

1.04 REFERENCES

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. ACI 301 – Specifications for Structural Concrete for Buildings
 - 2. ACI 304 – Guide for Measuring, Mixing, Transporting, and Placing Concrete
 - 3. ACI 305 – Hot Weather Concreting
 - 4. ACI 306 – Cold Weather Concreting
 - 5. ACI 308 – Standard Practice for Curing Concrete
 - 6. ASTM C171 – Standard Specifications for Sheet Materials for Curing Concrete
 - 7. ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
 - 8. ASTM C1315 – Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete

1.05 SUBMITTALS

- A. Submit the following in accordance with Section 01300, Submittals.
 - 1. Proposed procedures for protection of concrete under wet weather placement conditions.
 - 2. Proposed normal procedures for protection and curing of concrete.
 - 3. Proposed special procedures for protection and curing of concrete under hot and cold weather conditions.
 - 4. Proposed method of measuring concrete surface temperature changes.
 - 5. Manufacturer's literature and material certification for proposed curing compounds.

PART 2 – PRODUCTS

2.01 LIQUID MEMBRANE-FORMING CURING COMPOUND

- A. Clear curing and sealing compound shall be a clear styrene acrylate type complying with ASTM C 1315, Type 1, Class A with a minimum solids content of 30%. Moisture loss shall not be greater than 0.40 kg/m² when applied at 300 sq.ft./gal. Manufacturer's certification is required. Acceptable products are Super Diamond Clear VOX by the Euclid Chemical Company, Sonneborn Kure N Seal 30 by BASF Construction Chemicals, and Cure & Seal 30 Plus by Symons Corporation.
- B. Where specifically approved by Engineer, on slabs to receive subsequent applied finishes, compound shall conform to ASTM C 309. Acceptable products are "Kurez DR VOX" or "Kurez W VOX" by the Euclid Chemical Company. Install in strict accordance with manufacturer's requirements.

2.02 EVAPORATION REDUCER

- A. Evaporation reducer shall be BASF, "Confilm", or Euclid Chemical "Euco-Bar".

PART 3 – EXECUTION

3.01 PROTECTION AND CURING

- A. Protect freshly placed concrete from the elements, flowing water and from defacement of any nature during construction operations.
- B. As soon as the concrete has been placed and horizontal top surfaces have received their required finish, provision shall be made for maintaining the concrete in a moist condition for at least a 5-day period thereafter except for high early strength concrete, for which the period shall be at least the first three days after placement. Horizontal surfaces shall be kept covered, and intermittent, localized drying will not be permitted.
- C. Walls that will be exposed on one side with either fluid or earth backfill on the opposite side shall be continuously wet cured for a minimum of five days. Use of a curing compound will not be acceptable for applications of this type.
- D. Use one of the following methods to insure that the concrete remains in a moist condition for the minimum period stated above.
 - 1. Ponding or continuous fogging or sprinkling.
 - 2. Application of mats or fabric kept continuously wet.
 - 3. Continuous application of steam (under 150 degrees F).
 - 4. Application of sheet materials conforming to ASTM C171.
 - 5. If approved by the Engineer, application of a curing compound in accordance with Article 3.4.
- E. Keep absorbent wood forms wet until they are removed. After form removal, the concrete shall be cured by one of the methods in paragraph D.
- F. Any of the curing procedures used in Paragraph 3.1-D may be replaced by one of the other curing procedures listed in Paragraph 3.1-D after the concrete is one-day old. However, the concrete surface shall not be permitted to become dry at any time.

3.02 CURING CONCRETE UNDER COLD WEATHER CONDITIONS

- A. Suitable means shall be provided for a minimum of 72 hours after placing concrete to maintain it at or above the minimum as placed temperatures specified in Section 03300, Cast-In-Place Concrete, for concrete work in cold weather. During the 72-hour period, the concrete surface shall not be exposed to air more than 20 degrees F above the minimum as placed temperatures.
- B. Stripping time for forms and supports shall be increased as necessary to allow for retardation in concrete strength caused by colder temperatures. This retardation is magnified when using concrete made with blended cements or containing fly ash or ground granulated blast furnace slag. Therefore, curing times and stripping times shall be further increased as necessary when using these types of concrete.
- C. The methods of protecting the concrete shall be approved by the Engineer and shall be such as will prevent local drying. Equipment and materials approved for this purpose shall be on the site in sufficient quantity before the work begins. The Contractor shall assist the Engineer by providing holes in the forms and the concrete in which thermometers can be placed to determine the adequacy of heating and protection. All such thermometers shall be furnished by the Contractor in quantity and type which the Engineer directs.
- D. Curing procedures during cold weather conditions shall conform to the requirements of ACI 306.

3.03 CURING CONCRETE UNDER HOT WEATHER CONDITIONS

- A. When air temperatures exceed 85 degrees F, take extra care in placing and finishing techniques to avoid formation of cold joints and plastic shrinkage cracking. If ordered by the Engineer, temporary sun shades and/or windbreakers shall be erected to guard against such developments, including generous use of wet burlap coverings and fog sprays to prevent drying out of the exposed concrete surfaces.

SECTION 03370 – CONCRETE CURING

- B. Immediately after screeding, horizontal surfaces shall receive an application of evaporation reducer. Apply in accordance with manufacturer's instructions. Final finish work shall begin as soon as the mix has stiffened sufficiently to support the workmen.
- C. Curing and protection of the concrete shall begin immediately after completion of the finishing operation. Continuous moist-curing consisting of method 1 or 2 listed in paragraph 3.1D is mandatory for at least the first 24 hours. Method 2 may be used only if the finished surface is not marred or blemished during contact with the coverings.
- D. At the end of the initial 24-hour period, curing and protection of the concrete shall continue for at least four (4) additional days using one of the methods listed in paragraph 3.1D.
- E. Curing procedures during hot weather conditions shall conform to the requirements of ACI 305.

3.04 USE OF CURING COMPOUND

- A. Use curing compound only where specifically approved by the Engineer. Curing compound shall never be used for curing exposed walls with fluid or earth backfill on the opposite side. A continuous wet cure for a minimum of five days is required for these applications. Curing compound shall not be used on surfaces exposed to water in potable water storage tanks and treatment plants unless curing compound is certified in accordance with ANSI/NSF Standard 61.
- B. When permitted, the curing compound shall maintain the concrete in a moist condition for the required time period, and the subsequent appearance of the concrete surface shall not be affected.
- C. Apply compound in accordance with the manufacturer's recommendations after water sheen has disappeared from the concrete surface and after finishing operations. Maximum coverage for the curing and sealing compound shall be 300 square feet per gallon for trowel finishes and 200 square feet per gallon for floated or broom surfaces. Maximum coverage for compounds placed where subsequent finishes will be applied shall be 200 square feet per gallon. For rough surfaces, apply in two directions at right angles to each other.

3.05 EARLY TERMINATION OF CURING

- A. Moisture retention measures may be terminated earlier than the specified times only when at least one of the following conditions is met:
 - 1. The strength of the concrete reaches 85 percent of the specified 28-day compressive strength in laboratory-cured cylinders representative of the concrete in place, and the temperature of the in-place concrete has been constantly maintained at 50 degrees Fahrenheit or higher.
 - 2. The strength of concrete reaches the specified 28-day compressive strength as determined by accepted nondestructive methods or laboratory-cured cylinder test results.

END OF SECTION

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SECTION 03400 – PRECAST CONCRETE

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Construct all precast concrete items as required in the Contract Documents, including all appurtenances necessary to make a complete installation.

1.02 RELATED SECTIONS

- A. Section 02604 - Utility Structures
- B. Section 03200 – Concrete Reinforcing
- C. Section 03300 - Cast-in-Place Concrete
- D. Section 03350 - Concrete Finishes
- E. Section 03370 - Concrete Curing
- F. Section 03600 - Grout
- G. Section 05050 - Metal Fastening

1.03 REFERENCES

- A. Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the end of the Bid.
 - 1. Building Code of New York State
 - 2. ACI 318-Building Code Requirements for Structural Concrete
 - 3. PCI Standard MNL-116 - Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products
 - 4. PCI Design Handbook
 - 5. ASTM C-478 Precast reinforced Concrete Manhole Sections

1.04 DESIGN REQUIREMENTS

- A. Design in accordance with ASTM C-180 – Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete water and Wastewater Structures.
- B. Loading: AASHTO HS20 with 30 percent impact and 130 lb/cu ft equivalent soil pressure.

1.05 SUBMITTALS

- A. Submit the following for review in accordance with Section 01300, Submittals.
 - 1. Shop drawings for all precast concrete items showing all dimensions, locations, and type of lifting inserts, and details of reinforcement and joints.
 - 2. A list of the design criteria used by the manufacturer for all manufactured, precast items.
 - 3. Design calculations, showing at least the design loads and stresses on the item, shall be submitted. Calculations shall be signed and sealed by a Professional Engineer registered in the State of New York.
 - 4. Certified reports for all lifting inserts, indicating allowable design loads.
 - 5. Information on lifting and erection procedures.

1.06 QUALITY ASSURANCE

- A. All manufactured precast concrete units shall be produced by an experienced manufacturer regularly engaged in the production of such items. All manufactured precast concrete and site-cast units shall be free of defects, spalls, and cracks. Care shall be taken in the mixing of materials, casting, curing and shipping to avoid any of the above. The Engineer may elect to examine the units at the casting yard or upon arrival of the same at the site. The Engineer shall have the option of rejecting any or all of the precast work if it does not meet with the requirements specified herein or on the Drawings. All rejected work shall be replaced at no additional cost to the Owner.

SECTION 03400 – PRECAST CONCRETE

- B. Plant production and engineering must be under direct supervision and control of an Engineer who possesses a minimum of five years experience in precast concrete work.

PART 2 – PRODUCTS

2.01 CONCRETE

- A. Concrete materials including Portland Cement, aggregates, water, and admixtures shall conform to Section 03300, Cast-in-Place Concrete.
- B. Minimum compressive strength of concrete at 28 days shall be 4000 psi unless otherwise specified.

2.02 GROUT

- A. Grout for joints between panels shall be a cement grout in conformance with Section 03600, Grout.
- B. Minimum compressive strength of grout at 7 days shall be 3,000 psi.

2.03 REINFORCING STEEL

- A. Reinforcing steel used for precast concrete construction shall conform to Section 03200, Reinforcing Steel.

2.04 STEEL INSERTS

- A. Steel inserts shall be in accordance with Section 05010, Metal Materials.
- B. All steel inserts protruding from or occurring at the surface of precast units shall be hot-dipped galvanized in accordance with ASTM A123.

2.05 WELDING

- A. Welding shall conform to Section 05050, Metal Fastening.

PART 3 –EXECUTION

3.01 FABRICATION AND CASTING

- A. Fabricate and cast all precast members to the shapes, dimensions and lengths shown on the Drawings and in compliance with PCI MNL-116. Precast members shall be straight, true and free from dimensional distortions, except for camber and tolerances permitted later in this clause. All integral appurtenances, reinforcing, openings, etc., shall be accurately located and secured in position with the form work system. Form materials shall be steel and the systems free from leakage during the casting operation.
- B. All cover of reinforcing shall be the same as detailed on the Drawings.
- C. Coordinate the communication of all necessary information concerning openings, sleeves, or inserts to the manufacturer of the precast members.
- D. Finish concrete in accordance with Section 03350, Concrete Finishes. Grout all recesses due to cut tendons which will not otherwise be grouted during erection.
- E. Curing of precast members shall be in accordance with Section 03370, Concrete Curing. Use of a membrane curing compound will not be allowed.
- F. The manufacturer shall provide lifting inserts or other approved means of lifting members.

3.02 HANDLING, TRANSPORTING AND STORING

- A. Precast members shall not be transported away from the casting yard until the concrete has reached the minimum required 28 day compressive strength and a period of at least 5 days has elapsed since casting, unless otherwise permitted by the Engineer.
- B. No precast member shall be transported from the plant to the job site prior to approval of that member by the plant inspector. This approval will be stamped on the member by the plant inspector.

SECTION 03400 – PRECAST CONCRETE

- C. During handling, transporting, and storing, precast concrete members shall be lifted and supported only at the lifting or supporting points as indicated on the shop drawings.
- D. All precast members shall be stored on solid, unyielding, storage blocks in a manner to prevent torsion, objectionable bending, and contact with the ground.
- E. Precast concrete members shall not be used as storage areas for other materials or equipment.
- F. Precast members damaged while being handled or transported will be rejected or shall be repaired in a manner approved by the Engineer.

3.03 ERECTION

- A. Provide foundation mat of NYSDOT 703-0201 No. 2 crushed stone to support precast structure base Mat shall be 6 inches minimum depth and shall bear on sound undisturbed earth. Excavate and remove subgrade material as necessary to reach sound stratum.
- B. Mat outside perimeter shall be a minimum of 2 feet greater than the outside perimeter of the precast structure and shall be compacted to a uniform level surface.
- C. Prepare all bearing surfaces to a true and level line prior to erection. All supports of the precast members shall be accurately located and of required size and bearing materials.
- D. Installation of the precast members shall be made by leveling the top surface of the assembled units keeping the units tight and at right angles to the bearing surface.
- E. Connections which require welding shall be properly made in accordance with Section 05050, Metal Fastening.
- F. Grouting between adjacent precast members and along the edges of the assembled precast members shall be accomplished as indicated on the drawings, care being taken to solidly pack such spaces and to prevent leakage or droppings of grout through the assembled precast members. Any grout which seeps through the precast members shall be removed before it hardens.
- G. In no case shall concentrated construction loads, or construction loads exceeding the design loads, be placed on the precast members. In no case shall loads be placed on the precast members prior to the welding operations associated with erection, and prior to placing of topping (if required).
- H. Do not arbitrarily cut, drill, punch or otherwise tamper with the precast members.
- I. Precast members damaged while being erected will be rejected or shall be repaired in a manner approved by the Engineer.

END OF SECTION

SECTION 03400 – PRECAST CONCRETE

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PART 1 – GENERAL

1.01 DESCRIPTION

- A. Furnish all materials, labor, and equipment required to provide all grout used in concrete work and as bearing surfaces for base plates, in accordance with the Contract Documents.

1.02 RELATED SECTIONS

- A. Requirements of related work are included in Division 1 and Division 2 of these Specifications.

1.03 PAYMENT

- A. Payment for work furnished and installed under this Section shall be included in the lump sum price bid for the Contract, as described in Section 01150 – Measurement and Payment.

1.04 REFERENCES

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 1. ACI 211.1, Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
 2. ACI 301, Structural Concrete for Buildings.
 3. ASTM C33/C33M, Specification for Concrete Aggregates.
 4. CRD-C 621 Corps of Engineers Specification for Non-shrink Grout
 5. ASTM C109 Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch or 50 mm cube Specimens)
 6. ASTM C230/C230M, Specification for Flow Table for Use in Tests of Hydraulic Cement.
 7. ASTM C531 Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts and Monolithic Surfacing
 8. ASTM C579 Test Method for Compressive Strength of Chemical-Resistant Mortars and Monolithic Surfacing
 9. ASTM C827 Standard Test Method for Early Volume Change of Cementitious Mixtures
 10. ASTM C882/C882M, Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.
 11. ASTM C939, Text Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
 12. ASTM C1107/C1107M, Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
 13. ASTM C1181, Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts.
 14. ASTM C144 Standard Specification for Aggregate for Masonry Mortar
 15. ASTM C1107 Standard Specification for Packaged Dry, Hydraulic Cement Grout (Nonshrink)

1.05 SUBMITTALS

- A. Submit the following in accordance with Section 01300 - Submittals.
 1. Certified test results verifying the compressive strength and shrinkage and expansion requirements specified herein.
 2. Schedule of Project-specific grout applications, installation locations, and the grout type proposed for each
 3. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of grout used in the work.
 4. List of grout materials and proportions for the proposed mix designs. Include data sheets, test results, certifications, and mill reports to qualify the materials proposed for use in the mix designs.

1.06 QUALITY ASSURANCE

- A. Field Tests

SECTION 03600 – GROUTING

1. Compression test specimens will be taken during construction from the first placement of each type of grout and at intervals thereafter as selected by the Engineer to insure continued compliance with these Specifications. The specimens will be made by the Engineer or its representative.
 - a. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed as specified in ASTM C 109 at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven days, 28 days and any additional time period as appropriate.
 - b. Compression tests and fabrication of specimens for epoxy grout will be performed as specified in ASTM C 579, Method B, at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven days and any other time period as appropriate.
 - 1) The cost of all laboratory tests on grout will be borne by the Owner, but the Contractor shall assist the Engineer in obtaining specimens for testing. The Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the specifications. Supply all materials necessary for fabricating the test specimens, at no additional cost to the Owner.
 - 2) All grout, already placed, which fails to meet the requirements of these Specifications, is subject to removal and replacement at no additional cost to the Owner.

PART 2 -- PRODUCTS

2.01 MATERIALS

- A. General: Non-shrink grout shall be a prepackaged, inorganic, flowable, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water. Manufacturer's instructions shall be printed on each bag or container in which the materials are packaged. Specific formulation for each type or class of non-shrink grout specified in this Section shall be that recommended by the grout manufacturer for the particular application.
 1. Class I Non-Shrink Grout:
 - a. Class I non-shrink grouts shall have a minimum 28-day compressive strength of 7,000 psi. Use grout for precision grouting and where water-tightness and non-shrink reliability in both plastic and hardened states is critical, in accordance with 3.5-Schedule in this Section.
 - b. Products and Manufacturer: Provide one of the following:
 - 1) Masterflow 928, by Master Builders, Inc.
 - 2) Five Star Grout, by Five Star Products, Inc.
 - 3) Hi-Flow Grout, by Euclid Chemical Company.
 - 4) Or equal.
 - 5) Comply with ASTM C1107/C1107M, Grade C and B (as modified below) when tested using amount of water required to achieve the following properties:
 - (a) Fluid consistency (20 to 30 seconds) shall be in accordance with ASTM C939.
 - (b) At temperatures of 45, 73.4, and 95 degrees F.
 - 6) Length change from placing to time of final set shall not have shrinkage greater than the expansion measured at three or fourteen days. Expansion at three or fourteen days shall not exceed the 28-day expansion.
 - 7) Non-shrink property shall not be based on chemically-generated gas or gypsum expansion.
 - 8) Fluid grout shall pass through the flow cone, with continuous flow, one hour after mixing.
 2. Class II Non-Shrink Grout:
 - a. Class II non-shrink grouts shall have minimum 28-day compressive strength of 7,000 psi. Use grout for general-purpose grouting applications in accordance with 3.5-Schedule in this Section.
 - b. Products and Manufacturer: Provide one of the following:

SECTION 03600 – GROUTING

- 1) Construction Grout, by Master Builders, Inc.
 - 2) FSP Construction Grout, by Five Star Products, Inc.
 - 3) NS Grout, by Euclid Chemical Company.
 - 4) Or equal.
 - 5) Comply with ASTM C1107/C1107M and the following when tested using the quantity of water required to achieve the following properties:
 - (a) Flowable consistency (140 percent flow in accordance with ASTM C230/C230M, five drops in 30 seconds).
 - (b) Fluid working time of at least 15 minutes.
 - (c) Flowable for at least 30 minutes.
 - 6) When tested, grout shall not bleed at maximum allowed water.
 - 7) Non-shrink property shall not be based on chemically-generated gas or gypsum expansion.
3. Class III Non-Shrink Epoxy Grout:
- a. Epoxy grout shall be a pourable, non-shrink, 100-percent solids system.
 - b. Products and Manufacturer: Provide one of the following:
 - 1) E3G, by Euclid Chemical Company.
 - 2) Sikadur 42 Grout Pak, by Sika Corporation.
 - 3) HP Epoxy Grout, by Five Star Products, Inc.
 - 4) Or equal.
 - 5) Epoxy grout system shall have three components: resin, hardener, and specially blended aggregate, all pre-measured and prepackaged. Resin component shall not contain non-reactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are unacceptable. Variation of component ratios is not allowed without specific recommendation by manufacturer. Manufacturer's instructions shall be printed on each container in which products are packaged.
 - 6) The following properties shall be attained with the minimum quantity of aggregate allowed by epoxy grout manufacturer.
 - (a) Vertical volume change at all times before hardening shall be between zero percent shrinkage and 4.0 percent expansion when measured in accordance with ASTM C827 (modified for epoxy grouts by using an indicator ball with specific gravity between 0.9 and 1.1).
 - (b) Length change after hardening shall be less than 0.0006-inch per inch and coefficient of thermal expansion shall be less than 0.00003-inch per inch per degree F when tested in accordance with ASTM C531.
 - (c) Compressive creep at one year shall be less than 0.001-inch per inch when tested under a 400-psi constant load at 140 degrees F in accordance with ASTM C1181.
 - (d) Minimum seven-day compressive strength shall be 14,000 psi when tested in accordance with ASTM C579
 - (e) Grout shall be capable of maintaining at least a flowable consistency for minimum of 30 minutes at 70 degrees F.
 - (f) Shear bond strength to Portland cement concrete shall be greater than shear strength of concrete when tested in accordance with ASTM C882/C882M.
 - (g) Minimum effective bearing area shall be 95 percent.
 - c. Grout Fill
 - 1) Cement grout shall be composed of Portland Cement and sand in the proportion specified in the Contract Documents and the minimum amount of water necessary to obtain the desired consistency. If no proportion is indicated, cement grout shall consist of one part Portland Cement to three parts sand. Water amount shall be as required to achieve desired consistency without compromising strength requirements. White Portland Cement shall be mixed with the Portland Cement as required to match color of adjacent concrete.

SECTION 03600 – GROUTING

- 2) The minimum compressive strength at 28 days shall be 4000 psi.
- 3) For beds thicker than 1-1/2 inch and/or where free passage of grout will not be obstructed by coarse aggregate, 1-1/2 parts of coarse aggregate having a top size of 3/8 inch should be added. This stipulation does not apply for grout being swept in by a mechanism. These applications shall use a plain cement grout without coarse aggregate regardless of bed thickness.
- 4) Sand shall conform to the requirements of ASTM C144.

2.02 CURING MATERIALS

- A. Curing materials shall be as specified in Section 03370, Concrete Curing for cement grout and as recommended by the manufacturer for prepackaged grouts.

PART 3 – EXECUTION

3.01 GENERAL

- A. The different types of grout shall be used for the applications stated in the Schedule unless noted otherwise in the Contract Documents. Where grout is called for in the Contract Documents which does not fall under any of the applications stated below, non-shrink grout shall be used unless another type is specifically referenced.
 1. Cement grout shall be used for grout toppings and for patching of fresh concrete.
 2. Non-shrink grout shall be used for grouting beneath base plates of structural metal framing.
 3. Epoxy grout shall be used for bonding new concrete to hardened concrete.
 4. Epoxy base plate grout shall be used for precision seating of base plates including base plates for all equipment such as engines, mixers, pumps, vibratory and heavy impact machinery, etc.
 - a. New concrete surfaces to receive cement grout shall be as specified in Section 03350, Concrete Finishes, and shall be cleaned of all dirt, grease and oil-like films. Existing concrete surfaces shall likewise be cleaned of all similar contamination and debris, including chipping or roughening the surface if a laitance or poor concrete is evident. The finish of the grout surface shall match that of the adjacent concrete. Curing and protection of cement grout shall be as specified in Section 03370, Concrete Curing.
 - b. All mixing, surface preparation, handling, placing, consolidation, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.
 - c. The Contractor, through the manufacturer of a non-shrink grout and epoxy grout, shall provide on-site technical assistance upon request, at no additional cost to the Owner.

3.02 CONSISTENCY

- A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow.

3.03 MEASUREMENT OF INGREDIENTS

- A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurement shall not be allowed.
- B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

3.04 GROUT INSTALLATION

- A. Place grout quickly and continuously. Completely fill the space to be grouted and thoroughly compact free of air pockets. The grout may be poured in place, pressure grouted by gravity, or pumped. The use of pneumatic pressure or dry-packed grouting requires approval of the Engineer. For grouting beneath base plates, pour grout from one side only and thence flow across to the open side to avoid air-entrapment.

3.05 SCHEDULE**GROUT APPLICATIONS AND MATERIAL TYPES**

APPLICATION	REQUIRED GROUT MATERIAL TYPE
BEAM AND COLUMN (ONE- OR TWO-STORY HEIGHT) BASE PLATES AND PRECAST CONCRETE BEARING LESS THAN 16 INCHES IN THE LEAST DIMENSION	CLASS II NON-SHRINK
COLUMN BASE PLATES AND PRECAST CONCRETE BEARING (GREATER THAN TWO-STORY HEIGHT OR LARGER THAN 16 INCHES IN THE LEAST DIMENSION)	CLASS I NON-SHRINK
BASE PLATES FOR STORAGE TANKS AND OTHER NON-MOTORIZED EQUIPMENT, AND MOTORIZED EQUIPMENT OR MACHINERY LESS THAN 50 HORSEPOWER	CLASS I NON-SHRINK (UNLESS OTHERWISE RECOMMENDED BY EQUIPMENT MANUFACTURER)
MOTORIZED EQUIPMENT OR MACHINERY EQUAL TO AND GREATER THAN 50 HORSEPOWER, AND MOTORIZED EQUIPMENT OR MACHINERY EQUIPMENT LESS THAN 50 HORSEPOWER SUBJECT TO SEVERE SHOCK LOADS OR HIGH VIBRATION	CLASS III NON-SHRINK EPOXY (UNLESS OTHERWISE RECOMMENDED BY EQUIPMENT MANUFACTURER)
FILLING BLOCKOUT SPACES FOR EMBEDDED ITEMS SUCH AS RAILING POSTS, GUIDE FRAMES FOR HYDRAULIC GATES, AND SIMILAR APPLICATIONS	CLASS II NON-SHRINK (CLASS I WHERE PLACEMENT TIME EXCEEDS 15 MINUTES)
GROUT FILL OR GROUT TOPPINGS LESS THAN FOUR INCHES THICK	GROUT FILL
GROUT FILL GREATER THAN FOUR INCHES THICK	CLASS "B" CONCRETE IN ACCORDANCE WITH SECTION 03300, CAST-IN-PLACE CONCRETE
APPLICATIONS NOT LISTED ABOVE, WHERE GROUT IS INDICATED ON THE DRAWINGS	CLASS I NON-SHRINK, UNLESS SHOWN OR INDICATED OTHERWISE

END OF SECTION

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SECTION 03930 – CONCRETE REPAIR AND REHABILITATION

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Provide labor, materials, equipment, and incidentals as shown, specified, and required to repair or rehabilitate, as required, existing concrete shown or indicated in the Contract Documents as being repaired or rehabilitated.
- B. Repair damage to new concrete construction as specified in this Section except for repair Work specified in Section 03300, Cast-in-Place Concrete.
- C. Coordination: Review installation procedures under this and other Sections and coordinate the Work that must be installed with or before repair and rehabilitation of concrete.

1.02 RELATED SECTIONS

- A. Section 03251, Concrete Accessories.
- B. Section 03300, Cast-in-Place Concrete.
- C. Section 03600, Grouting.

1.03 REFERENCES

- A. Standards referenced in this Section are:
 - 1. ASTM C109/C109M, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
 - 2. ASTM C882/C882M, Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
 - 3. ASTM D1042, Test Method for Linear Dimensional Changes of Plastics Under Accelerated Service Conditions.
 - 4. ASTM D3574, Test Methods for Flexible Cellular Materials – Slab, Bonded, and Molded Urethane Foams.
 - 5. ASTM G109, Test Method for Determining the Effects of Chemical Admixtures on the Corrosion of Embedded Steel Reinforcement in Concrete Exposed to Chloride Environments.

1.04 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Product Data: Information on products proposed for use, including manufacturer's brochures, technical data, specifications, and other applicable data.
- B. Informational Submittals: Submit the following:
 - 1. Certificates: Certificates documenting that repair materials that will be in contact with potable water or water that will be treated to become potable are listed in NSF/ANSI 61.
 - 2. Manufacturer's Instructions: Manufacturer's recommended procedures for installing materials proposed for use.
 - 3. Site Quality Control Submittals: Results of specified Site quality control testing.
 - 4. Special Procedure Submittals: When requested by Engineer, submit information on methods for supporting during demolition and repair Work existing structures, pipes, and other existing facilities affected by the Work.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery and Handling of Materials:
 - 1. Conform to Section 01610, Transportation and Handling of Materials and Equipment, and this Section.
 - 2. Clearly mark on containers manufacturer's name and label, name or title of material, manufacturer's stock number, and date of manufacture.
 - 3. Handle materials carefully to prevent inclusion of foreign matter.
 - 4. Do not open containers or mix components until necessary preparatory Work has been completed and application Work is to start immediately.
- B. Storage of Materials:

SECTION 03930 – CONCRETE REPAIR AND REHABILITATION

1. Conform to Section 01610 and this Section.
2. Store only approved materials at the Site.

PART 2 – PRODUCTS

2.01 SYSTEM REQUIREMENTS

- A. Repair and rehabilitation materials that can or will come into contact with potable water or that will be treated to become potable shall be listed in ANSI/NSF 61.

2.02 REPAIR MORTAR

- A. Product Description: Repair mortar shall be prepackaged, cement-based product specifically formulated for repairing concrete surface defects and suitable for use in moist and submerged conditions.
- B. Products and Manufacturers: Provide one of the following:
1. Five Star Structural Concrete, by Five Star Products, Inc. Use formulation recommended by manufacturer for the specific application conditions.
 2. SikaTop 122 Plus, SikaTop 123 Plus, SikaTop 111 Plus, or Sikacem 133, by Sika Corporation. Use formulation from among those listed in this paragraph recommended by manufacturer for specific application conditions.
 3. Emaco S88-CI or S66-CI, by Master Builders Inc. Use formulation from among those listed in this paragraph recommended by manufacturer for specific application conditions.
 4. DuralTop Gel, DuralTop Flowable Mortar, Verticoat, Verticoat Supreme, or Euco SR-VO, by Euclid Chemical Company. Use formulation from among those listed in this paragraph recommended by manufacturer for specific application conditions.
 5. Or equal.
- C. Materials:
1. Provide a two-component, polymer-modified, Portland cement, fast-setting, trowel-grade mortar. Repair mortar shall be enhanced with penetrating corrosion inhibitor, and shall have the following properties:

PHYSICAL PROPERTY	VALUE	ASTM STANDARD
MINIMUM COMPRESSIVE STRENGTH AT ONE DAY	2,000 PSI	C109
MINIMUM COMPRESSIVE STRENGTH AT 28 DAYS	6,000 PSI	C109
MINIMUM BOND STRENGTH AT 28 DAYS	1,800 PSI	C882*

- A. * Modified for use with repair mortars.
- B. Where the least dimension of the placement in width or thickness exceeds four inches, extend repair mortar by adding aggregate as recommended by repair mortar manufacturer.

2.03 EXPANSION JOINT REPAIR SYSTEM

- A. System Description: Joint repair system shall consist of two components: an epoxy resin adhesive and hypalon sheeting.
- B. Products and Manufacturers: Provide one of the following:
1. Sikadur Combiflex, by Sika Corporation.
 2. Or equal.
- C. Materials:
1. Epoxy Resin Adhesive: Provide two-component epoxy resin as follows:
 - a. Component "A" shall be modified epoxy resin of epichlorohydrin bisphenol-A type containing suitable viscosity control agents and pigments. Resin shall not contain butyl glycidyl ether.

SECTION 03930 – CONCRETE REPAIR AND REHABILITATION

- b. Component “B” shall be primarily a reaction product of selected amine blend with epoxy resin of epichlorohydrin bisphenol-A type containing suitable viscosity control agents, pigments, and accelerators.
- 2. Hypalon Sheeting:
 - a. Provide sheeting of hypalon rubber, perforated along bonding edge to provide mechanical key. Sheeting shall have ability to be vulcanized with hydrocarbon solvent for adhesion to an epoxy resin adhesive.
 - b. Provide sheeting in 12-inch width with thickness of 40 mils.
 - c. Sheeting shall be able to be lapped or seamed by heat or by anaromatic hydrosolvent strip.
 - d. Provide sheeting with removable center expansion strip.

2.04 CORROSION INHIBITOR

- A. Product Description: Corrosion inhibitor shall penetrate the hardened concrete surface and form a protective layer on reinforcing steel.
- B. Products and Manufacturers: Provide one of the following:
 - 1. Sika FerroGard 903, by Sika Corporation.
 - 2. Or equal.
- C. Materials:
 - 1. Corrosion inhibitor shall:
 - a. Not change the substrate’s color, appearance, or texture.
 - b. Penetrate independently of orientation (horizontal, vertical, overhead) at rate up to 1/10 to 4/5 inches per day, depending on density of concrete, measured using secondary neutron mass spectroscopy.
 - c. Form on reinforcing steel a protective layer of high integrity of at least 100 angstroms thickness, measured using x-ray photon spectroscopy and secondary ion mass spectroscopy.
 - d. Demonstrate reduction in corrosion currents after treatment as determined using cracked beam corrosion tests of concrete, as adapted from ASTM G109.
 - e. Be capable of reducing active corrosion rates by at least 65 percent. Reduction shall be demonstrated by project references and an independent corrosion engineer using linear polarization resistance.
 - f. Penetrate up to three inches in 28 days, measured using secondary neutron mass spectroscopy.

2.05 PROTECTIVE SLURRY MORTAR

- A. Product Description: Material shall be two-component, polymer-modified, cementitious waterproofing and protective slurry mortar. Provide two coats at coverage of 50 square feet per gallon per coat.
- B. Products and Manufacturers: Provide one of the following:
 - 1. Sikatop Seal 107, by Sika Corporation.
 - 2. Or equal.

2.06 CRACK INJECTION MATERIALS

- A. Structural Crack Repair System:
 - 1. Epoxy for injection shall be low-viscosity, high-modulus moisture insensitive type.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Sikadur 35, Hi-Mod L.V. and Sikadur 31, Hi-Mod Gel, by Sika Corporation.
 - b. Eucopoxy Injection Resin, by Euclid Chemical Company.
 - c. Or equal.
- B. Non-structural Crack Repair System:
 - 1. Hydrophilic Polyurethane Chemical Resin:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Prime Flex 900 XLV, manufactured by Prime Resins, Inc.

- 2) 2) Or equal.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Examine areas and conditions under which the repair Work is to be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Preparation:
1. Initial Surface Preparation: Remove by chipping, abrasive blasting, or hydro blasting laitance, foreign material, and unsound concrete from entire area to be repaired. Further roughen surface as specified in this Section. Where non-shrink grout or repair mortar is used, perform additional surface preparation, if any, recommended by product manufacturer.
 2. Wetting Procedure: Where repair concrete, shotcrete, or cement grout is used, and bonding agent is not required, or where repair mortar or non-shrink grout manufacturer recommends wet or saturated surface, perform the following:
 - a. Continuously apply water for at least four hours to surface being repaired. Where large surface areas are to be repaired, use fog-spray nozzles, mounted on stands, in sufficient number so that entire surface to be repaired is contacted by fog spray cloud.
 - b. Prevent concrete from drying until after repair is completed. Re-wet surfaces not yet repaired using water sprays at least a daily; should more than four days elapse without re-wetting surfaces not yet repaired, repeat the original saturating procedure.
 - c. Remove standing water in areas to be repaired before placing repair material. Provide means to remove excess water from structure.
 3. Preparation for Epoxy Bonding Agent: Where repair material manufacturer recommends use of epoxy-bonding agent, conform to recommendations of both repair material manufacturer and bonding agent manufacturer.

3.03 INSTALLATION, GENERAL

- A. Construction Tolerances: Shall be as specified in Section 03300, Cast-in-Place Concrete, except as specified in this Section and elsewhere in the Contract Documents.
- B. Take care to fully consolidate repair material, completely filling portions of space to be filled.
- C. Bring surface being repaired into alignment with adjacent surfaces, providing uniform, even surface. Surface repaired shall match adjacent existing surfaces in texture and shall receive coatings or surface treatments, if any, provided for the existing surface adjacent to repaired surface.
- D. Curing:
1. Cure repair mortar and non-shrink grout in accordance with manufacturer's recommendations, except that minimum cure period shall be three days.
 2. Curing of other materials shall be in accordance with requirements of Section 03300, Cast-in-Place Concrete.

3.04 REPAIR OF SURFACE DEFECTS

- A. Surface defects are depressions in a concrete surface that do not extend the way through the concrete. Surface defects can result from removal of an embedded item, removal of an intersecting concrete member, physical damage, or unrepaired rock pockets created during original placement. For spalls that result from corroded reinforcing steel or other embedment refer to Article 3.7 of this Section.
- B. Preparation: Perform the following in addition to requirements of Article 3.2 of this Section:
1. Remove by chipping loose, damaged concrete to sound material.

SECTION 03930 – CONCRETE REPAIR AND REHABILITATION

2. Where existing reinforcing is exposed, remove concrete to minimum of one-inch around exposed bars. If existing bars are cut through, cracked, or cross sectional area is reduced by more than 25 percent from original, immediately notify Engineer.
 3. Score-cut perimeter of area to be repaired to minimum depth of 1/2-inch and maximum depth that will not cut existing reinforcing steel. Chip out existing concrete to the score line so that minimum thickness of repair mortar will be 1/2-inch.
- C. Repair Material:
1. Completely fill the surface defect with specified repair material, in accordance with material manufacturer's instructions and the Contract Documents.
 2. Perform, with repair mortar, repairs of surface defects in concrete normally in contact with water or soil, and interior surfaces of structures that contain water.
 3. Repair of other surface defects may be by applying repair mortar, repair concrete, shotcrete, or cement grout, as appropriate.

3.05 PATCHING OF HOLES IN CONCRETE

- A. For holes larger than 12-inch diameter or equivalent area of hole, refer to the Drawings for reinforcing details.
- B. Fill openings less than four inches in their least dimension with Class III non-shrink epoxy grout in accordance with Section 03600, Grouting.
- C. Openings greater than four inches and less than 16 inches in their least dimension shall be coated with an epoxy bonding agent prior to filling with Class I non-shrink grout in accordance with Section 03600, Grouting.
- D. Openings greater than 16 inches in their least dimension shall be coated with an epoxy bonding agent prior to filling with Class A concrete in accordance with Section 03300, Cast-in-Place Concrete.
- E. Where repaired holes are in contact with water or soil, provide hydrophilic rubber waterstop within the opening in accordance with Section 03251, Concrete Accessories, prior to filling with repair material.

3.06 REPAIR OF LINED HOLES

- A. This Article applies to openings with embedded material over or a portion of inside surface of hole. Where indicated on the Drawings, remove embedded materials and repair the hole in accordance with Article 3.5 of this Section, as modified in this Article 3.6.
- B. Where embedded material is allowed to remain, remove embedded material to at least two inches into the hole, as measured from the plane surface of concrete wall or slab, as applicable. Embedded material left in place shall be roughened or abraded for proper bonding to repair material. Completely remove substances that interfere with proper bonding.
- C. Completely remove embedded items not securely and permanently anchored into concrete.
- D. Completely remove embedded items larger than 12 inches in their smallest dimension. In lieu of removing the embedded item, where reinforcing is required as shown or indicated in the Contract Documents, weld reinforcing to embedded item to remain, provided embedded item to remain is composed of metal to which reinforcing steel can be welded.

3.07 REPAIR OF DETERIORATED CONCRETE

- A. This Article pertains to deteriorated concrete which has been damaged due to corrosion of reinforcing steel, physical damage due to abrasion, or damage due to chemical attack. Use repair mortar, as specified in this Article, for repairing deteriorated concrete. Where repaired surface will be subsequently covered with plastic liner material, coordinate finishing with requirements for installing plastic liner material.
- B. Surface Preparation: In addition to requirements of Article 3.2 of this Section, perform the following surface preparation:
 1. Remove loose, broken, softened, and acid-contaminated concrete by abrasive blasting and chipping to sound, uncontaminated concrete.

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2. Upon completion of removal of deteriorated concrete, notify Engineer in writing. Allow two weeks for Engineer to evaluate the surface, perform testing for acid contamination if required, determine if additional concrete shall be removed, and to develop special repair details (if any) required. Should Engineer determine that additional concrete be removed to reach sound, uncontaminated concrete, allow another two-week period for further evaluation and testing following the additional removal.
 3. Surface preparation shall conform to recommendations of repair mortar manufacturer.
 4. Repair and rehabilitate isolated areas of exposed reinforcing bars in accordance with Article 3.4 and Article of 3.9 of this Section. If extensive areas of reinforcing steel are uncovered after removal of deteriorated concrete, Engineer will determine the repair methods required.
- C. Repair Mortar Placing:
1. Conform to manufacturer's recommended procedures for mixing and placing repair mortar.
 2. After initial mixing of repair mortar, addition of water is not allowed.
 3. Minimum Thickness:
 - a. Install repair mortar to not less than minimum thickness recommended by manufacturer, and not less than 1/2-inch.
 - b. Where removal of deteriorated concrete results in repair thickness of less than minimum required thickness to return to original concrete surface in isolated areas totaling less than ten percent of total repair surface area, remove additional concrete to obtain at least the required minimum thickness.
 - c. Where surface area with repair thickness less than minimum required thickness exceeds ten percent of total repair area, notify Engineer.
 - d. Provide repair mortar so that minimum cover over existing reinforcing steel is two inches. Do not place repair mortar creating locally raised areas.
 - e. Where transitioning to or from wall surfaces not requiring repair, do not feather-out repair mortar at transition. Instead, form the transition by saw cutting a score line to not less than minimum required repair mortar depth and chip out concrete to the saw cut line. Do not cut or otherwise damage reinforcing steel.
 4. Place repair mortar to an even, uniform plane to restore concrete member to its original surface. Out-of-plane tolerance shall be such that the gap between 12-inch long straight edge and repair mortar surface does not exceed 1/8-inch, and gap between a four-foot long straight edge and repair mortar surface shall not exceed 1/4-inch. Tolerances specified in this paragraph apply to straight edges placed in orientation at location.
- D. Finishing:
1. Provide smooth, steel trowel finish to repair mortar.
 2. When completed, there shall be no sharp edges. Provide exterior corners, such as at penetrations, one-inch radius. Interior corners shall be square, except corners to receive plastic lining which shall be made with two-inch fillet in repair mortar.

3.08 REPAIR OF EXPANSION JOINTS

- A. Surface Preparation: Remove the following from surfaces to be repaired: laitance, foreign material, and unsound concrete. Remove by chipping, abrasive blasting, or hydro blasting. Additional surface preparation, if required, shall be as recommended by expansion joint repair system manufacturer.
- B. Installation: Installation shall be as recommended by expansion joint repair system manufacturer.

3.09 REPAIR OF EXPOSED REINFORCING

- A. Remove, by abrasive blasting or hydro blasting, corrosion, foreign materials, and unsound concrete from area to be repaired.
- B. For mortar coating, conform to Paragraphs 3.7.B, 3.7.C, 3.7.D of this Section.

3.10 PROTECTIVE SLURRY MORTAR COATING

- A. Remove, by abrasive blasting or hydro blasting, corrosion, foreign materials, and unsound concrete from area to be repaired.
- B. Surface shall be visually dry before applying corrosion inhibitor. Liberally apply corrosion inhibitor to achieve coverage of 100 square feet per gallon in two or more coats, by allowing corrosion inhibitor to soak into substrate. Time between coats shall be the longer of: one hour, or as recommended by corrosion inhibitor manufacturer. Apply using rollers, brushes, or hand-pressure spray equipment.
- C. After applying final coat of corrosion inhibitor, minimum cure time of 24 hours is required.
- D. Provide high-pressure wash to surfaces to be repaired to remove filmy residue from corrosion inhibitor.
- E. Apply protective slurry mortar per manufacturer recommendations.

3.11 CRACK INJECTION

- A. Examine areas under which injection Work will be installed and locate cracks that require injection. Identify and inject cracks greater than 0.010-inch wide in structures that retain or contain water, wastewater, or similar liquid.
- B. Install injection material in accordance with crack injection manufacturer's requirements.
- C. After injecting and curing, verify that injected material penetrated the crack adequately and that there is no visible leakage through the crack. After injecting, if crack continues to leak, re-inject crack at no additional cost to Owner until structure is watertight.
- D. If proper penetration of crack cannot be achieved, submit to Engineer a proposed alternate approach for modifying the specified injection procedure to properly seal the crack. In new concrete and in concrete cracked as a result of Contractor's operations, perform modifications to crack injection procedure and fully repair the crack without additional cost to Owner or extension of the Contract Times.

3.12 SITE QUALITY CONTROL

- A. Owner will employ and pay for services of testing laboratory for Site quality control testing. Engineer will direct the number of tests and specimens required. Contractor shall make standard compression test specimens as specified in this Section under the observation of Engineer. Contractor shall provide:
 - 1. Necessary assistance required by Engineer.
 - 2. All labor, material, and equipment required, including rods, molds, thermometer, curing in heated storage box, and other incidentals required, subject to approval by Engineer.
 - 3. All necessary storage, curing, and transportation required for testing.
 - 4. Contractor will be charged for cost of additional testing and investigation, if any, for Work performed that is not in accordance with the Contract Documents or is otherwise defective.
- B. Site Tests of Cement-based Grouts and Repair Mortar:
 - 1. Obtain compression test specimens during construction from first placement of each type of mortar or grout, and at intervals thereafter as selected by Engineer, to verify compliance with the Contract Documents.
 - 2. Compression tests and fabrication of specimens for repair mortar and non-shrink grout will be performed in accordance with ASTM C109. Set of three specimens will be made for each test. Tests will be made at seven days, 28 days, and additional time periods as deemed appropriate by Engineer.
 - 3. Material, already placed, failing to conform to the Contract Documents, is defective.
- C. Repair Concrete: Repair concrete shall be tested as required in Section 03300, Cast-in-Place Concrete.

END OF SECTION

SECTION 03930 – CONCRETE REPAIR AND REHABILITATION

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SECTION 05050 – METAL FASTENING

PART 1 -- GENERAL

1.01 DESCRIPTION

- A. Furnish all materials, labor, and equipment required to provide all metal welds and fasteners not otherwise specified, in accordance with the Contract Documents.

1.02 RELATED SECTIONS

- A. Section 05051 – Anchor Systems
- B. Section 16131 – Electric Conduit System

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. Building Code of New York State
 - 2. AC 193 Acceptance Criteria for Mechanical Anchors in Concrete Elements
 - 3. AC 308 Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements
 - 4. ACI 318 Building Code Requirements for Structural Concrete
 - 5. ACI 355.2 Qualifications of Post-Installed Mechanical Anchors in Concrete
 - 6. ACI 355.4 Qualifications of Post-Installed Adhesive Anchors in Concrete
 - 7. AISC 348 The 2009 RCSC Specification for Structural Joints
 - 8. AISC Code of Standard Practice
 - 9. AWS D1.1 Structural Welding Code - Steel
 - 10. AWS D1.2 Structural Welding Code - Aluminum
 - 11. AWS D1.6 Structural Welding Code – Stainless Steel
 - 12. Aluminum Association Specifications for Aluminum Structures
 - 13. ASTM A572/A572M-94C Standard Specification for High Strength Low-Alloy Columbium-Vanadium Structural Steel Grade 50
 - 14. ASTM A36 Standard Specification for Carbon Structural Steel
 - 15. ASTM A325 Standard Specification for High-Strength Bolts for Structural Steel Joints
 - 16. ASTM A489 Standard Specification for Eyebolts
 - 17. ASTM A490 Standard Specification for Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints
 - 18. ASTM A563 Standard Specifications for Carbon and Alloy Steel Nuts
 - 19. ASTM D1785 Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe
 - 20. ASTM E488 Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
 - 21. ASTM F436 Standard Specification for Hardened Steel Washers
 - 22. ASTM F467 Standard Specification for Nonferrous Nuts for General Use
 - 23. ASTM F593 Standard Specification for Stainless Steel Bolts; Hex Cap Screws, and Studs
 - 24. ASTM F594 Standard Specification for Stainless Steel Nuts
 - 25. ASTM F1554 Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300, Submittals.
 - 1. Shop Drawings providing the fastener's manufacturer and type and certification of the fastener's material and capacity.
 - 2. Manufacturer's installation instructions.
 - 3. Copy of valid certification for each person who is to perform field welding.
 - 4. Certified weld inspection reports, when required.
 - 5. Welding procedures.
 - 6. Installer qualifications.

SECTION 05050 – METAL FASTENING

7. Certification of Installer Training.
8. Inspection Reports.
9. Results of Anchor Proof Testing.

1.05 QUALITY ASSURANCE

- A. Fasteners not manufactured in the United States shall be tested and certification provided with respect to specified quality and strength standards. Certifications of origin shall be submitted for all U.S. fasteners supplied on the project.
 1. Installer Qualifications: Drilled-in anchors shall be installed by an installer with at least three years of experience performing similar installations. Installer shall be certified as an Adhesive Anchor Installer in accordance with ACI-CRSI Adhesive Anchor Installation Certification Program.
- B. Installer Training: Conduct a thorough training with the manufacturer or the manufacturer's representative for the Installer on the project. Training shall consist of a review of the complete installation process for drilled-in anchors, to include but not be limited to the following:
 1. Hole drilling procedure.
 2. Hole preparation and cleaning technique.
 3. Adhesive injection technique and dispenser training/maintenance.
 4. Rebar doweling preparation and installation.
 5. Proof loading/torquing.
- C. All steel welding shall be performed by welders certified in accordance with AWS D1.1. All aluminum welding shall be performed by welders certified in accordance with AWS D1.2. All stainless steel welding shall be performed by welders certified in accordance with AWS D1.6. Certifications of field welders shall be submitted prior to performing any field welds.
- D. Welds and high strength bolts used in connections of structural steel will be visually inspected in accordance with Article 3.4.
- E. The Owner may engage an independent testing agency to perform testing of welded connections and to prepare test reports in accordance with AWS. Inadequate welds shall be corrected or redone and retested to the satisfaction of the Engineer and/or an acceptable independent testing laboratory, at no additional cost to the Owner.
- F. Provide a welding procedure for each type and thickness of weld. For welds that are not prequalified, include a Performance Qualification Report. The welding procedure shall be given to each welder performing the weld. The welding procedure shall follow the format in Annex E of AWS D1.1 with relevant information presented.

PART 2 -- PRODUCTS

2.01 ANCHOR RODS (ANCHOR BOLTS)

- A. Anchor rods shall conform to ASTM F1554 Grade 36 except where stainless steel or other approved anchor rods are shown on the Drawings. Anchor rods shall have hexagonal heads and shall be supplied with hexagonal nuts meeting the requirements of ASTM A563 Grade A.
- B. Where anchor rods are used to anchor galvanized steel or are otherwise specified to be galvanized, anchor rods and nuts shall be hot-dipped galvanized in accordance with ASTM F1554.
- C. Where pipe sleeves around anchor rods are shown on the Drawings, pipe sleeves shall be cut from Schedule 40 PVC plastic piping meeting the requirements of ASTM D1785.

2.02 HIGH STRENGTH BOLTS

- A. High strength bolts and associated nuts and washers shall be in accordance with ASTM A325 or ASTM A490. Bolts, nuts and washers shall meet the requirements of AISC 348 "The 2009 RCSC Specification for Structural Joints".
- B. Where high strength bolts are used to connect galvanized steel or are otherwise specified to be galvanized, bolts, nuts, and washers shall be hot-dipped galvanized in accordance with ASTM A325.

2.03 STAINLESS STEEL BOLTS

- A. Stainless steel bolts shall conform to ASTM F593. All underwater fasteners, fasteners in confined areas containing fluid, and fasteners in corrosive environments shall be Type 316 stainless steel unless noted otherwise. Fasteners for aluminum and stainless steel members not subject to the above conditions shall be Type 304 stainless steel unless otherwise noted.
- B. Stainless steel bolts shall have hexagonal heads with a raised letter or symbol on the bolts indicating the manufacturer, and shall be supplied with hexagonal nuts meeting the requirements of ASTM F594. Nuts shall be of the same alloy as the bolts.

2.04 WELDS

- A. Electrodes for welding structural steel and all ferrous steel shall comply with AWS Code, using E70 series electrodes for shielded metal arc welding (SMAW), or F7 series electrodes for submerged arc welding (SAW).
- B. Electrodes for welding aluminum shall comply with the Aluminum Association Specifications and AWS D1.2.
- C. Electrodes for welding stainless steel and other metals shall comply with AWS D1.6.

2.05 WELDED STUD CONNECTORS

- A. Welded stud connectors shall conform to the requirements of AWS D1.1 Type C.

2.06 EYEBOLTS

- A. Eyebolts shall conform to ASTM A489 unless noted otherwise.

2.07 HASTELLOY FASTENERS

- A. Hastelloy fasteners and nuts shall be constructed of Hastelloy C-276.

2.08 ANTISEIZE LUBRICANT

- A. Antiseize lubricant shall be C5-A Anti-Seize by Loctite Corporation, Molykote P-37 Anti-Seize Paste by Dow Corning, 3M Anti-Seize by 3M, or equal.

PART 3 -- EXECUTION

3.01 MEASUREMENTS

- A. Verify all dimensions and review the Drawings. Report discrepancies to the Engineer for clarification prior to starting fabrication.

3.02 ANCHOR INSTALLATION

- A. Anchor Rods
 - 1. Install anchor rods in accordance with AISC "Code of Standard Practice" by setting in concrete while it is being placed and positioned by means of a rigidly held template. Overhead adhesive anchors, and base plates or elements they are anchoring, shall be shored as required and securely held in place during anchor setting to prevent movement during anchor installation. Movement of anchors during curing is prohibited.
 - 2. Concrete anchors shall not be used in place of anchor rods without Engineer's approval.
 - 3. All stainless steel threads shall be coated with antiseize lubricant.
- B. High Strength Bolts
 - 1. All bolted connections for structural steel shall use high strength bolts. High strength bolts shall be installed in accordance with AISC 348 "The 2009 RCSC Specification for Structural Joints". All bolted joints shall be Type N, snug-tight, bearing connections in accordance with AISC Specifications unless noted otherwise on the Drawings.
- C. Other Bolts
 - 1. All dissimilar metal shall be connected with appropriate fasteners and shall be insulated with a dielectric or approved equal.
 - 2. All stainless steel bolts shall be coated with antiseize lubricant.

SECTION 05050 – METAL FASTENING

3.03 WELDING

- A. All welding shall comply with AWS Code for procedures, appearance, quality of welds, qualifications of welders and methods used in correcting welded work.
- B. Welded stud connectors shall be installed in accordance with AWS D1.1.

3.04 INSPECTION

- A. High strength bolting will be visually inspected in accordance with AISC 348 "The 2009 RCSC Specification for Structural Joints". Rejected bolts shall be either replaced or retightened as required.
- B. Field welds will be visually inspected in accordance with AWS Codes. Inadequate welds shall be corrected or redone as required in accordance with AWS Codes.
 - 1. Post-installed concrete anchors shall be inspected as required by ACI 318.

3.05 CUTTING OF EMBEDDED REBAR

- A. Do not cut embedded rebar cast into structural concrete during installation of post-installed fasteners without prior approval of the Engineer.

END OF SECTION

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Scope:
 - 1. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install anchor systems.
 - 2. This Section includes all anchor systems required for the Work, but not specified under other Sections.
- B. Coordination: Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before anchor systems Work.

1.02 REFERENCES

- A. Standards referenced in this Section include:
 - 1. ACI 318 - Building Code Requirements for Structural Concrete.
 - 2. ACI 350 - Code Requirements for Environmental Engineering Concrete Structures.
 - 3. ACI 355.2 - Qualification of Post-Installed Mechanical Anchors in Concrete.
 - 4. ANSI B212.15 - Cutting Tools - Carbide-tipped Masonry Drills And Blanks For Carbide-tipped Masonry Drills.
 - 5. ANSI/MSS SP-58 - Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application, and Installation.
 - 6. ASTM A194/A194M - Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
 - 7. ASTM A276 - Specification for Stainless Steel Bars and Shapes.
 - 8. ASTM A493 - Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging.
 - 9. ASTM A563 - Specification for Carbon and Alloy Steel Nuts.
 - 10. ASTM A1011/A1011M - Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
 - 11. ASTM B633 - Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
 - 12. ASTM C307 - Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing.
 - 13. ASTM C579 - Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
 - 14. ASTM C881/C881M - Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
 - 15. ASTM D695 - Test Method for Compressive Properties of Rigid Plastics.
 - 16. ASTM D790 - Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
 - 17. ASTM E329 - Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
 - 18. ASTM E488 - Test Methods for Strength of Anchors in Concrete and Masonry Elements.
 - 19. ASTM F593 - Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - 20. ASTM F594 - Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - 21. ASTM F1554 - Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength.
 - 22. FS A-A-1922A - Shield, Expansion (Caulking Anchors, Single Lead).
 - 23. FS A-A-1923A - Concrete Expansion Anchors.
 - 24. FS A-A-1925A - Shield, Expansion (Nail Anchors).
 - 25. FS A-A-55614 - Shield, Expansion (non-drilling expansion anchors).
 - 26. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements.
 - 27. ICC-ES AC58 - Acceptance Criteria for Adhesive Anchors in Masonry Elements.
 - 28. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements.
 - 29. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.

SECTION 05051 – ANCHOR SYSTEMS

30. ISO 3506-1 - Mechanical Properties of Corrosion-Resistant Stainless Steel Fasteners -- Part 1: Bolts, Screws and Studs.
31. NSF/ANSI 61 - Drinking Water System Components – Health Effects.

1.03 QUALITY ASSURANCE

- A. Qualifications:
 1. Testing Laboratory: Shall comply with ASTM E329 and shall be experienced in tension testing of post-installed anchoring systems.
 2. Post-installed Anchor Installer: Shall be experienced and trained by post-installed anchor system manufacturer in proper installation of manufacturer's products. Product installation training by distributors or manufacturer's representatives is unacceptable unless the person furnishing the training is qualified as a trainer by the anchor manufacturer.

1.04 SUBMITTALS

- A. Action Submittals: Submit the following:
 1. Shop Drawings: Listing of all anchor systems products intended for use in the Work including product type, intended location in the Project, and embedded lengths.
 2. Product Data:
 - a. Manufacturer's specifications, load tables, dimension diagrams, acceptable base material conditions, acceptable drilling methods, and acceptable bored hole conditions.
 - b. When required by Engineer, copies of valid ICC ES reports that presents load-carrying capacities and installation requirements for anchor systems.
 3. Samples: Representative Samples of anchor systems proposed for use in the Work. Review will be for type and finish only. Compliance with all other requirements is Contractor's exclusive responsibility.
- B. Informational Submittals: Submit the following:
 1. Certificates:
 - a. For each type of anchor bolt or threaded rod, submit copies of laboratory test reports and other data required to demonstrate compliance with the Contract Documents. Reports shall demonstrate compliance with ductile steel element definition of ACI 350, Appendix D, Section D.1.
 - b. Post-installed anchor system manufacturer's certification that installer received training in the proper installation of manufacturer's products required for the Work.
 2. Manufacturer's Instructions: Installation instructions for each anchor system product proposed for use, including bore hole cleaning procedures and adhesive injection, cure and gel time-tables, and temperature ranges (storage, installation and in-service).
 3. Field Quality Control Submittals: Submit results of field quality control testing and inspections performed by testing laboratory.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Storage and Protection:
 1. Keep materials dry during delivery and storage.
 2. Store adhesive materials within manufacturer's recommended storage temperature range.
 3. Protect anchor systems from damage at the Site. Protect products from corrosion and deterioration.

PART 2 – PRODUCTS

2.01 SYSTEM PERFORMANCE

- A. General:
 1. At locations where conditions dictate that Work specified in other Sections is to be of corrosion resistant materials, provide associated anchor systems of stainless steel materials, unless other corrosion-resistant anchor system material is specified. Provide anchor systems of stainless steel materials where stainless steel materials are required in the Contract Documents.
 2. Stainless Steel Nuts:

SECTION 05051 – ANCHOR SYSTEMS

- a. For anchor bolts and adhesive anchors, provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts for stainless steel anchors used for anchoring equipment, gates, and weirs, and other locations, if any, where the attachment will require future removal for operation or maintenance. Provide lock washer or double nuts on each anchorage device provided for equipment, as required by equipment manufacturer.
 - b. For other locations, provide for each anchorage device a nut as specified or as required by anchor manufacturer. When ASTM A194/A194M, Grade 8S (Nitronic 60) nuts are not required for anchor bolts and adhesive anchors as specified in this Section, provide anti-seizing compound where stainless steel rods are used with stainless steel nuts of the same type.
 3. Materials that can contact potable water or water that will be treated to become potable shall be listed in NSF/ANSI 61.
- B. Design Criteria
1. Size, Length, and Load-carrying Capacity: Comply with the Contract Documents. When size, length or load-carrying capacity of anchor system is not otherwise shown or indicated, provide the following:
 - a. Anchor Bolts: Provide size, length, and capacity required to carry design load based on values and requirements of Paragraph 3.2.A of this Section. For conditions outside limits of critical edge distance and spacing in Paragraph 3.2.A of this Section, minimum anchor bolt embedment as shown or indicated in Paragraph 3.2.A of this Section apply and capacity shall be based on requirements of Laws and Regulations, including applicable building codes.
 - b. Adhesive Anchors, Expansion Anchors, or Concrete Inserts: Provide size, length, type, and capacity required to carry design load. Anchor capacity shall be based on the procedures required by the building code in effect at the Site. Where Evaluation Service Reports issued by the ICC Evaluation Service are required in this Section, anchor capacities shall be based on design procedure required in the applicable ICC Evaluation Service Report.
 - 1) General: Determine capacity considering reductions due to installation and inspection procedures, embedment length, strength of base fastening materials, spacing, and edge distance, as indicated in the manufacturer's design guidelines. For capacity determination, concrete shall be assumed to be in the cracked condition, unless calculations demonstrate that the anchor system will be installed in an area that is not expected to crack under any and all conditions of design loading.
 - 2) Concrete Adhesive Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by Engineer, provide minimum embedment depth of the greater of the following: required to develop tensile strength of anchor, or a minimum embedment of 10 anchor diameters; and minimum anchor spacing and edge distance of 12 anchor diameters.
 - 3) Concrete Masonry Adhesive Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by Engineer, provide minimum anchor spacing and edge distance as indicated in anchor manufacturer's instructions.
 - 4) Concrete Expansion Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by Engineer, provide minimum embedment depth of six anchor diameters, and minimum anchor spacing and edge distance of seven anchor diameters.
 - 5) Concrete Masonry Expansion Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by Engineer, provide minimum anchor spacing and edge distance as indicated in anchor manufacturer's instructions.
 - 6) Concrete Undercut Anchors: Unless otherwise shown or indicated in the Contract Documents, or approved by Engineer, provide minimum anchor spacing and edge distance as tabulated in anchor manufacturer's instructions.

SECTION 05051 – ANCHOR SYSTEMS

2. Design Loads. Comply with the Contract Documents. When design load of supported material, equipment, or system is not otherwise shown or indicated, provide the following:
 - a. Equipment Anchors: Use design load recommended by equipment manufacturer. When equipment can be filled with fluid, use loads that incorporate equipment load and load imposed by fluid.
 - b. Pipe Hangers and Supports: Use full weight of pipe, and fluid contained in pipe that are tributary to the support plus the full weight of valves and accessories located between the hanger or support being anchored and the next hanger or support.
 - c. Hangers and Supports for Electrical Systems, and HVAC, Plumbing, and Fire Suppression Systems and Piping: Use the full weight of supported system that is tributary to the support plus the full weight of accessories located between the hanger or support being anchored and the next hanger or support. When piping or equipment is to be filled with fluid, anchor systems shall be sized to support such loads in addition to the weight of the equipment, piping, or system, as applicable.
 - d. Delegated Design: When anchor systems are used for supporting materials, equipment, or systems delegated to a design professional retained by Contractor, provide anchor system suitable for loads indicated in delegated design documents and consistent with the design intent expressed in the Contract Documents.
- C. Application:
 1. Anchor Bolts:
 - a. Where anchor bolt is shown or indicated, use cast-in-place anchor bolt unless another anchor type is approved by Engineer.
 - b. Provide anchor bolts as shown or indicated, or as required to secure structural element to appropriate anchor surface.
 2. Concrete Adhesive Anchors:
 - a. Use where adhesive anchors are shown or indicated for installation in concrete.
 - b. Suitable for use where subject to vibration.
 - c. Suitable for use in exterior locations or locations subject to freezing.
 - d. Suitable for use in submerged, intermittently submerged, or buried locations.
 - e. Do not use in overhead applications, unless otherwise shown or approved by Engineer.
 - f. Do not use for pipe hangers, unless otherwise shown or approved by Engineer.
 3. Grout-filled Concrete Masonry Adhesive Anchors:
 - a. Use where adhesive anchors are shown or indicated for installation in grout-filled concrete masonry units.
 - b. Suitable for use where subject to vibration.
 - c. Suitable for use in exterior locations or locations subject to freezing.
 - d. Do not use for pipe hangers, unless otherwise shown or approved by Engineer.
 4. Hollow Concrete Masonry Adhesive Anchors:
 - a. Use where adhesive anchors are shown or indicated for installation in hollow concrete unit masonry.
 - b. Suitable for use where subject to vibration.
 - c. Suitable for use in exterior locations or locations subject to freezing.
 - d. Do not use for pipe hangers, unless otherwise shown or approved by Engineer.
 5. Concrete Wedge Expansion Anchors:
 - a. Use where expansion anchors are shown or indicated for installation in concrete.
 - b. Do not use where subject to vibration.
 - c. Do not use in exterior locations or locations subject to freezing.
 - d. Do not use in submerged, intermittently submerged, or buried locations.
 - e. Suitable for use in overhead applications.
 6. Grout-filled Concrete Masonry Wedge Expansion Anchors:
 - a. Use where expansion anchors are shown or indicated for installation on the interior face of grout-filled unit masonry.
 - b. Do not use where subject to vibration.

SECTION 05051 – ANCHOR SYSTEMS

- c. Do not use in exterior locations or locations subject to freezing.
- 7. Hollow Concrete Masonry Sleeve Expansion Anchors:
 - a. Use where expansion anchors are shown or indicated for installation in hollow concrete unit masonry or solid brick.
 - b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.
 - c. Do not use where subject to vibration.
 - d. Do not use in exterior locations or locations subject to freezing.
- 8. Drop-in Expansion Anchors:
 - a. Use drop-in expansion anchors installed in concrete where light-duty anchors are required to support piping or conduit two-inch diameter or smaller.
 - b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.
 - c. Do not use where subject to vibration.
 - d. Do not use at submerged, intermittently submerged, or buried locations.
 - e. Do not use in exterior locations or locations subject to freezing.
 - f. Suitable for use in overhead applications.
- 9. Concrete Undercut Anchors:
 - a. Use where undercut anchors are shown or indicated for installation in concrete.
 - b. Suitable for use where subject to vibration.
 - c. Do not use in submerged, intermittently submerged, or buried locations.
 - d. Do not use in exterior locations or locations subject to freezing.
 - e. Suitable for use in overhead applications.
- 10. Concrete Inserts:
 - a. Use only where shown or indicated in the Contract Documents.
 - b. Allowed for use to support pipe hangers and pipe supports for pipe size and loading recommended by the concrete insert manufacturer.
- 11. Drive-In Expansion Anchors:
 - a. Use drive-in expansion anchors installed in concrete, precast concrete, grouted masonry units, or brick, where light-duty anchors are required to support piping or conduit one-inch diameter and smaller.
 - b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.
 - c. Do not use in overhead applications.
- 12. For Use in Precast Concrete Planks:
- 13. To support piping or conduit six-inch diameter and smaller, use low-profile drop-in anchors, hollow concrete masonry adhesive anchors, or through-bolts.
- 14. For piping greater than six-inch diameter, or to support safety-related systems, use through-bolts. Each through-bolt shall consist of threaded rod, nuts, washers, and bearing plate.

2.02 MATERIALS

- A. Anchor Bolts:
 - 1. Interior Dry Non-corrosive Locations: Provide straight threaded carbon steel rods complying with ASTM F1554, Grade 36, with heavy hex nuts complying with ASTM A563 Grade 36, unless otherwise shown or indicated on the Drawings. Hooked anchor bolts are unacceptable.
 - 2. Exterior, Buried, Submerged Locations, or When Exposed to Wastewater: Provide stainless steel straight threaded rods complying with ASTM F593, AISI Type 316, Condition A, with ASTM F594, AISI Type 316, stainless steel nuts. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required. Other AISI types may be used when approved by Engineer. Hooked bolts are unacceptable.
 - a. Stainless steel straight threaded rod shall comply with ductility requirements of ACI 350 or ACI 318 Appendix D, Section D.3.3.

SECTION 05051 – ANCHOR SYSTEMS

3. Equipment: Provide anchor bolts complying with material requirements of this Section and equipment manufacturer's requirements relative to size, embedment length, and anchor bolt projection. Anchor bolts shall be straight threaded rods with washers and nuts as specified in this Section. Hooked bolts are unacceptable.
 4. Anchoring of Structural Elements: Provide anchor bolts of size, material, and strength shown or indicated in the Contract Documents.
- B. Concrete Adhesive Anchors:
1. General: Adhesive anchors shall consist of threaded rods anchored into hardened concrete using an adhesive system.
 2. Products and Manufacturers: Provide one of the following:
 - a. HIT-RE 500-SD Injection Epoxy Adhesive Anchoring System, by Hilti Fastening Systems, Inc.
 - b. SET-XP Epoxy-Tie Adhesive, by Simpson Strong-Tie Company, Inc.
 - c. Or equal.
 3. Adhesive:
 - a. Adhesive system shall use two-component adhesive mix.
 - b. Epoxy adhesives shall comply with physical requirements of ASTM C881/C881M, Type IV, Grade 2 and 3, Class A, B, and C, except gel times.
 - c. Adhesives shall have a current evaluation report by ICC Evaluation Service for use in both cracked and uncracked concrete with seismic recognition for SDC A through F as tested and assessed in accordance with ICC-ES AC308.
 - d. Adhesives shall have minimum bond strength and minimum design bond strength (bond strength multiplied by strength reduction factor) in accordance with Table 05051-A:

TABLE 05051-A:
ADHESIVE BOND STRENGTH 1,2

Anchor Rod Diameter / Dowel Size	Uncracked Concrete		Cracked Concrete	
	Bond Strength (psi)	Design Bond Strength (psi)	Bond Strength (psi)	Design Bond Strength (psi)
3/8-inch / #3	2040	1300	1090	700
1/2-inch / #4	1920	1200	920	560
5/8-inch / #5	1830	1150	710	390
3/4-inch / #6	1760	1050	710	460
7/8inch / #7	1670	900	610	340
1-inch / #8	1650	1050	850	460
- / #9	1900	1000	800	400
1.25-inch/ #10	1580	1000	730	400

4. Table Notes:
5. Bond strengths listed for hammer-drilled, dry hole.
6. Bond strengths listed for maximum short term concrete temperature of 110 degrees F and maximum long term concrete temperature of 75 degrees F.
7. Anchor:
 - a. Provide continuously-threaded, AISI Type 316 stainless steel adhesive anchor rod. Threaded rods shall comply with the concrete adhesive anchor manufacturer's specifications as included in the ICC Service Evaluation Report for the anchor submitted. Nuts shall have specified proof load stresses equal to or greater than the minimum tensile strength of the stainless steel threaded rod used. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required.
 - b. Stainless steel threaded rod shall comply with ductility requirements of ACI 350 or ACI 318 Appendix D, Section D.3.3.

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C. Grout-filled Concrete Masonry Adhesive Anchors:

1. General:
 - a. Adhesive anchors shall consist of threaded rods anchored into grout-filled concrete block masonry using an adhesive system.
2. Products and Manufacturers: Provide one of the following:
 - a. HIT-HY 150 Max Adhesive Anchoring System, by Hilti Fastening Systems, Inc.
 - b. Acrylic-Tie Adhesive, by Simpson Strong-Tie Company, Inc.
 - c. Or equal.
3. Adhesive: Adhesive system shall use two-component adhesive mix.
4. Acrylate hybrid adhesives shall comply with the following:
 - a. ASTM C579 compressive strength greater than 7,252 psi, or ASTM D695 compressive yield strength greater than or equal to 10,210 psi.
 - b. ASTM C307 modulus of elasticity greater than 507,000 psi or ASTM D695 compressive modulus of elasticity greater than 660,800 psi.
 - c. Adhesives shall have current ICC Evaluation Service Report for use in grout-filled concrete masonry, tested and assessed in accordance with ICC-ES AC 58.
5. Anchor: Provide stainless steel adhesive anchor rod complying with ASTM F593, AISI Type 316, Condition CW, with ASTM F594, AISI Type 316 stainless steel nuts. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required.

D. Hollow Concrete Masonry Adhesive Anchors:

1. General: Adhesive anchors shall consist of threaded rods with a cylindrical mesh steel or plastic screen tube anchored into hollow concrete block masonry using an adhesive system.
2. Products and Manufacturers: Provide one of the following:
 - a. HIT-HY 20 for Masonry Anchoring System, by Hilti Fastening Systems, Inc.
 - b. Acrylic-Tie Anchoring Adhesive, by Simpson Strong-Tie Company, Inc.
 - c. Or equal.
3. Adhesive:
 - a. Adhesive system shall use two-component adhesive mix.
 - b. Hybrid adhesives shall comply with the following:
 - 1) ASTM D695 compressive strength, greater than 7,410 psi.
 - 2) ASTM D790 modulus of elasticity: 0.33 x 106 psi or ASTM D695 compressive modulus of elasticity greater than 0.668 x106 psi.
 - c. Adhesives shall have a current ICC Evaluation Service Report for use in hollow concrete masonry as tested and assessed in accordance with ICC-ES AC58.
4. Anchor: Provide stainless steel adhesive anchor rod complying with ASTM F593, AISI Type 316, Condition CW, with ASTM F594, AISI Type 316, stainless steel nuts. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required.
5. Mesh Screen Tube:
 - a. Provide with mesh size, length, and diameter as specified by adhesive anchor manufacturer.
 - b. Mesh: AISI 304 stainless steel.

E. Concrete Wedge Expansion Anchors:

1. General:
 - a. Concrete wedge expansion anchors shall consist of stud, wedge, nut, and washer.
2. Products and Manufacturers: Provide one of the following:
 - a. Kwik Bolt TZ Wedge Anchor, by Hilti Fastening Systems, Inc.
 - b. Or equal.
3. Anchors shall comply with physical requirements of FS A-A-1923A, Type 4. Provide concrete wedge expansion anchors suitable for use in cracked and uncracked concrete in accordance with ACI 318 and ACI 350, Appendix D. Demonstrate suitability of cracked concrete wedge anchors in accordance with ACI 355.2 prequalification tests.
4. Interior Dry Non-corrosive Locations: Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633.

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5. Other Locations: Provide expansion anchors complete with nuts and washers, AISI Type 304 stainless steel anchor body, in accordance with ASTM A276 or ASTM A493.
 6. Anchor shall comply with ductility requirements of ACI 350 or ACI 318 Appendix D, Section D.3.3.
 7. Concrete wedge expansion anchors shall have a current ICC Evaluation Service Report for use in both cracked and uncracked concrete with seismic recognition in seismic design Categories A through F when tested and assessed in accordance with ICC-ES AC193.
- F. Grout-filled Masonry Wedge Expansion Anchors:
1. General: Grout-filled masonry wedge expansion anchors shall each consist of stud, wedge, nut, and washer.
 2. Product and Manufacturers: Provide one of the following:
 - a. Kwik-Bolt 3 Expansion Anchors, by Hilti Fastening Systems, Inc.
 - b. Wedge-All Wedge Anchors, by Simpson Strong-Tie Company, Inc.
 - c. Or equal.
 3. Anchors shall comply with physical requirements of FS A-A-1923A, Type 4. Anchors shall be non-bottom bearing type with single-piece steel expansion clip providing 360-degree contact with base material and shall not require oversized holes for installation.
 4. Interior Dry Non-corrosive Locations: Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633.
 5. Other Locations: Provide AISI Type 316 stainless steel anchor, complete with nut and washer, in accordance with ASTM A276 or ASTM A493.
 6. Grout-filled masonry wedge expansion anchors shall have a current ICC Evaluation Service report for use in fully-grouted concrete masonry construction when tested and assessed in accordance with ICC-ES AC01.
- G. Hollow Concrete Masonry Sleeve Expansion Anchors:
1. General: Sleeve expansion anchors shall each consist of an externally threaded stud with full length expanding sleeve.
 2. Products and Manufacturers: Provide one of the following:
 - a. HLC Sleeve Anchors, by Hilti Fastening Systems, Inc.
 - b. Dynabolt Sleeve Anchors, by ITW Red Head.
 - c. Or equal.
 3. Anchors shall comply with physical requirements of FS A-A-1922A. Anchors shall be non-bottom bearing type with single-piece steel expansion sleeve providing 360-degree contact with base material and shall not require oversized holes for installation.
 4. Interior Dry Non-Corrosive Locations: Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633.
 5. Other Locations: Provide expansion anchors complete with nuts and washers, Type 304 stainless steel, in accordance with ASTM A276 or ASTM A493.
- H. Drop-in Expansion Anchors:
1. General: Drop-in expansion anchors shall each consist of an internally threaded, deformation-controlled expansion anchor with pre-assembled expander plug.
 2. Products and Manufacturers: Provide one of the following:
 - a. HDI Drop-In Anchors, by Hilti Fastening Systems, Inc.
 - b. Drop-In Anchor, by Simpson Strong-Tie Company, Inc.
 - c. Or equal.
 3. Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633, complying with physical requirements of FS A-A-55614, Type I. Anchors shall be flush or shell type. Provide low-profile anchors for use in precast concrete planks.
- I. Concrete Undercut Anchors:
1. General: Each concrete undercut anchor shall consist of threaded stud, thick-walled expansion sleeve, expander coupler, and nut and washer. Anchors shall be pre-set type or through-set type, as shown on the Drawings.

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2. Products and Manufacturers: Provide one of the following:
 - a. HDA Undercut Anchor, by Hilti Fastening Systems, Inc.
 - b. DUC Ductile Undercut Anchor, by USP Structural Connectors.
 - c. Or equal
 3. Provide concrete undercut expansion anchors in accordance with ACI 318 and ACI 350, Appendix D. Demonstrate suitability of cracked concrete undercut anchors in accordance with ACI 355.2 prequalification tests. Anchor shall comply with ductility requirements of ACI 350 or ACI 318 Appendix D, Section D.3.3.
 4. Installed anchor shall exhibit form fit between bearing elements and the undercut in the concrete.
 5. Interior Dry Non-Corrosive Locations: Provide carbon steel anchors, complete with nuts and washers, zinc plated, in accordance with ASTM B633.
 6. Other Locations: Provide stainless steel anchors, complete with nuts and washers, manufactured of AISI Type 316 stainless steel or materials complying with ISO 3506-1 and having corrosion resistance equivalent to AISI Type 316 stainless steel.
 7. Concrete undercut anchors shall have a current ICC Evaluation Service Report for use in both cracked and uncracked concrete for seismic recognition for seismic design Categories A through F when tested and assessed in accordance with ICC-ES AC193.
- J. Concrete Inserts:
1. Manufacturers: Provide products of one of the following:
 - a. Unistrut Corporation.
 - b. Cooper B-Line, Inc.
 - c. Anvil International, Inc.
 - d. Or equal.
 2. Spot Concrete Inserts:
 - a. Provide inserts recommended by insert manufacturer for required loading. Inserts shall comply with ANSI/MSS SP-58, malleable iron, Type 18. Spot inserts shall allow for lateral adjustment and have means for attachment to forms. Provide nuts compatible with insert and to suit threaded hanger rod sizes.
 3. Continuous Concrete Inserts:
 - a. Provide inserts recommended by insert manufacturer for required loading. Inserts shall be continuous type and shall be manufactured from minimum 12-gage cold-formed channel sections, complying with ASTM A1011/A1011M, stainless steel, Grade 33, complete with styrofoam inserts, end caps, and means for attaching to forms. Provide channel nuts compatible with insert suitable for threaded hanger rod sizes.
 4. Provide inserts with plain finish.
- K. Drive-In Expansion Anchors:
1. General: Drive-In expansion anchors shall each consist of stainless steel drive pin and expanding alloy body.
 2. Products and Manufacturers: Provide one of the following:
 - a. Metal HIT Anchor, by Hilti Fastening Systems, Inc.
 - b. Zinc Nailon Anchor, by Simpson Strong-Tie Company, Inc.
 - c. Or equal.
 3. Provide Type 304 stainless steel drive pin with zinc alloy body. Anchor shall comply with physical requirements of FS A-A-1925A, Type 1.
- L. Unless approved by Engineer, do not use power-actuated fasteners or other types of bolts and fasteners not specified in this Section.
- M. Anti-Seizing Compound:
1. Products and Manufacturers: Provide one of the following:
 - a. Pure Nickel Never-Seez, by Bostik.
 - b. Nickel-Graf, by Anti-Seize Technology.
 - c. Or equal.

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2. Provide pure nickel anti-seizing compound.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Examine conditions under which materials will be installed and advise Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.02 INSTALLATION

- A. Anchor Bolts:
 1. Provide anchor bolts as shown or indicated in the Contract Documents, or as required to secure structural element to the appropriate anchor surface.
 2. Locate and accurately set anchor bolts using templates or other devices as required, prior to placing concrete. Wet setting of anchor bolts is unacceptable.
 3. Protect threads and shank from damage during installation and subsequent construction operations.
 4. Unless otherwise shown or approved by Engineer anchor bolts shall comply with Table 05051-B:

TABLE 05051-B:
SINGLE ANCHOR ALLOWABLE LOADS ON ANCHOR BOLTS ¹

Bolt Diameter (inch)	F1554 Grade 36				F1554			
	F593 Type 316, Condition A				Grade 55			
	Minimum Embedment (inch)	Minimum Edge Distance and Spacing ² (inch)	Shear ³ , ⁴ (lb)	Tension ³ (lb)	Minimum Embedment (inch)	Minimum Edge Distance and Spacing ² (inch)	Shear ³ (lb)	Tension ³ (lb)
1/2	6	9	947	1,815	8.5	12.75	1,245	2,393
5/8	7.5	11.25	1,508	2,895	10.5	15.75	1,980	3,810
3/4	9	13.5	2,231	4,290	13	19.5	2,933	5,640
7/8	10.5	15.75	3,080	5,918	15	22.5	4,050	7,793
1	12	18	4,040	7,770	17	25.5	5,318	10,088
1 1/8	13.5	20.25	5,090	9,789	19	28.5	8,930	12,435
1.1/4	15	22.5	6,463	12,429	21	31.5	8,505	15,030

5. Table Notes:
6. Table is based on ACI 318 and ACI 350, Appendix D, $f'_c = 4000$ psi. Table 05051-B is not applicable to anchor bolts embedded in grouted masonry.
7. Critical edge distance and spacing are indicated in the table. Capacity of anchor bolts for other combination of edge distances and spacing shall be evaluated in accordance with ACI 318 and ACI 350, Appendix D.
8. Values for shear and tension listed are not considered to act concurrently. Interaction of tension and shear will be evaluated by Engineer in accordance with ACI 318 and ACI 350, Appendix D.
- B. Adhesive Anchors, Undercut Anchors, and Expansion Anchors – General: Prior to drilling, locate existing reinforcing steel in vicinity of proposed holes. If reinforcing conflicts with proposed hole location, obtain Engineer's approval of alternate hole locations to avoid drilling through or damaging existing reinforcing bars.
- C. Adhesive Anchors:
 1. Comply with manufacturer's written installation instructions and the following.

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2. Drill holes to adhesive system manufacturer's recommended drill bit diameter to the specified depth. Drill holes in hammering and rotation mode with carbide-tipped drill bits that comply with the tolerances of ANSI B212.15. Core-drilled holes are unacceptable.
 3. Before setting adhesive anchor, hole shall be made free of dust and debris by method recommended by adhesive anchor system manufacturer. Hole shall be brushed with adhesive system manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles. Hole shall be dry as defined by adhesive system manufacturer.
 4. Before injecting adhesive, obtain Engineer's concurrence that hole is dry and free of oil and other contaminants.
 5. Prior to injecting adhesive into the drilled hole, dispense, to a location appropriate for such waste, an initial amount of adhesive from the mixing nozzle, until adhesive is uniform color.
 6. Inject adhesive into hole through injection system-mixing nozzle and necessary extension tubes, placed to bottom of hole. Discharge end shall be withdrawn as adhesive is placed but kept immersed to prevent formation of air pockets. Fill hole to depth that ensures that excess material is expelled from hole during anchor placement.
 7. Twist anchors during insertion into partially-filled hole to guarantee full wetting of rod surface with adhesive. Insert rod slowly to avoid developing air pockets.
 8. Provide adequate curing in accordance to adhesive system manufacturer's requirements prior to continuing with adjoining Work that could place load on installed adhesive anchors. Do not begin adjoining Work until adhesive anchors are successfully tested or when allowed by Engineer.
 9. Limitations:
 - a. Installation Temperature: Comply with manufacturer's instructions for installation temperature requirements. Provide temporary protection and other measures, such as heated enclosures, necessary to ensure that base material temperature complies with anchor system manufacturer's requirements during installation and curing of adhesive anchor system.
 - b. Oversized Holes: Advise Engineer immediately if size of drilled hole is larger than recommended by anchor system manufacturer. Cost of corrective measures, including but not limited to redesign of anchors due to decreased anchor capacities, shall be paid by Contractor.
 - c. Embedment depths shall be based on installation in normal-weight concrete with compressive strength of 2,500 psi when embedded in existing concrete, and 4,000 psi when embedded in new concrete.
- D. Expansion Anchors:
1. Comply with expansion anchor manufacturer's written installation instructions and the following:
 2. Drill holes using anchor system manufacturer's recommended drill bit diameter and to the specified depth. Drill holes in hammering and rotation mode with carbide-tipped drill bits complying with tolerances of ANSI B212.15. Core drilled holes are unacceptable.
 3. Before installing anchor, hole shall be made free of dust and debris by method recommended by anchor system manufacturer. Hole shall be brushed with anchor system manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles.
 4. Before installing anchor, obtain Engineer's concurrence that hole is dry and free of oil and other contaminants.
 5. Protect threads from damage during anchor installation. Drive anchors not less than four threads below surface of the attachment. Set anchors to anchor manufacturer's recommended torque using a torque wrench.
- E. Concrete Undercut Anchors:
1. Comply with undercut anchor manufacturer's written installation instructions and the following.

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2. Protect threads from damage during anchor installation.
 3. Drill hole to anchor manufacturer's specified depth and diameter using a drill bit matched to the specific anchor.
 4. Before setting the undercut anchor, hole shall be free of dust and debris using method recommended by undercut anchor system manufacturer. Hole shall be blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles.
 5. Insert the anchor by hand until anchor reaches bottom of hole.
 6. Set anchor in accordance with manufacturer's instructions using anchor manufacturer's specified setting tool.
 7. Verify that the setting mark is visible on the threaded rod above the sleeve.
 8. Anchor shall be set to manufacturer's recommended torque, using a torque wrench.
- F. Concrete Inserts:
1. Comply with concrete insert manufacturer's installation instructions.
 2. Inserts shall be flush with slab bottom surface.
 3. Protect embedded items from damage during concrete placing. Ensure that embedded items are securely fastened to prevent movement during concrete placing, and ensure that embedded items do fill with concrete during concrete placing.
 4. Inserts intended for piping greater than four-inch diameter shall be provided with hooked rods attached to concrete reinforcing.
- G. Anti-Seizing Compound:
1. Provide anti-seizing compound in accordance with anti-seizing compound manufacturer's installation instructions, at locations indicated in Paragraph 2.1.B of this Section.
 2. Do not use anti-seizing compound at locations where anchor bolt or adhesive anchor will contact potable water or water that will be treated to become potable.

3.03 CLEANING

- A. After embedding concrete is placed, remove protection and clean bolts and inserts.

3.04 FIELD QUALITY CONTROL

3.05 MANUFACTURER'S SERVICES: PROVIDE AT THE SITE SERVICES OF QUALIFIED ADHESIVE MANUFACTURER'S REPRESENTATIVE DURING INITIAL INSTALLATION OF ADHESIVE ANCHOR SYSTEMS TO TRAIN CONTRACTOR'S PERSONNEL IN PROPER INSTALLATION PROCEDURES. MANUFACTURER'S REPRESENTATIVE SHALL OBSERVE TO CONFIRM THAT INSTALLER DEMONSTRATES PROPER INSTALLATION PROCEDURES FOR ADHESIVE ANCHORS AND ADHESIVE MATERIAL.

3.06 SITE TESTS:

- A. Owner Will employ testing agency to perform field quality tensile testing of production adhesive anchors at the Site, unless otherwise specified.
1. Testing shall comply with ASTM E488.
 2. Test at least ten percent of all types of adhesive anchors. If one or more adhesive anchors fail the test, Contractor shall pay cost of testing, or at Engineer's option Contractor may arrange for testing paid by Contractor, for all adhesive anchors of same diameter and type installed on the same day as the failed anchor. If anchors installed on the same day as the failed anchor also fail the test, Engineer may require retesting of all anchors of the same diameter and type installed in the Work. Contractor shall be responsible for retesting costs.
 3. Engineer will direct which adhesive anchors are to be tested and indicate test load to be used
 4. Apply test loads with hydraulic ram.
 5. Displacement of post-installed anchors shall not exceed $D/10$, where D is nominal diameter of anchor being tested.
 6. Mechanical Anchors:
 - a. Responsibility:

SECTION 05051 – ANCHOR SYSTEMS

- 1) Owner Will employ testing agency to perform field quality control tensile testing of mechanical anchors at the Site.
 - 2) Contractor shall demonstrate competence in installing mechanical anchors by performing field quality control tests.
- b. Perform field quality control tests on test anchors at location directed by Engineer. Test anchors shall not be part of the finished Work.
- c. Test not less than one installation of each type of mechanical anchor used in the Work.
 - 1) Load each test anchor to failure.
 - 2) Testing shall comply with ASTM E488.
 - 3) Apply test loads with hydraulic ram.
- d. Anchors that fail to reach the specified test load shall be considered as not passing the test and shall be re-tested at no additional cost to Owner.
- e. Testing agency shall submit test results to Contractor and Engineer within 24 hours of completion of test.
7. Correct defective Work by removing and replacing or correcting, as directed by Engineer.
8. Contractor shall pay for all corrections and subsequent testing required to confirm competence in the installation of post-installed mechanical anchors.
9. Testing agency shall submit test results to Contractor and Engineer within 24 hours of completion of test.

END OF SECTION

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SECTION 05 1200
STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Structural steel.
 - 2. Grout.
 - 3. Base Plates.
- B. Related Requirements:
 - 1. Division 01 - "Quality Requirements" for independent testing agency procedures and administrative requirements.
 - 2. Section 055100 "Metal Stairs".
 - 3. Section 09 9113 "Exterior Painting" and Section 09 9123 "Interior Painting" and for surface-preparation and priming requirements.

1.03 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.
- C. Heavy Sections: Rolled and built-up sections as follows:
 - 1. Shapes included in ASTM A6/A6M with flanges thicker than 1-1/2 inches (38 mm).
 - 2. Welded built-up members with plates thicker than 2 inches (50 mm).
 - 3. Column base plates thicker than 2 inches (50 mm).

1.04 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.05 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.06 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Shop drawings and required calculations shall bear the seal and signature of a registered Professional Engineer licensed in the state in which the project is located. Structural steel shop drawings will not be reviewed without said seal and signature.
 - a. A full set of engineered calculations for all beam to column moment connections shall be submitted to the engineer of record for approval. The steel fabricator drawings shall not be reviewed without said engineering calculations affixed with a seal and signature of a professional engineer licensed in the state in which the project is located.
 - 2. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 3. Include embedment Drawings.

4. Indicate profiles, sizes, spacing and locations of structural members, openings, attachments, fasteners, connections, cambers, holes and other pertinent data. Include locations of structural members, openings, attachments and loads.
 5. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 6. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
 7. For structural steel connections indicated to comply with design loads, include structural design data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.07 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For installer / fabricator.
- B. Welding certificates: Submit certificates certifying that welders employed in the work have met AWS qualifications within in the previous 12 months.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural steel, including chemical and physical properties. Indicate structural strength, destructive and non-destructive test analysis.
- E. Product Test Reports: For the following:
 1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 2. Direct-tension indicators.
 3. Tension-control, high-strength, bolt-nut-washer assemblies.
 4. Shear stud connectors.
 5. Shop primers.
 6. Non-shrink grout.

1.08 QUALITY ASSURANCE

- A. Fabricator shall have a minimum of five (5) years documented experience with performing the work of this section.
- B. Installer Qualifications: A qualified installer specializing in performing the work of this section with a minimum of three (3) years of documented experience.
- C. Delegated Connection Designer: Connections not fully detailed on the contract drawings shall be designed under the direct supervision of a professional structural engineer experienced in the design of this work and licensed in the state in which the work is located. The shop drawings shall bear the seal and signature of same professional engineer.
- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
 2. Welders who are welding structural members fabricated in the shop or in the field, in the five boroughs must have a NYCDOB issued welder licence.
- E. Comply with applicable provisions of the following specifications and documents:
 1. AISC Code of Standard Practice for Steel Buildings and Bridges - AISC 303.
 2. AISC Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings - AISC 360.
 3. RCSC's "Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts."

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and handle products to/at the site under the supervision of Division 01 of this Project Manual.
- B. Schedule deliveries of materials to the site at intervals which will ensure uninterrupted progress of the work.
- C. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- D. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and experience. who bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F1852 fasteners and for retesting fasteners after lubrication.

1.10 COORDINATION

- A. Coordinate the work under Division 01 specification of this Project Manual.
- B. Coordinate the selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturer's recommendations to ensure that shop primers and topcoats are compatible with one another.
- C. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions and directions for installation.
- D. Coordinate the work of this section with utility installations and all other adjacent work.
- E. Coordinate the work of this section such that general progress of the Work is not interrupted.

1.11 FIELD MEASUREMENTS

- A. Verify that field measurements are as shown on the plans and approved shop drawings.
- B. The contractor is responsible for the proper location and elevations of the work.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated where beam end reactions are not shown on drawings. Connection designer shall design shear connections to resist the reaction resulting from the maximum allowable uniform load of the beam found in the AISC Specification being applied along its full length.
 - 1. Select and complete connections using AISC 360.
 - 2. Use Load and Resistance Factor Design; data are given at factored-load level.
- B. Moment Connections: Type FR, fully restrained. Provide design and details of moment connections to resist forces shown on the contract drawings.
- C. Construction: Moment frame and Braced frame.

2.02 STRUCTURAL-STEEL MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. W-Shapes: ASTM A 992/A 992M.

- C. Channels, Angles, M-Shapes: ASTM A 36/A 36M.
- D. Plate and Bar: ASTM A 36/A 36M.
- E. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: ASTM A588/A588M, Grade 50 (345).
- F. Welding Electrodes: Comply with AWS requirements.

2.03 BOLTS, CONNECTORS, AND ANCHORS

- A. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
 - 1. Finish: Hot-dip zinc coating.
 - 2. Direct-Tension Indicators: ASTM F959/F959M, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with mechanically deposited zinc coating finish.
- B. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers; all with plain finish.
- C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A490 (A 490M), Type 1, heavy-hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends; ASTM A563, Grade DH, (ASTM A563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers with plain finish.
 - 1. Direct-Tension Indicators: ASTM F959, Type 490 (ASTM F 959M, Type 10.9), compressible-washer type with plain finish.
- D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F1852, Type 1, round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
 - 1. Finish: Plain.
- E. Shear Connectors: ASTM A108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- F. Anchor Bolts: ASTM A307, Grade C for non-moment resisting anchor rods. ASTM F1554, 36 and 55 ksi yield strength for moment resisting anchor rods.
 - 1. Nuts: ASTM A563 heavy-hex carbon steel.
 - 2. Plate Washers: ASTM A36/A36M carbon steel.
 - 3. Washers: ASTM F436/F436M, Type 1, hardened carbon steel.
 - 4. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.
- G. Threaded Rods: ASTM A 36/A 36M.
 - 1. Nuts: ASTM A563 ASTM A563M heavy-hex carbon steel.
 - 2. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
 - 3. Finish: Plain.
- H. Clevises: Made from cold-finished carbon steel bars, ASTM A108, Grade 1035.
- I. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A108, Grade 1030.
- J. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A108, Grade 1018.

2.04 PRIMER

- A. Primer: Comply with Division 09
- B. Primer: SSPC-Paint 15, Type I, red oxide.
- C. Ensure primer is compatible with required topcoat.
- D. Galvanizing Repair Paint: ASTM A 780/A 780M.

2.05 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
- B. Grout shall consist of a premixed compound with cement, water reducing and plasticizing additives capable of developing a minimum compressive strength of 7000 psi at 28 days.

2.06 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.
 - 3. Identify high-strength structural steel according to ASTM A6/A6M and maintain markings until structural steel has been erected.
 - 4. Mark and match-mark materials for field assembly.
 - 5. All wide flange structural steel members shall be fabricated in accordance with ASTM A992/A992M. All miscellaneous steel members including channels, angles, S, HP, and M shapes shall be fabricated in accordance with ASTM A36/A36M.
 - 6. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
 - 7. All shop connections shall be welded or high strength bolted.
 - 8. Bearing surfaces shall be planed true to provide full bearing over the entire surface.
 - 9. Continuously seal joined members by intermittent welds and plastic filler. Grind welds smooth where exposed or where interference with other building materials is encountered.
 - 10. Splicing is not permitted unless indicated on the Contract Documents or accepted on the final approved Shop Drawings.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces. Mechanically thermal cut bolt holes shall not be permitted unless prior approval by the Architect is obtained in writing.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 2, "Hand Tool Cleaning," or SSPC-SP 3, "Power Tool Cleaning," unless a more stringent cleaning method is required for selected primers and / or other coatings.
- F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.
- G. Shop prime non-exposed steel members after fabrication in accordance with SSPC- PA. Do not prime surfaces that will be fireproofed, field welded or are in contact with concrete or high strength bolts.
- H. Paint exposed structural steel members in accordance with the applicable Division 09 Specification section.
- I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning unless approved by the Architect in writing.
 - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.07 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM F3125/F3125M, Grade A325 or Grade A490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened unless otherwise shown on the contract documents or required by the connection designer.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.08 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
 - 2. Surfaces to be field welded.
 - 3. Surfaces of high-strength bolted, slip-critical connections.
 - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 - 5. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
 - 2. SSPC-SP 3, "Power Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 - 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.09 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A123/A123M.
 - 1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
 - 2. Galvanize lintels, shelf angles and welded door frames attached to structural-steel frame and located in exterior walls.

2.10 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
 - 1. Inspection and Tests will not relieve the contractor of responsibility for providing materials, fabrication and erection procedures in compliance with the specified requirements. The contractor shall verify that all materials meet or exceed the requirements specified in these specifications, Contract drawings and related references. Materials not in compliance with the specified requirements will be rejected and required to be removed from the site.

- C. Bolted Connections: Inspect and test shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM F3125/F3125M , Grade A325 or Grade A490 Bolts."
- D. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M type required for materials being welded and the following inspection procedures, at testing agency's option:
 - 1. Liquid Penetrant Inspection: ASTM E165/E165M.
 - 2. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - 3. Ultrasonic Inspection: ASTM E164.
 - 4. Radiographic Inspection: ASTM E94.
- E. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - 1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other drawings for compliance with requirements.
 - 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other drawings showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected. Commencement of installation will indicate that the erector accepts the conditions which exist.

3.02 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
 - 1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.
 - 2. Clean bearing surfaces and other surfaces which will be in permanent contact with the work.

3.03 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Proceed with the installation only after unsatisfactory conditions have been corrected. Commencement of installation will indicate that the erector accepts the conditions which exist.
- C. Allow for erection loads and for sufficient temporary bracing to maintain structure safe, plumb and in true alignment until completion of erection and installation of permanent bracing.
- D. Coordinate placement of anchors in concrete or masonry construction for securing bearing plates.
- E. Erect all components in accordance with the approved shop drawings.
- F. Field weld components and shear studs as indicated on approved shop drawings and in accordance with AWS D1.1/D1.1M.
- G. Do not field cut or alter structural members without written approval of the Engineer.

- H. Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.
 - 3. Snug-tighten Pretension anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
 - 5. Coordinate placement of anchors in concrete or masonry construction for securing base plates.
- I. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- J. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- K. Splice members only where indicated.
- L. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.
- M. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- N. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.
- O. Erect all components in accordance with approved shop drawings. After erection, prime welds, abrasions and surfaces not shop primed or galvanized as required, except surfaces to be in contact with concrete.
- P. Field weld components and shear studs as indicated on the approved shop drawings and in accordance with AWS D1.1/D1.1M.

3.04 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM F3125/F3125M, Grade A325 or Grade A490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened Pretensioned unless specifically identified as pretensioned or slip-critical on the contract documents or calculations by the Delegated Connection designer.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

4. Connections and abrasions shall be cleaned, prepared and finished in the same manner and with the same materials used in shop finishing.

3.05 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 1. Verify structural-steel materials and inspect steel frame joint details.
 2. Verify weld materials and inspect welds.
 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Bolted Connections: Inspect and test high strength bolted connections according to RCSC's "Specification for Structural Joints Using ASTM F3125/F3125M, Grade A325 or Grade A490 Bolts."
- D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.
 1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E165/E165M.
 - b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Inspection: ASTM E164.
 - d. Radiographic Inspection: ASTM E94.
- E. Post Installed Mechanical Anchors, Adhesive Anchors and Screw Anchors: Comply with 2020 New York State Building Code Table 1705.3.
 1. The special inspection shall include the verification of compliance with approved construction documents and standards established by the Commissioner pursuant to Section 28-113.2.2 of the Administrative Code.
- F. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.
- G. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.06 TOLERANCES

- A. All members shall be installed within AISC tolerances and as follows:
 1. Maximum variation from plumb: 1/4" (6mm) per story, non-cumulative.
 2. Maximum offset from true alignment: 1/4" (6mm).

3.07 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A780/A780M.
- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
- C. Touchup Painting: Cleaning and touchup painting are specified in Section 09 9113 "Exterior Painting" and Section 09 9123 "Interior Painting."
- D. Touchup Priming: Cleaning and touchup priming as specified in Division 9 "High-Performance Coatings" or compatible primer established at the fabricators shop to be compatible with the final finish.

3.08 ADJUSTING

- A. All misfits due to errors in location, fabrication, inaccuracies in the setting of anchor bolts or other items of attachment or support shall be immediately reported to the Engineer and corrected in a manner subject to the approval of the Engineer.
- B. Submit method of correction to the Architect under Division 01 Specification provisions.
- C. Proceed with corrective work only after receiving written approval from the Architect.
- D. All corrections shall be made at no additional cost to the Owner.

END OF SECTION 05 1200

SECTION 05501 – MISCELLANEOUS METAL FABRICATIONS

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Scope:
 - 1. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish miscellaneous metal fabrications including surface preparation and shop priming.
 - 2. The Work also includes providing openings in miscellaneous metal fabrications to accommodate the Work under this and other Sections, and attaching to miscellaneous metal fabrications all items such as sleeves, bands, studs, fasteners, and all items required for which provision is not specifically included under other Sections.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the Work to be installed with, or attached to miscellaneous metal fabrications Work.
 - 2. Hot-dip Galvanizing: Coordinate with steel fabricator detailing for and fabrication of assemblies to be hot-dip galvanized, to minimize distortion during galvanizing process.
- C. Related Sections:
 - 1. Section 03600, Grouting.
 - 2. Section 04211, Brick Masonry.
 - 3. Section 05051, Anchor Systems.
 - 4. Section 05522, Aluminum Handrails and Railings.
 - 5. Section 08315, Access Doors
 - 6. Section 09900, Painting.

1.02 REFERENCES

- A. Standards referenced in this Section include:
 - 1. ANSI Z359.1 - Safety Requirements for Personal Fall Arrest Systems, Subsystems, and Components.
 - 2. ASTM A36/A36M - Specification for Carbon Structural Steel.
 - 3. ASTM A53/A53M - Specification for Pipe Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 4. ASTM A123/A123M - Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 5. ASTM A153/A153M - Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 6. ASTM A240/A240M - Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications.
 - 7. ASTM A384/A384M-02 - Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
 - 8. ASTM A500 - Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - 9. ASTM A572/A572M - Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
 - 10. ASTM A992/A992M - Specification for Structural Steel Shapes.
 - 11. ASTM B209 - Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 12. ASTM B211 - Specification for Aluminum and Aluminum-Alloy Bar, Rod and Wire.
 - 13. ASTM B308/B308M - Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
 - 14. ASTM B429 - Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
 - 15. ASTM B632/B632M - Specification for Aluminum-Alloy Rolled Tread Plate.
 - 16. ASTM F593 – Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - 17. AWS D1.1/D1.1M - Structural Welding Code – Steel.
 - 18. AWS D1.2/D1.2M - Structural Welding Code – Aluminum.
 - 19. AWS D1.6 - Structural Welding Code – Stainless Steel.
 - 20. OSHA 29 CFR 1910 - Occupational Health and Safety Standards.

SECTION 05501 – MISCELLANEOUS METAL FABRICATIONS

21. ASTM A514/A514M - Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding.

1.03 QUALITY ASSURANCE

- A. Qualifications:
 1. Welding:
 - a. Qualify welding processes and welding operators in accordance with AWS D1.1/D1.1M, D1.2/D1.2M, or D1.6, as applicable.
 - b. Provide certification that each welder employed on or to be employed for the Work have satisfactorily passed AWS qualification tests within previous 12 months. Ensure that all certifications are current.

1.04 SUBMITTALS

- A. Action Submittals: Submit the following:
 1. Shop Drawings: Fabrication and erection details for assemblies of miscellaneous metal Work. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items. Include setting drawings and templates for locating and installing miscellaneous metal items and anchorage devices.
 2. Product Data: Copies of manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions for products to be used in miscellaneous metal Work.
 3. Samples: Sets of representative Samples of materials including nosings, rungs, and other finished products as requested by Engineer. Engineer's review will be for color, texture, style, and finish only. Compliance with other requirements is exclusive responsibility of Contractor.
- B. Informational Submittals: Submit the following:
 1. Test and Evaluation Reports: Mill test report that indicate chemical and physical properties of each type of material, when requested by Engineer.
 2. Qualifications Statements: Copies of welder's certifications, when requested by Engineer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Packing, Shipping, Handling and Unloading: Deliver products to Site to ensure uninterrupted progress of the Work. Deliver anchorage materials to be embedded in other construction in ample time to prevent delaying the Work.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Steel:
 1. W-Shapes and WT-Shapes: ASTM A992/A992M.
 2. S-Shapes and Channels: ASTM A572/A572M, Grade 50.
 3. Hollow Structural Sections: ASTM A500, Grade B.
 4. Angles, Plates, Bars: ASTM A36/A36M, ASTM A514/A514M AR400.
 5. Steel Pipe: ASTM A53/A53M, Grade B.
- B. Aluminum:
 1. Aluminum Shapes: ASTM B308/B308M, Alloy 6061-T6, ASTM B 221, Alloy 6061-T6.
 2. Aluminum Tubes and Pipes: ASTM B429, Alloy 6061-T6.
 3. Aluminum Bars and Rod: ASTM B211, Alloy 6061-T6.
 4. Aluminum Plates: ASTM B209, Alloy 6061-T6.
- C. Stainless Steel:
 1. Plates and Sheets: ASTM A240/A240M, Type 304L or Type 316 stainless steel.
 2. Submerged or Intermittently Submerged: Type 316 stainless steel.
 3. Non-submerged: Type 304L stainless steel.
- D. Stainless Steel Fasteners: ASTM F593.
- E. Stainless Steel Fittings: ASTM A 320/A 320M, Type 304L or Type 316 Stainless Steel.

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F. Zinc-coated Hardware: ASTM A153/A153M.

2.02 MISCELLANEOUS METAL ITEMS

A. Shop Assembly: Pre-assemble items in the shop to the greatest extent possible to minimize field-splicing and field-assembly of units at the Site. Disassemble units only to extent necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Steel Lintels:

1. Provide loose structural steel lintels for openings and recesses in masonry walls and brick walls as specified or as shown.
2. Weld adjoining members together to form a single unit, where shown or indicated.
3. Provide not less than eight inches bearing at each side of openings, unless otherwise shown.
4. Steel lintels to be installed in exterior walls shall be hot-dip galvanized to ASTM A123/A123M, 2.3 oz./s.f. (Grade 100) and finish painted. Other steel lintels shall be painted.
5. Surface preparation and painting shall conform to Section 09900, Painting.
6. Where lintels are not shown on the Drawings, provide lintels as specified in the following table. Provide other lintels where shown and of size indicated on the Drawings.

Clear Span (Max)	Exterior Angle	Interior Angles (typical 8-inch wall)
4.0 feet	3.5 inches by 3.5 inches by 5/16 inches	Two 3.5 inches by 3.5 inches by 5/16 inches
6.0 feet	Four inches by 3.5-inches by 5/16 inches	Two 4 inches by 3.5 inches by 5/16 inches
8.0 feet	Five inches by 3.5 inches by 5/16 inches	Two 5 inches by 3.5 inches by 5/16 inches

C. Shelf Angles:

1. Provide structural steel shelf angles of sizes shown, for attachment to concrete or masonry construction. Provide slotted holes to receive 3/4-inch bolts, spaced not more than six inches from ends and not more than 2.0 feet on centers, unless otherwise shown.
 - a. Provide galvanized shelf angles on outdoor construction.
2. Provide wedge-type concrete inserts, complete with fasteners, for attachment of shelf angles to cast-in-place concrete.

D. Aluminum Stair Nosings:

1. Manufacturers: Provide products of one of the following:
 - a. Supergrit Type 241BF by Wooster Products, Inc.
 - b. Or equal.
2. Fabricate extruded aluminum nosing of sizes and configurations as shown on the Drawings. Unless otherwise shown, provide ribbed abrasive filled type, using black abrasive filler.
3. Provide anchors for embedding in concrete, either integral or applied to treads, as standard with manufacturer.

E. Manhole Steps:

1. Provide manhole steps as shown on the Drawings. Conform to requirements of 29 CFR 1910 and ANSI A14.3.
2. Products and Manufacturers: Provide one of the following:
 - a. R-1982-W, manufactured by Neenah Foundry Company.
 - b. Or equal.
3. Vertical separation of steps shall be uniform at maximum of 12 inches on centers. Steps shall project evenly from manhole or chamber walls.
4. Material: Extruded aluminum.

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- F. Bollards: Provide Schedule 80 galvanized steel pipe filled with concrete as shown on the Drawings. Paint as required in accordance with Section 09900, Painting. Unless otherwise shown or specified, finish-paint bollard "Safety Yellow."
- G. Safety Tie-Back Anchor:
 - 1. Design Performance: Design system fall arrest safety anchors and equipment supports to AISC S342L (including supplement No.1) and ANSI/IWCA I-14.1, and as follows:
 - 2. Comply with OSHA 1910, Subpart F, Appendix C.
 - 3. Fall arrest force against fracture or detachment: 5,000 lbs.
 - 4. Products and Manufacturers: Provide products of one of the following:
 - a. Safety Tie-Back Anchor by Safeguard Safety, Inc.
 - b. Safety Tie-Back Anchor by Pro-Bel Group of Companies.
 - c. Safety Tie-Back Anchor by Flexible Lifeline Systems.
 - d. Or equal.
 - 5. Safety Anchor Eye Plate: Mild steel, Type 300W with 44 Ksi minimum yield strength, hot-dip galvanized to ASTM A123/A123M.
 - 6. Plate: 0.875 inches diameter material with 2 inch eye opening.
 - 7. Hollow Steel Section (HSS) Piers: Mild steel, Type 300W with 50 Ksi minimum yield strength, hot dipped galvanized to ASTM A123/A123M.
- H. Miscellaneous Framing and Supports:
 - 1. Provide miscellaneous metal framing and supports that are not part of structural steel framework and are required to complete the Work.
 - 2. Fabricate miscellaneous units to sizes, shapes, and profiles shown on the Drawings or, if not shown, of required dimensions to receive adjacent grating, plates, tanks, doors, and other work to be retained by the framing.
 - 3. Except as otherwise shown, fabricate from structural shapes, plates, and bars, of all-welded construction using mitered corners, welded brackets, and splice plates and minimum number of joints for field connection.
 - 4. Cut, drill, and tap units to receive hardware and similar items to be anchored to the Work.
 - 5. Furnish units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units are to be installed after concrete is placed.
 - a. Except as otherwise shown, space anchors, 2.0 feet on centers, and provide units the equivalent of 1.25-inch by 1/4-inch by eight-inch strips.
 - b. Galvanize exterior miscellaneous frames and supports.
 - c. Where shown or indicated, galvanize miscellaneous frames and supports that are not to be installed outdoors.
 - 6. Miscellaneous steel framing and supports shall be hot-dip galvanized and finish-painted, unless otherwise shown or indicated.
 - 7. For railings, refer to Section 05522, Aluminum Handrails and Railings.
 - 8. For grating requirements refer to Section 06602, Fiberglass Reinforced Plastic Grating.
 - 9. Surface preparation and painting of galvanized surface shall conform to Section 09900, Painting
- I. Aluminum Raised-Pattern Floor Plate:
 - 1. Provide raised-pattern floor plate conforming to ASTM B632/B632M and manufacturer's standards. Provide plates of thicknesses shown.
 - 2. Products and Manufacturers: Provide products of one of the following:
 - a. 4-Way Safety Aluminum Plate, by Ryerson Tull Company.
 - b. Raised Pattern Floor Aluminum Plate, by Central Steel and Wire Company.
 - c. Or equal.
 - 3. Provide removable plates at locations and sizes shown. Provide perforated plates where shown.
 - 4. Provide each plate section with four lifting handles as recommended by manufacturer. Lifting handles shall be recessed, drop handle type. Maximum weight of checkered plate or plank section shall be 150 pounds.

SECTION 05501 – MISCELLANEOUS METAL FABRICATIONS

- 5. Finish: Anodized. Protect finish with factory-applied coating of manufacturer's standard lacquer coating, suitable for service on floor.
- J. Fasteners and Hardware: Provide Type 316 stainless steel fasteners for aluminum fabrications and zinc-coated hardware for galvanized fabrications, unless otherwise shown or specified.
- K. Anchors and Expansion Anchors: Refer to Section 05051, Anchor Systems.

2.03 FINISHING

- A. Surface Preparation and Shop Priming: Perform surface preparation and apply primer coat to miscellaneous metal fabrications in the shop. Conform to surface preparation and shop priming requirements in Section 09900, Painting.
- B. Galvanizing:
 - 1. Galvanizing of fabricated steel items shall comply with ASTM A123/A123M.
 - 2. Details of fabrication of steel items and assemblies to be hot-dip galvanized shall conform to recommendations of ASTM A384/A384M to minimize the potential for distortion.
- C. Aluminum Finish: Provide natural mill finish for aluminum Work unless otherwise shown or specified.

2.04 SOURCE QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Materials and fabrication procedures shall be subject to inspection and tests in the mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve Contractor of responsibility for providing materials and fabrication procedures complying with the Contract Documents.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine conditions under which the Work is to be performed and notify Engineer in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.02 INSTALLATION

- A. Install miscellaneous metal fabrications accurately in location, alignment, and elevation, plumb, level, true, and free of rack, measured from established lines and levels. Brace temporarily or anchor temporarily in formwork where fabrications are to be built into concrete, masonry, or other construction.
- B. Anchor securely as shown and as required for the intended use, using concealed anchors where possible.
- C. Fit exposed connections accurately together to form tight, hairline joints. Field-weld steel connections that are not to be exposed joints and cannot be shop-welded because of shipping size limitations. Comply with AWS D1.1/D1.1M, D1.2/D1.2M and D1.6, as applicable to the material being welded. Grind steel joints smooth and touch-up shop paint coat. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.
- D. Protection of Aluminum from Dissimilar Materials: Coat surfaces of aluminum that will contact dissimilar materials such as concrete, masonry, and steel, in accordance with Section 09900, Painting.

END OF SECTION

SECTION 05501 – MISCELLANEOUS METAL FABRICATIONS

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PART 1 – GENERAL

1.01 DESCRIPTION

- A. Scope:
 - 1. Provide all labor, materials, tools, equipment, and incidentals as specified, and required to furnish and install aluminum handrail and railing systems. The Work also includes:
 - a. Provide an aluminum two-rail system with toeboards at all required locations.
 - b. Providing openings in, and attachments to, aluminum handrail and railing systems to accommodate the Work under this and other Specification Sections. Provide all items for aluminum handrails and railings, including anchorages, fasteners, studs, and other items required for which provision for is not specifically included under other Sections.
 - 2. Aluminum handrails and railings Work shall include components and features specified, and all components and features available from specified manufacturers required for providing complete aluminum handrail and railing system in accordance with the Contract Documents.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before aluminum handrails and railings Work.
 - 2. Aluminum handrail and railing locations shall conform with Laws and Regulations.
- C. Related Sections:
 - 1. Section 03600, Grouting.
 - 2. Section 05051, Anchor Systems.
 - 3. Section 09900, Painting.

1.02 REFERENCES

- A. Standards referenced in this Section include:
 - 1. Aluminum Association (AA) - Aluminum Design Manual.
 - 2. ASTM B26/B26M - Specification for Aluminum-Alloy Sand Castings.
 - 3. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - 4. ASTM B136 - Standard Method for Measurement of Stain Resistance of Anodic Coatings on Aluminum.
 - 5. ASTM B137 - Standard Test Method for Measurement of Coating Mass per Unit Area on Anodically Coated Aluminum.
 - 6. ASTM B221 - Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
 - 7. ASTM B241/B241M - Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
 - 8. ASTM B244 - Standard Test Method for Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments.
 - 9. ASTM B247 - Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and rolled Ring Forgings.
 - 10. ASTM B429 - Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
 - 11. ASTM E935 - Standard Test Methods for Permanent Metal Railing Systems and Rails for Buildings.
 - 12. NAAMM/Architectural Metal Products Division (AMP) - Pipe Railing Manual.
 - 13. NAAMM/AMP - AMP 501 Finishes for Aluminum.

1.03 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer: Manufacturer shall be able to document at least five years successful experience in fabricating aluminum handrail and railing systems of scope and type similar to that required.

SECTION 05522 – ALUMINUM HANDRAILS AND RAILINGS

2. Contractor or handrail and railing manufacturer shall retain a registered Professional Engineer legally qualified to practice in same state as the Site. Responsibilities include:
 - a. Reviewing aluminum handrail and railing system performance and design criteria stated in the Contract Documents.
 - b. Preparing written requests for clarifications or interpretations of performance or design criteria for submittal to Engineer by Contractor.
 - c. Preparing or supervising preparation of design calculations verifying compliance of aluminum handrail and railing system with requirements of the Contract Documents.
 - d. Signing and sealing all calculations.
 - e. Certifying that:
 - 1) Design of aluminum handrail and railing system was performed in accordance with performance and design criteria stated in the Contract Documents, and
 - 2) Design conforms to all applicable local, state, and federal Laws and Regulations, and to prevailing standards of practice.
3. Installer Qualifications:
 - a. Retain a single installer trained and with record of successful experience in installing aluminum handrail and railing systems.
 - b. Installer shall have record of successfully installing aluminum handrail and railing systems in accordance with recommendations and requirements of manufacturer, or shall provide evidence of being acceptable to the manufacturer.
 - c. Installer shall employ only trade workers with specific skill and successful experience in the type of Work required.
 - d. When requested by Engineer, submit name and qualifications of installer with the following information for at least three successful, completed projects:
 - 1) Names and telephone numbers of owner and architect or engineer responsible for each project.
 - 2) Approximate contract cost of the aluminum handrail and railing systems for which installer was responsible.
 - 3) Amount (linear feet) of aluminum handrail and railing installed.
- B. Component Supply and Compatibility:
 1. Obtain all products included in this Section regardless of component manufacturer, from a single aluminum handrail and railing system manufacturer.
 2. Aluminum handrail and railing system manufacturer shall review and approve or prepare all Shop Drawings and other submittals (except for delegated design submittals, when professional engineer is retained by other than handrail and railing manufacturer) for all components furnished under this Section.
 3. Components shall be specifically constructed for specified service conditions and shall be integrated into overall assembly by aluminum handrails and railings manufacturer.
- C. Regulatory Requirements: Conform to Laws and Regulations including:
 1. OSHA Part 1910.23, Guarding Floor and Wall Openings and Holes.
 2. New York State Building Codes.
- D. Certifications:
 1. Furnish certification, signed by authorized officer of manufacturer and notarized, stating that handrail and railing systems conform to the design prepared by the professional engineer.
 2. Furnish certification, signed by authorized officer of Contractor and notarized, stating that all components and fittings are furnished by the same manufacturer.

1.04 SUBMITTALS

- A. Action Submittals: Submit the following:
 1. Shop Drawings:
 - a. Drawings for fabrication and installation of aluminum handrail and railing systems with sizes of members, pipe wall thickness, information on components, and

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- anchorage devices. Show all anchorages. Provide details drawn at scale of 1.5-inch equal to one foot.
 - b. Indicate required location of posts.
 - c. Indicate locations and details of all expansion joints, if any.
 - d. Indicate locations and details of gaps across seismic joints, if any.
 - e. Profile drawings of aluminum handrail and railing system components.
 - f. Custom detail drawings. Details of forming, jointing, sections, connections, internal supports, trim and accessories. Provide details drawn at scale of 1.5-inch equal to one foot.
2. Product Data:
- a. Manufacturer's specifications, standard detail drawings, and installation instructions for aluminum handrail and railing systems.
 - b. Manufacturer's catalogs showing complete selection of standard and custom components and miscellaneous accessories for selection by Engineer.
3. Delegated Design Submittals:
- a. Design Data:
 - 1) Design computations or complete structural analysis of handrail and railing systems, signed and sealed by professional engineer. Professional engineer's seal shall be clearly legible, including state of registration, registration number, and name on seal.
 - 2) Certification by professional engineer that professional engineer has performed design of aluminum handrail and railing systems in accordance with performance and design criteria stated in the Contract Documents, and that design conforms to all local, state, and federal Laws and Regulations, and to prevailing standards of practice.
4. Samples:
- a. Full-size Sample, 2 feet long, of assembled railing system at post and rail intersections. Sample shall have all associated components including typical connections, mounted toeboard and sleeve, and handrail at wall return, complete with mounting brackets, all with specified controlled uniform metal finish.
 - b. Color Samples: Maximum range of clear anodized aluminum that shall appear in finished Work. Prepare range Samples, to show highest level of color control feasible for actual handrail and railing systems, as determined by licensor of finishing process specified, on actual extrusions and castings of the Work.
 - c. Samples will be reviewed for finish, color, joint tolerances, workmanship, and general component assembly only. Compliance with other requirements is the responsibility of the Contractor.
5. Test Procedure: Submit detailed description of proposed shop testing procedures. Do not perform shop testing until Engineer approves shop test procedure:
- B. Informational Submittals: Submit the following:
- 1. Certificates:
 - a. Certification on source of supply, as specified in Article 1.3 of this Section.
 - b. Manufacturer certification specified in Article 1.3 of this Section.
 - 2. Source Quality Control Submittals: Manufacturer's load testing report in accordance with ASTM E935 for completed aluminum handrail and railing systems, demonstrating compliance with applicable requirements of building codes, safety codes, and other Laws and Regulations.
 - 3. Qualifications Statements: Submit qualifications for the following:
 - a. Manufacturer, when requested by Engineer.
 - b. Professional engineer.
 - c. Installer, when requested by Engineer. Qualifications statement shall include record of experience with references specified.
- C. Closeout Submittals: Submit the following:
- 1. Maintenance Manuals: Furnish detailed maintenance manuals that include the following:

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- a. Product name and number.
 - b. Detailed procedures for routine maintenance and cleaning, including cleaning materials, application methods and precautions in use of products that may be detrimental to finish when improperly applied.
 - c. Handrail and railings systems manufacturer's current catalog including individual parts.
 - d. Conform to Section 01781, Operations and Maintenance Data.
2. Guarantee: Provide in maintenance manual the guarantee specified.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, and Unloading:
 1. Prior to shipping, completely inspect products to assure that components are complete and comply with requirements of Contract Documents and recommendations of manufacturer. Box or crate products as required to prevent damage during shipment.
 2. Deliver products to Site to ensure uninterrupted progress of the Work. Deliver anchorage products that are to be embedded in concrete in ample time to prevent delaying the Work.
 3. Inspect all boxes, crates, and packages upon delivery to Site and notify Engineer in writing of loss or damage to products. Promptly remedy loss and damage to new condition per manufacturer's instructions.
 4. Conform to Section 01610, Transportation and Handling of Materials and Equipment.
- B. Storage and Protection:
 1. Keep products off ground using pallets, platforms, or other supports. Protect products from corrosion and deterioration.
 2. Conform to Section 01610, Transportation and Handling of Materials and Equipment.
- C. Handling of Products:
 1. Do not subject handrail and railing products to bending or stress.
 2. Do not damage edges or handle products in a manner that will cause scratches, warping, or dents.
 3. Protect handrails and railings by paper or coating as acceptable to handrail and railing manufacturer, against scratching, splashes of mortar, paint, and other marring during transportation, handling, and erection. Protect until completion of adjacent work.

1.06 GUARANTEE

- A. Guarantee: Manufacturer shall provide written guarantee of availability of replacement parts and components for period of at least five years after completion of the Project.

PART 2 – PRODUCTS

2.01 SYSTEM PERFORMANCE

- A. System Description: Aluminum handrail and railing system shall consist of equally spaced horizontal rails with totally concealed mechanical fasteners, internally threaded tubular rivets and components fastened to posts spaced no more than 5.0 feet on centers and system of handrails supported from adjacent construction by mounting brackets spaced at no more than 5.0 feet on centers.
- B. Design Criteria and Performance Criteria:
 1. Design, fabricate, and install aluminum handrail and railing systems to withstand the most critical effects resulting from the following loads (loads listed below do not act concurrently):
 - a. Uniform Load: 50 pounds per foot, applied at top in any direction.
 - b. Concentrated Load: 200 pounds single load, applied at any point along the top in any direction.
 - c. Components: Intermediate rails (all rails except the handrail), balusters, and panel fillers, if any, shall withstand horizontally-applied normal load of 50 pounds on an area equal to one square foot, including openings and space between rails. Reactions due to this loading are not required to be superimposed to loading specified for main supporting members of handrails and railings.

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- d. Conform to requirements of AA Aluminum Design Manual for determining allowable stresses and safety factors for aluminum structural components.
- e. Limit deflection in each single span of railing and handrail to 1.5-inch maximum, and to 1.4-inch maximum on railing posts. Applied loads shall not produce permanent deflection in the completed Work when loads are removed.
2. Thermal Control: Provide adequate expansion within fabricated systems that allows for thermal expansion and contraction caused by material temperature change of 140 degrees F to -20 degrees F without warp or bow of system components. Distance between expansion joints shall be based on providing 1/4-inch wide joint at 70 degrees F, which accommodates movement of 150 percent of calculated amount of movement for specified temperature range.
3. Where handrail and railing systems cross expansion joints in the building or structure, provide expansion joints in handrail and railings systems.
4. For posts located at or near end of runs as shown, uniformly space intermediate posts as required to conform to loading and deflection criteria specified, at intervals no greater than maximum post spacing specified. Where posts are shown for handrails along both sides of walkways and other similar locations, locate posts opposite each other; do not stagger post locations.

2.02 MANUFACTURERS

2.03 PRODUCTS AND MANUFACTURERS: PROVIDE ONE OF THE FOLLOWING:

- A. Custom Fabricated Connectorail System by Julius Blum & Company, Inc.
- B. Custom Fabricated Series 500 Non-Welded Aluminum Pipe Aluminum handrails and railing systems by Superior Aluminum Products, Inc.
- C. Or Equal.

2.04 MATERIALS

- A. Extruded Aluminum Architectural and Ornamental Shapes: ASTM B221, Alloy 6063-T52.
- B. Aluminum Forgings: ASTM B247.
- C. Extruded or Drawn Aluminum Pipe and Tube:
 1. ASTM B429 or ASTM B241/B241M, Alloy 6063-T5, 6063-T52, or 6063-T832 as required by loadings, deflections, and post spacing specified.
 2. Provide Schedule 40 pipe, minimum, unless conditions of detail and fabrication require extra-heavy pipe to comply with Specifications. Rails and posts shall have minimum outside diameter of 1.90 inches.
- D. Reinforcing Bars: Solid, circular profile, 24 inches long, 6061-T6 aluminum reinforcing bars with same outside diameter as inside diameter of post.
- E. Anchors and Fastenings:
 1. For anchors and fasteners, use Type 316 stainless steel; minimum 0.5-inch diameter.
 2. Provide minimum of four bolt fasteners per post where surface-mounted posts are shown. Components shall be in accordance with manufacturer's recommendations and as approved or accepted (as applicable) by Engineer on submittals.
 3. Anchors: As specified in Section 05051, Anchor Bolts, Toggle Bolts, and Concrete Inserts.
- F. Castings:
 1. Provide high-strength aluminum alloy brackets, flanges, and fittings suitable for anodizing as specified.
 2. Aluminum alloy sand castings: ASTM B26/B26M.
- G. Connector Sleeves: Schedule 40, 5.0-inch long by 1.610-inch diameter.
- H. Sockets: Provide six-inch deep by 2.5-inch outside diameter aluminum sockets with 3.5-inch wide socket cover on bottom of each socket and on top and bottom of removable post sockets.
- I. Custom Cover Flanges: 1/4-inch high by 4.0-inch diameter, aluminum.

2.05 ADHESIVE: TWO-PART WATERPROOF EPOXY-TYPE AS RECOMMENDED BY HANDRAIL AND RAILING SYSTEMS MANUFACTURER.

- A. Non-shrink Grout: Refer to Section 03600, Grout.
- B. Toeboards:
 - 1. Provide extruded Alloy 6063-T5 or T52 aluminum alloy toeboards, unless railing is mounted on curbs or other construction of sufficient height and type to conform to OSHA 1910.23. Bars or plates are not acceptable.
 - 2. Unless otherwise specified, toeboards shall conform to requirements of OSHA 1910.23, Section (e).
- C. System Components and Miscellaneous Accessories: Provide complete selection of manufacturer's standard and custom aluminum handrail and railing systems components and miscellaneous accessories required. Show type and location of all such items on Shop Drawings and other submittals as applicable.

2.06 FABRICATION

- A. General: Unless otherwise shown or specified, provide typical non-welded construction details and fabrication techniques recommended in NAAMM/AMP Pipe Railing Manual and NAAMM/AMP AMP 501.
- B. Fabricate handrail and railing systems true to line and level, with accurate angles surfaces and straight edges. Fabricate corners without using fittings. Provide bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work. Form elbow bends and wall returns to uniform radius, free from buckles and twists, with smooth finished surfaces, or use prefabricated bends. Provide not less than four-inch outside radius.
- C. Provide stainless steel chains across openings in railings where shown. Attach one end of each chain to a stainless steel eyebolt in post and other end attached by means of stainless steel swivel eye snap hook to similar eyebolt in opposite post.
- D. Remove burrs from exposed edges.
- E. Close aluminum pipe ends by using prefabricated fittings.
- F. Weep Holes:
 - 1. Fabricate joints that will be exposed to weather to exclude water.
 - 2. Provide 15/64-inch diameter weep holes at lowest possible point on each post in handrail and railing systems.
 - 3. Provide pressure relief holes at closed ends of handrail and railing systems.
- G. Toeboards:
 - 1. Provide manufacturer's standard toeboard, which accommodates movement caused by thermal change specified without warping or bowing toeboards.
 - 2. Provide manufacturer's standard toeboard, which accommodates storage for removable socket covers.
 - 3. Coordinate and cope toeboard as required to accommodate cover flanges at posts.
 - 4. Toeboards shall follow curvature of railing. Where railing is shown to have curved contours at corners, or other locations, toeboard shall likewise be curved to follow line of railing system.
- H. Reinforcing Bars: Provide reinforcing bar friction-fitted at each post in railing system. Extend reinforcing bars of tubes six inches into cast-in-place sleeves or other types of supporting brackets.
- I. Mechanically Fitted Component Pipe Handrail and Railing System:
 - 1. Use non-welded pipe handrail and railing system with posts, top and intermediate rail(s), and flush joints.
 - 2. Provide top and one intermediate horizontal rail, equally spaced.
 - 3. Do not use blind rivets, pop rivets, or other exposed fastening devices in the Work. Fasteners used for side-mounting fascia flanges where shown or specified may be exposed in the Work. Provide internal threaded aluminum rivets, stainless steel through-

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bolts with lock nuts, stainless steel sheet metal screws with lock washers, and epoxy adhesive for fastening components of the Work.

2.07 FINISHES

- A. General:
 - 1. Prepare surfaces for finishing in accordance with recommendation of aluminum producer and the finisher or processor.
 - 2. Adjust and control direction of mechanical finishes specified to achieve best overall visual effect in the Work.
 - 3. Color and Texture Tolerance: Provide uniform color and continuous mechanical texture for aluminum components. Engineer reserves the right to reject aluminum materials because of color or texture variations that are visually objectionable, but only where variation exceed range of variations established by manufacturer prior to fabrication, by means of range of samples approved by Engineer.
 - 4. Anodize aluminum components.
 - 5. Provide the following railing finishes:
 - 6. Rooftop railing finish shall be anodized bronze to match coping.
 - 7. Interior railings and exterior deck mounted railing shall be clear anodized finish.
- B. Mechanically finish aluminum by wheel or belt polishing with aluminum oxide grit of 180 to 220 size, using peripheral wheel speed of 6,000 feet per minute; AA Designation - M32 Medium Satin Directional Texture.
 - 1. Hand Rubbed Finish: Where required to complete the Work and provide uniform, continuous texture, provide hand-rubbed finish to match medium satin directional texture specified to even out and blend satin finishes produced by other means.
- C. Provide non-etching chemical cleaning by immersing aluminum in inhibited chemical solution, as recommended by coating applicator, to remove lard oil, fats, mineral grease, and other contamination detrimental to providing specified finishes. Clean and rinse with water between steps as recommended by aluminum manufacturer.
- D. Exposed Aluminum Anodic Coating: Provide anodic coatings as specified that do not depend on dyes, organic or inorganic pigments, or impregnation processes to obtain color. Apply coatings using only the alloy, temperature, current density, and acid electrolytes to obtain specified colors in compliance with designation system and requirements of NAAMM/AMP Pipe Railing Manual and NAAMM/AMP AMP 501. Comply with the following:
 - 1. Provide Architectural Class I high density anodic treatment by immersing the components in tank containing solution of 15 percent sulfuric acid at 70 degrees F with 12 amperes per square foot of direct current for minimum of sixty minutes; AA Designation A41 Clear or AA Designation A42 Bronze as indicated above.
 - 2. Physical Properties:
 - a. Anodic Coating Thickness, ASTM B244: Minimum of 0.7-mils thick.
 - b. Anodic Coating Weight, ASTM B137: Minimum of 32 mg/sq. in.
 - c. Resistance to Staining, ASTM B136: No stain after five minutes dye solution exposure.
 - d. Salt Spray, ASTM B117: 30,000 hours exposure with no corrosion or shade change.
 - 3. Seal finished anodized coatings using deionized boiling water to seal pores and prevent further absorption.
 - 4. Products and Manufacturers: Provide one of the following:
 - a. Alumilite 215 Clear or Duranodic 313 by Aluminum Company of America, Inc.
 - b. Or equal.

2.08 SOURCE QUALITY CONTROL

- A. Allowable Tolerances:
 - 1. Limit variation of cast-in-place inserts, sleeves and field-drilled anchor and fastener holes to the following:
 - a. Spacing: Plus-or-minus 3/8-inch.
 - b. Alignment: Plus-or-minus 1/4-inch.

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- c. Plumbness: Plus-or-minus 1/8-inch.
2. Minimum Handrails and Railings Systems Plumb Criteria:
 - a. Limit variation of completed handrail and railing system alignment to 1/4-inch in 12.0 feet with posts set plumb to within 1/16-inch in 3.0 feet.
 - b. Align rails so variations from level for horizontal members and from parallel with rake of stairs and ramps for sloping members do not exceed 1/4-inch in 12.0 feet.
3. Provide “pencil-line” thin butt joints.

2.09 FACTORY TESTING:

- A. Perform load test on completed handrail and railing systems. Extent of handrail and railing systems to be factory-tested shall be as shown and specified.
- B. Load test completed handrail and railing systems in accordance with requirements of ASTM E935. Provide written report to Engineer identifying and documenting testing methods used, magnitude and location of loads superimposed, and results of such tests on actual completed handrail and railing systems, including all anchors and fasteners to be used in the Work. Testing setup shall simulate actual conditions of installation to be used in the Work.
- C. Do not ship products from factory until Engineer accepts load testing report.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Examine conditions under which Work is to be performed and notify Engineer, in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with installation until unsatisfactory conditions are corrected.
- B. Verify to Engineer gauge of aluminum pipe railing posts and rails brought to the Site by actual measurement of on-Site material in presence of Engineer.

3.02 INSTALLATION

- A. General:
 1. Do not erect components that have become scarred, dented, chipped, discolored, other-wise damaged or defaced. Remove from Site railing and handrail system components that have holes, cuts, gouges, deep scratches, or dents of any kind. Repairs to correct such Work will not be accepted. Remove and replace with new material.
 2. Comply with installation and anchorage recommendations of NAAMM/AMP Pipe Railing Manual and NAAMM/AMP AMP 501 in addition to requirements specified and approved or accepted (as applicable) submittals.
- B. Fastening to In-Place Construction:
 1. Remove protective plastic immediately before installing.
 2. Adjust handrails and railings prior to securing in place, to ensure proper matching at butting joints and correct alignment throughout their length. Plumb posts in each direction. Secure posts and rail ends to building or structure as follows:
 - a. Anchor posts in concrete by means of sockets set and anchored into concrete floor slab. Provide closure secured to bottom of sleeve. Before installing posts, remove debris and water from sleeves. Verify that reinforcing bars or tubes have been inserted into posts before installation. Do not install posts without reinforcing bar. For all non-removable handrail and railing systems sections, after posts have been inserted into sockets, fill annular space between posts and sockets solid with grout as specified in Section 03600, Grouting. Crown the grout and slope grout to drain away from posts.
 - b. Side-mount posts by fastening them securely in brackets attached to steel in accordance with approved or accepted (as applicable) submittals.
 - c. Posts set in concrete shall be provided with an aluminum floor cover flange.
 3. Use devices and fasteners recommended by handrail and railing systems manufacturer and as shown on approved or accepted (as applicable) submittals.
- C. Cutting, Fitting and Placement:

SECTION 05522 – ALUMINUM HANDRAILS AND RAILINGS

1. Perform cutting, drilling and fitting required for installation. Set the Work accurately in location, alignment, and elevation, plumb, level, true, and free of rack, measured from established lines and levels.
 2. Fit exposed connections accurately together to form tight hairline joints. Do not cut or abrade surfaces of units that have been finished after fabrication, and are intended for field connections.
 3. Make permanent field splice connections using manufacturer's recommended epoxy adhesive and 5.0-inch minimum length connector sleeves. Tight press-fit field splice connectors and install in accordance with manufacturer's written instructions. Follow epoxy manufacturer's recommendations for requirements of installation and conditions of use.
 4. Make splices as near as possible to posts, but not exceeding 12.0 inches from nearest post.
 5. Field welding is not allowed. Make splices using pipe splice lock employing a single allen screw to lock joint.
 6. Securely fasten toeboards in place with not more than 1/4-inch clearance above floor level.
 7. Drill one 15/64-inch diameter weep hole not more than 1/4-inch above top of location of solid reinforcing bar or tube in each post.
- D. Protection from Dissimilar Materials:
1. Coat aluminum surfaces in contact with dissimilar materials such as concrete, masonry, and steel, in accordance with Section 09900, Painting.
 2. Do not extend coating beyond contact surfaces. Remove coating where exposed-to-view in the finished Work.

3.03 CLEANING AND REPAIRING

- A. Cleaning: Clean exposed surfaces of handrail and railing systems after completing installation. Comply with recommendations of both handrail and railing system manufacturer and finish manufacturer. Do not use abrasives or unacceptable solvent cleaners. Test cleaning techniques on an unused section of railing before employing cleaning technique.
1. Remove stains, dirt, grease, and other substances by washing handrails and railings systems thoroughly using clean water and soap; rinse with clean water.
 2. Do not use acid solution, steel wool, or other harsh abrasives.
 3. If stain remains after washing, remove defective sections and replace with new material meeting requirements of this Section.
- B. Handrails and railings shall be free from dents, burrs, scratches, holes, and other blemishes. Replace damaged or otherwise defective Work with new material that conforms with this Section at no additional cost to Owner.
- C. At Substantial Completion, replace adjacent work marred by the Work of this Section.

END OF SECTION

SECTION 05522 – ALUMINUM HANDRAILS AND RAILINGS

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SECTION 05540 – METAL CASTINGS

PART 1 -- GENERAL

1.01 SECTION INCLUDES

- A. Furnish all materials, labor, and equipment required to provide all castings in accordance with the requirements of the Contract Documents.

1.02 RELATED SECTIONS

- A. Section 02604 – Utility Structures

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. Building Code of New York State

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300, Submittals.
 - 1. Complete fabrication and erection drawings of all castings specified herein.
 - 2. Other submittals as required in accordance with Section 05010, Metal Materials.

PART 2 -- PRODUCTS

2.01 METAL MATERIALS

- A. Metal materials for castings: ASTM A48 - Standard Specification for Gray Iron Castings.

2.02 METAL FASTENING

- A. All welds and fasteners used for castings shall conform to Section 05050, Metal Fastening, unless noted otherwise.

2.03 IRON CASTINGS

- A. General - Iron Castings shall include, but not be limited to frames, covers, and grates for trench drains, catch basins, inlets, and manholes.
 - 1. Castings shall be of gray iron of uniform quality, free from defects, smooth and well cleaned by shotblasting.
 - 2. Catalog numbers on the Drawings are provided only to show required types and configuration. All covers shall be cast with raised letters as designated on the Drawings.
 - 3. Casting manufacturers: Campbell Foundry, Neenah Foundry Company, East Jordan Iron Works, or equal.
- B. Covers and Grates
 - 1. Provide covers and grates with matching frames. Cover shall fit flush with the surrounding finished surface. The cover shall not rock or rattle when loading is applied.
 - 2. Round covers and frames shall have machined bearing surfaces.
 - 3. Design loadings:
 - a. Where located within a structure, a minimum design loading of 300 psf shall be used, unless noted otherwise.
 - b. At all locations not within a structure, the design loading shall be a standard AASHTO H-20 truck loading, unless otherwise noted.
- C. Watertight gasketing, bolting, locking devices, patterns, lettering, pickholes, vents, or self-sealing features shall be as detailed on the Drawings.

PART 3 -- EXECUTION

3.01 FABRICATION

- A. All measurements and dimensions shall be based on field conditions and verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.
- B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. Provide all miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation.

SECTION 05540 – METAL CASTINGS

- C. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.

3.02 INSTALLATION

- A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.
- B. Install castings square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

END OF SECTION

SECTION 06202
GLASS FIBER REINFORCED PLASTIC FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Glass fiber reinforced, resin fabrications.
- B. FRP guardrail and handrail systems.
- C. FRP gratings, support systems and connections.
- D. FRP stair treads.
- E. FRP toeplates

1.02 REFERENCE STANDARDS

- A. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2022.
- C. FM (AG) - FM Approval Guide; Current Edition.
- D. ITS (DIR) - Directory of Listed Products; Current Edition.
- E. UL (DIR) - Online Certifications Directory; Current Edition.

1.03 DESIGN REQUIREMENTS

- A. Grating and stair design Live and Dead Loads: 100 lbs/sq ft (690 kPa) or a concentrated load of 300 pounds with deflection limited to 1/360 of span unless noted otherwise on the design drawings.
- B. Railing systems shall be designed to withstand a single concentrated 200 pound point load applied in any direction at any point along the top rail in accordance with the Building Code of New York State.
- C. Molded grating and molded stair treads shall not deflect more than 1/4" and structural support members shall not deflect more than L/180 of span for structural members unless specifically stated otherwise in drawings and/or supplementary conditions. Connections shall be designed to transfer the design loads.
- D. Layout: Each grating section shall be readily removable, except where indicated on drawings. Manufacturer to provide openings and holes where located on the contract drawings. Grating openings which fit around protrusions (pipes, cables, machinery, etc.) shall be discontinuous at approximately the centerline of opening so each section of grating is readily removable.
- E. Design items with sufficient strength for handling stresses.
- F. The FRP standard railing system, including connections, shall be designed to meet the configuration and loading requirements of OSHA 1910.23 and IBC with a minimum 2.0 factor of safety.
- G. Additional ADA handrail to be installed where indicated on plans.
- H. The completed ladder installation shall meet the following load requirements set forth in OSHA 1910.27. The ladder shall also be capable of supporting a concentrated vertical load of 1,200 pounds applied at the mid-span of the rung. Manufacturer shall be required to provide supporting test data for rung capacity.
- I. All ladders shall be designed and laid out in strict accordance with OSHA 1910.27.
- J. Temperature exposure is limited to 100°F (38°C) unless specifically stated otherwise in drawings and/or supplementary conditions.
- K. Stair Tread Design:
 - 1. Load/Deflection: Fibertred® stair treads shall meet manufacturer's published recommended loading with deflection not to exceed the following:

- a. Concentrated load of 500 pounds, placed at the centerline of a 36" tread span with a maximum deflection not to exceed 0.32".
- b. The concentrated load is applied at the centerline of the tread, over a width of 4" and a depth of 6", starting at the nosing edge to simulate the landing of a foot.
- c. The manufacturer shall certify that the stiffness of all panels manufactured are never more than 2.5% below the published load-deflection values.

1.04 SUBMITTALS

- A. See Section - 013300 - SHEET METAL WORK for submittal procedures.
- B. Product Data: Provide data on specified component products.
- C. Shop Drawings: Indicate design load parameters, dimensions, adjacent construction, materials, thicknesses, fabrication details, required clearances, field jointing, tolerances, connections, colors, finishes, methods of support, integration of plumbing and electrical components, and anchorages.
- D. Samples: Submit two samples, 6 x 6 inch (152 x152 mm) in size, illustrating color, texture, and finish.
- E. Maintenance Data: Include instructions for stain removal, surface and gloss restoration, and general cleaning recommendations.
- F. Guardrail and railing assembly shop drawings and calculations provided shall bear the seal and signature of a registered professional engineer licensed in the state of New York.

1.05 QUALITY ASSURANCE

- A. Designer Qualifications: Design under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.
- B. The material covered by these specifications shall be furnished by an ISO-9001:2008 certified manufacturer of proven ability who is regularly engaged in the manufacture, fabrication and installation of FRP systems.
- C. Manufacturer Qualifications: Company specializing in architectural glass fiber and resin components with five years documented experience with sufficient production capacity to produce required units without causing delay in the work.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. All systems, sub-systems and structures shall be shop fabricated and assembled into the largest practical size suitable for transporting.
- B. Protect components from damage by retaining shipping protection in place until installation.
- C. Identify and match-mark all materials, items and fabrications for installation and field assembly.
- D. All materials and equipment necessary for the fabrication and installation of guardrail/handrail and appurtenances shall be stored before, during, and after shipment in a manner to prevent cracking, twisting, bending, breaking, chipping or damage of any kind to the materials or equipment, including damage due to over exposure to the sun. Any material which, in the opinion of the Architect, has become damaged as to be unfit for use, shall be promptly removed from the site of work, and the Contractor shall receive no compensation for the damaged material or its removal.

1.07 FIELD CONDITIONS

- A. Do not install site fabricated components when site conditions may be detrimental to successful installation.
- B. Maintain temperature and humidity conditions favorable to proper curing of resin during and after installation.
- C. Field verify measurements for stair and railing assemblies that require coordination and consideration to existing and new previously installed construction, including items installed under other prime contracts.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Glass Fiber and Resin Fabrications:
1. Fibergrate Composite Structures, Inc.; Vi-Corr® molded grating, Fibertred® stair treads and Dynaform SAFRAIL railing systems
 2. Strongwell; DURAGRATE Molded grating and Strongwell Railing system. .
 3. Substitutions: See Section 01 6100 - Product Requirements.

2.02 REGULATORY REQUIREMENTS

- A. Conform to FM Assembly Design No. UL 94 V-0..
- B. Conform to applicable code for a flame/smoke index rating of 25/0 in accordance with ASTM E84 listed product requirements.

2.03 MATERIALS

- A. Pultruded FRP Materials:
1. Materials used in the manufacture of the FRP products shall be raw materials in conformance with the specification and certified as meeting the manufacturer's approved list of raw materials.
 2. All structural shapes are to be manufactured by the pultrusion process with a glass content minimum of 45%, maximum of 55% by weight. The structural shapes shall be composed of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions as specified in the Contract Documents.
 3. Fiberglass reinforcement shall be a combination of continuous roving, continuous strand mat, and surfacing veil in sufficient quantities as needed by the application and/or physical properties required.
 4. The visual quality of the pultruded shapes shall conform to ASTM D4385.
 5. FRP guardrail/handrail shall be manufactured using a pultruded process utilizing vinyl ester resin with flame retardant and ultraviolet (UV) inhibitor additives. Unless a phenolic resin system is utilized, a synthetic surface veil fabric shall encase the glass reinforcement. FRP shapes shall achieve a flame spread rating of 25 or less in accordance with ASTM test method E84, the flammability characteristics of UL 94 V0 and the self-extinguishing requirements of ASTM D635.
 6. FRP products exposed to weather shall contain an ultraviolet inhibitor. Should additional ultraviolet protection be required, a one mil minimum UV coating may be applied. Products manufactured with a phenolic resin system shall be coated with a one mil minimum UV coating.
 7. All exposed railing surfaces shall be smooth and true to form, consistent with ASTM D4385.

Fiberglass Pultruded Material Properties				
Properties	Test	Units	Value	
Tensile Strength	ASTM D790	psi	30,000	
Tensile Modulus	ASTM D638	psi	2.5 x 10 ⁶	
Flexural Strength	ASTM D790	psi	30,000	
Flexural Modulus	ASTM D790	psi	1.8 x 10 ⁶	
Flexural Modulus (Full Section)		psi	2.8 x 10 ⁶	
Short Beam Shear (Transverse)	ASTM D2344	psi	4,500	
Shear Modulus (Transverse)	N/A	psi	4.5 x 10 ⁵	
Coefficient of Thermal Expansion	ASTM D696	in/in/deg F	8.0 x 10 ⁻⁶	

Flame Spread	ASTM E84	N/A	25 or less	
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B. FRP Molded Grating Materials:

1. All mechanical performance standards set forth by the Fiberglass Grating Manufacturers Council (FGMC) in the FRP Composites Grating Manual for Pultruded and Molded Grating and Stair Treads.
2. A flame spread rating of 25 or less in accordance with ASTM E84, and flammability characteristics of UL 94 V0 and the self-extinguishing requirements of ASTM E84. (Polyester resin is available without flame retardant and UV inhibitor additives.)
3. NSF® Standard 61 Certified with flammability characteristics of UL 94 V0 and the self-extinguishing requirements of ASTM E84.
4. Food-grade with flammability characteristics of UL 94 V0 and the self-extinguishing requirements of ASTM D635.

Resin Systems	
Description	Resin Base
Chemical Resistant - Fire Retardant	Vinyl Ester
Industrial Grade - Fire Retardant	Isophthalic
Architectural Grade - Fire Retardant	Orthophthalic
High Temperature – Low Smoke/Low Flame	Phenolic
Low Flame/Class 1 Smoke	Custom Blend

C. FRP Molded Grating System:

1. Grating shall be reinforced with continuous rovings of equal number of layers in each direction. The top layer of reinforcement shall be no more than 1/8" below the top surface of the grating so as to provide maximum stiffness and prevent resin chipping of unreinforced surfaces. Percentage of glass (by weight) shall not exceed 35% so as to achieve maximum corrosion resistance, and as required to maintain the structural requirements of the CONTRACT.
2. The FRP molded grating and treads shall be manufactured by the open mold process.
3. Grating shall be 2 inches square mesh with a 2 inch depth with a tolerance of plus or minus 1/16 inch mesh centerline to centerline. Grating shall be a molded type with a meniscus top surface. Color shall be as selected by the Engineer.
4. Grating Pedestal Support System:
 - a. Grating pedestals shall be adjustable. Pedestal shall consist of molded bases and tops, with DYNAFORM® pedestals joining the bases and tops and Type 316 stainless steel threaded rods for adjustability.
 - b. Pedestals shall be 2-1/8 inches x 3/16 inch square tube as manufactured by the pultrusion process. Adjustability shall be achieved with a 316 stainless steel all-thread component that threads into the molded fittings. Color shall be light gray.
 - c. Provide Quad and Single Head Mini Pedestal support heads with retainer clips for grating supports as indicated on the approved manufacturer shop drawings.
 - d. Provide Type 316 stainless steel retainer and M saddle clips spaced at maximum of four feet apart with a minimum of four per piece of grating, for each grating connection and anchorage point as recommended by the manufacturer and as indicated on the approved shop drawings.
 - e. Design: Pedestal floor system shall be designed for a uniform load of 50 psf or concentrated load of 300 lb. Deflection of supported grating is not to exceed 0.375 inch. Grating pedestals are to be laid out according to the manufacturers published literature or as indicated in the contract drawings.
5. Provide 3 inch x 3 inch x 3/8 inch thick FRP ledge angles as required to mount grates to concrete surfaces. Provide 3/8 inch diameter 316SS Hilti Kwik Bolt TZ anchors stainless

steel expansion type epoxy set anchors spaced at 16 inches o.c. maximum or less if required for loading conditions.

6. Provide FRP embedment angles at recessed grating locations as indicated on the drawings. Coordinate provision of these embedments with the timing of the concrete installations in order to set into formwork prior to concrete installations.
7. Provide manufacturers embedment sleeves / angles for fixed handrails set into the poured concrete flatwork.
8. Molded stairtreads shall be 1-1/2 inches (38.1 mm) thick in a 1-1/2 inches (38.1 mm) x 6 inches (152.4 mm) rectangular mesh pattern. The resin system will be the same as the molded grating. The stairtread shall come complete with anti-slip nosing.

2.04 FRP RAILINGS

- A. The FRP standard railing system, including connections, shall be designed to meet the configuration and loading requirements of OSHA 1910.23 and IBC with a minimum 2.0 factor of safety.
- B. Guardrail height is 42" (1067mm) from the top of walkway to the top of the guardrail.
- C. The rails and posts shall be:
 1. 1 3/4 inches x 1 3/4 inches x 0.125 inch (50.8 mm x 50.8 mm x 3.81 mm) square tubes with 1 3/4 inch x 6 inch bottom plates and angle connectors to vertical subframe support posts with Quad-Head Pedestal caps and threaded adjustment rods set into support legs in sizes indicated or required to accommodate loading requirements.
 2. Provide continuous Toe Plates with corner and splice connectors bolted to the rail posts with 1/4 inch diameter stainless steel round head bolt assemblies as per the manufacturer.
 3. The pultruded parts shall be made with a fire retardant resin that achieves a flame spread rating of 25 or less in accordance with ASTM test method E84, flammability characteristics of UL 94 V0 and meet the self-extinguishing requirement of ASTM E84. The resin matrix shall be polyester and shall contain a UV inhibitor. The color shall be chosen from manufacturer's standard colors.
- D. The SAFRAIL fiberglass standard railing system shall be fabricated into finished sections by fabricating and joining together the pultruded square tube using glass-reinforced thermoset components; epoxy bonded and connected as shown in the fabrication details. Railing sections shall be fabricated to the size shown on the approved fabrication drawings and shall be piece marked with a water proof tag.
- E. For Side Mount: Post shall be constructed with a pultruded bottom plug. Length shall be sufficient to extend a minimum of 1 inch (25.4 mm) beyond the uppermost bolt hole to prevent crushing of post tubing. Bolt holes shall provide clearance of 1/16 inch (1.59 mm) for 1/2 inch (12.7 mm) diameter bolts/studs. On square tubes, holes shall be on longitudinal center line of post, 1 inch (25.4 mm) from bottom of post (minimum) and not less than 3 inches (76.2 mm) apart on center. Posts shall be fastened with stainless steel anchor bolts or studs, 1/2 inch (12.7 mm) diameter.
- F. Post locations shall be no greater than 18 inches (457 mm), nor less than 9 inches (229 mm) from horizontal or vertical change in handrail direction. For square tubes, post centers shall be no greater than 60 inches (1524 mm) apart on any straight run or rail, or 48 inches (1220 mm) apart on any inclined rail section.

2.05 FRP STAIR TREADS

- A. FRP Stair treads shall be Fibertred® as manufactured by Fibergrate Composite Structures Incorporated or approved equal. Fibertred® stair treads shall be of a one-piece molded construction and shall have a 1 1/2 inch x 6 inch rectangular mesh pattern providing unidirectional strength in the tread span direction. Fibertred® shall be reinforced with continuous rovings in each direction. The top layer of reinforcement shall be no more than 1/8 inch below the top surface of the tread so as to provide maximum stiffness and prevent resin chipping of unreinforced surfaces. Percentage of glass (by weight) shall not exceed 35% so as to achieve maximum corrosion resistance, and as required to maintain the structural requirements. After molding, no dry glass fibers shall be visible on any surface of bearing bars

or cross bars. All bars shall be smooth and uniform with no evidence of fiber orientation irregularities, interlaminar voids, porosity, resin rich or resin starved areas.

- B. Non slip surfacing: Fibertred® stair treads shall be manufactured with a concave, meniscus profile on the top of each bar providing maximum slip resistance. For additional safety, and to meet OSHA requirements, stair treads shall be manufactured with a 1 1/2 inch solid, molded nosing. Nosing shall be gritted with an angular quartz grit, integrally molded into the top surface of the nosing area only.
- C. Fire rating: Fibertred® stair treads shall be fire retardant with a tested flame spread rating of 25 or less when tested in accordance with ASTM E84. Test data performed only on the resin shall not be accepted.
- D. Resin system: The resin system used in the manufacture of Fibertred® stair treads shall be Vi-Corr®. Manufacturer may be required to submit corrosion data from tests performed on actual stair tread products in standard chemical environments. Corrosion resistance data of the base resin from the manufacturer is not a true indicator of stair tread product corrosion resistance and shall not be accepted.
- E. Thickness: 1-1/2 inch thick with a tolerance of plus or minus 1/16 inch.
- F. Mesh Configuration: 1-1/2 inch x 6 inch rectangular mesh pattern with double cross bars on 6 inch centers which allows optimum utilization and ease of fabrication.
- G. Hardware: Type 316 stainless steel hold down clips shall be provided and spaced as recommended by the manufacturer. A minimum of four hold-down clips shall be required for each tread.

2.06 FABRICATION

- A. Mold Material: Metal type.
- B. Finish other surfaces not in contact with the mold to match the molded surfaces in appearance.
- C. Finish trim corners and edges.
- D. Cure components prior to shipment and remove material that may be toxic to plant or animal life.
- E. The fabricated railing sections shall be supplied complete with fittings by the FRP manufacturer. The components used to join fabricated sections together may be shipped loose, to be epoxied and riveted together in the field by the contractor.
- F. All ladder rungs shall penetrate the wall of the tube side rails and shall be connected to the rails with both epoxy and rivets to provide both a chemical and mechanical lock, respectively.
- G. Ladders shall be fully shop assembled. Ladder cages shall be test assembled and drilled to ensure a proper fit in the field.

2.07 FINISH

- A. Color: Green grating, Yellow Railing..
- B. Exposed to view Surface Texture: Railing surfaces shall be smooth. grating surfaces shall be non-slip..

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work and dimensions are as indicated on shop drawings.

3.02 PREPARATION

- A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

3.03 INSTALLATION

- A. Install fabrications in accordance with shop drawings and fabricator's instructions.
- B. Fasten grating panels securely in place with hold down fasteners as specified herein.
- C. Fastening to in-place construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous FRP fabrications to in-place construction; include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts and other connectors as determined by the Design Engineer.
- D. Follow manufacturer's instructions when cutting or drilling fiberglass products or using resin products; provide adequate ventilation. Field cut and drill fiberglass reinforced plastic products with carbide or diamond tipped bits and blades for drilling and fitting required for installation of miscellaneous FRP fabrications. Set FRP fabrication accurately in location, alignment and elevation; with edges and surfaces level, plumb, true and free of rack; measured from established lines and levels.
 - 1. All field cut and drilled edges, holes and abrasions shall be sealed with a catalyzed resin compatible with the original resin as recommended by the manufacturer.
- E. The fabricated handrail sections shall be installed as shown on the approved shop drawings. The handrail sections shall be accurately located, erected plumb and level. The sections shall be fastened to the structure as shown on the approved shop drawings.

3.04 TOLERANCES

- A. Maximum variation from true position: 1/4 inch (6 mm).
- B. Maximum offset from true alignment: 1/8 inch (3 mm).

3.05 CLEANING

- A. Clean components of foreign material without damaging finished surface.
- B. Hand rub smooth surfaces with polishing cream.
- C. Clean fabrications in accordance with fabricator's instructions.

3.06 PROTECTION

- A. Place protective structural covering over installed units.

END OF SECTION 06602

SECTION 08315 – ACCESS DOORS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish and install, as shown on the plans and specified herein, flood tight access doors for the wet wells, valve chambers, and meter pits at the Knott Drive, Viola Drive, and Morgan Park pumping stations.

1.02 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Indicate on shop drawings plan layout, construction details and required clearances.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. USF Fabrication, Hialeah, FL.
- B. BILCO Company, New Haven, CT.
- C. Halliday Products, Orlando, FL.
- D. Approved equal.

2.02 ACCESS DOORS

- A. Fabricate frames of 1/4-inch thick aluminum channel with anchor flange round the perimeter.
- B. Fabricate door leaf of 1/4-inch aluminum diamond plate reinforced with aluminum stiffeners as required to withstand live load indicated in schedule
- C. Hinges: Heavy duty, bolted to underside of door.
- D. Doors shall open to 90° and lock automatically in that position. Provide stainless steel pins compression spring operators for easy operation. Provide a vinyl grip handle to release the cover for closing. Doors shall not protrude into the channel frame when open.
- E. Doors shall close flush with frame and rest on built in neoprene cushion/gasket.
- F. Equip doors with a stainless-steel slam lock. Provide two (2) removable square key wrenches.
- G. Hardware and safety chain: 316 stainless steel.
- H. Factory Finish: Mill finish with bituminous coating applied to exterior of frame.
- I. Secondary protective grating panel:
 - 1. Grating panel shall be hinged and supplied with positive latch to maintain unit in an upright position. Panel shall be hinged to open in the same direction of the access door(s) to limit obstruction of the opening.
 - 2. Grating panel color and finish shall be Safety Orange powder-coating.
 - 3. Grating panel shall be capable of supporting a minimum of 300 psf.
 - 4. A padlock hasp for owner-supplied padlock shall be provided.
- J. Guarantee access doors against defects in material and workmanship for a period of ten (10) years.
- K. Drain Coupling: 1 1/2- inch diameter drain coupling welded under the channel frame for connection of a drain pipe.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install access doors in accordance with manufacturer's instructions.
- B. Install the work of this Section in strict accordance with the approved shop drawings, the original design and all pertinent regulations and codes, anchoring all components firmly into position for long life under hard use.

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- C. Provide and install Schedule 40 PVC drain piping from the floor access hatch cover channel frame and route outside the structure.
- D. Provide 1 cubic foot of crushed stone or gravel below drain to prevent erosion of the sediment.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope:
1. Contractor shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install finish hardware
 2. Extent of door hardware is specified. Door finish hardware is defined to include all items known commercially as finish hardware, except special types of unique and non-matching hardware specified in the same Section as the door and door frame.
 3. Types of finish hardware required include the following:
 - a. Continuous hinges.
 - b. High-security mortise locksets.
 - c. Panic exit devices.
 - d. Keyed Removable mullions.
 - d. Heavy-duty, overhead, surface-mounted, door closers.
 - e. Heavy-duty, concealed, adjustable, overhead holders and stops.
 - f. Cylinders for doors specified in other Sections.
 - g. Stripping and seals.
 - h. Thresholds.
 - i. Silencers.
 - j. Miscellaneous items and accessories for a complete installation functioning in compliance with the requirements of governing authorities having jurisdiction at the Site.
- B. Coordination:
1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with, or before, the finish hardware.
 2. Coordinate the Work of other Sections to provide clearances and accurate positioning of recessed or cast-in-place items.

1.02 REFERENCES

- A. Standards referenced in this Section or referenced in Product Performance Standard are listed below:
1. ANSI A117.1, Accessible and Usable Buildings and Facilities.
 2. ANSI/BHMA A156.1, Butts and Hinges.
 3. ANSI/BHMA A156.3, Exit Devices.
 4. ANSI/BHMA A156.4, Door Controls - Closers.
 5. ANSI/BHMA A156.5, Auxiliary Locks and Associated Products.
 6. ANSI/BHMA A156.6, Architectural Door Trim.
 7. ANSI/BHMA A156.7, Template Hinge Dimensions.
 8. ANSI/BHMA A156.8, Door Controls - Overhead Stops and Holders.
 9. ANSI/BHMA A156.13, Mortise Locks and Latches, Series 1000.
 10. ANSI/BHMA A156.16, American National Standard for Auxiliary Hardware.
 11. ANSI/BHMA A156.18, Hardware - Materials and Finishes.
 12. ANSI/BHMA A156.21, Thresholds.
 13. ANSI/BHMA A156.22, Door Gasketing and Edge Seal Systems.
 14. ANSI/BHMA A156.24, Delayed Egress Locks.
 15. ANSI/DHI A115.1, Preparation of Mortise Locks in 1-3/8-inch and 1-3/4-inch Standard Steel Doors and Frames.
 16. ANSI/NFPA 252, Standard Methods of Fire Tests of Door Assemblies.
 17. ASTM E329, Standard Specification for Agencies Engaged in Construction Inspection and/or Testing.
 18. FF-TT-S-00227.
 19. NIST, U. S. Standard.

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20. NFPA 70, National Electric Code.
21. NFPA 80, Fire Doors and Fire Windows.
22. NFPA 101, Life Safety Code.
23. SDI 109, Hardware for Standard Steel Doors and Frames.
24. SDI 118, Basic Fire Door Requirements.
25. UL 10B, Fire Tests of Door Assemblies.
26. UL 10C, Positive Pressure Fire Tests of Door Assemblies.
27. UL 305, Panic Hardware.
28. UL, Building Materials Directory.
29. UL, List of Inspected Fire Protection Equipment and Material.

1.03 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 1. Provide finish hardware and accessories manufactured by firms specializing in the production of this type of Work and complying with specified standards of ANSI, BHMA, DHI, NFPA, HMMA, SDI and UL.
 2. Provide finish hardware from manufacturers who are members of BHMA and participate in BHMA certification programs.
- B. Installer's Qualifications:
 1. The finish hardware installer shall have in his employ an architectural hardware consultant. The architectural hardware consultant shall be a member of the Door and Hardware Institute, (DHI), who has passed the DHI certification examine and successfully completed an apprenticeship program. The architectural hardware consultant shall be responsible for preparing finish hardware schedules and Shop Drawings and be present at the Site for the purpose of checking and supervising the Work of the installer during the time of installation and adjustment of the finish hardware Work. Architectural hardware consultant shall prepare a written field report on status of completed finish hardware installation as specified.
 2. Submit name and qualifications of the installer and hardware consultant to Engineer.
- C. Architectural Hardware Consultant Qualifications:
 1. A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.
- D. Component Supply and Compatibility:
 1. Finish hardware equipment manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 2. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the finish hardware manufacturer.
- E. Testing Agency Qualifications: The independent testing agency shall demonstrate to Engineer's satisfaction, based on evaluation of criteria submitted by testing agency, that it has the experience and capability to satisfactorily conduct the testing indicated in accordance with ASTM E 329, without delaying the Work.
- F. Source Quality Control:
 1. Obtain each type of finish hardware item from only one manufacturer.
 2. Provide finish hardware schedule, for submission to, and for approval by, Engineer, prepared in compliance with specified DHI standards.
 3. Comply with specified BHMA standards.

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- G. Requirements of Regulatory Agencies:
1. Provide door finish hardware for fire-resistance-rated openings in compliance with NFPA 80.
 2. Provide only finish hardware that has been tested, listed and labeled by UL for the types and sizes of doors required, and complies with the requirements of the door and door frame labels.
 3. Modify features of finish hardware items specified, and provide additional accessories and features as required to meet UL and NFPA 80 requirements, at no additional cost to the Owner.
 4. Test Pressure: After 5 minutes into the test, neutral pressure level in furnace shall be established at 40 inches or less above the sill.
- H. Preconstruction and Keying Conference: Conduct conference at Project site to comply with requirements in Section 01210, Preconstruction Conference. In addition to OWNER, CONTRACTOR, and Engineer, conference participants shall also include Architectural Hardware Consultant and Owner's security consultant.
1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 2. Review required testing, inspecting, and certifying procedures.
 3. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
 - a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - b. Preliminary key system schematic diagram.
 - c. Requirements for key control system.
 - d. Address for delivery of keys.

1.04 SUBMITTALS

- A. Action Submittals
1. Shop Drawings: Submit the following:
 - a. Copies of manufacturer's data for each item of finish hardware. Include whatever information may be required to show compliance with specified requirements and include instructions for installation and for maintenance of operating parts and exposed finishes. Include mounting heights and locations for each item of finish hardware. Provide Engineer with latest complete technical catalogue of all available finish hardware manufactured by proposed manufacturers, even if manufacturer specified by Engineer is submitted by Contractor to perform the Work. Furnish templates to fabricators of other Work, which is to receive finish hardware.
 - b. Copies of the Door Finish Hardware Schedule, prepared by the Architectural Hardware Consultant, in the manner and format specified, complying with the actual construction Progress Schedule requirements (for each draft). Include explanation of abbreviations, symbols, and codes used to present scheduled information.
 - 1) Prepare and submit Door Finish Hardware Schedule in compliance with DHI standards.
 - c. Based on the finish hardware requirements specified, organize the final Door Finish Hardware Schedule into "hardware sets," indicating complete designation of every item required for each door or opening. Furnish initial draft of schedule at the earliest possible date, in order to facilitate the fabrication of other Work that may be critical in the Project Schedule. Furnish final draft of schedule after Samples, manufacturer's data sheets, coordination

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with Shop Drawings for other Work, delivery schedules and similar information have been completed and accepted.

- d. Include a separate key schedule, showing clearly how Owner's final instructions on keying of locks have been fulfilled.
- e. Door Finish Hardware Schedules are intended for coordination of the Work. Review and acceptance by Engineer does not relieve Contractor of responsibility to fulfill the requirements as shown and specified.
- f. Field Report: Architectural Hardware Consultant's Report.
- g. Maintenance Manual: Upon completion of the Work, furnish five copies of detailed maintenance manuals, including the following information:
 - 1) Product name and manufacturer.
 - 2) Name, address, e-mail address and telephone number of manufacturer and local distributor.
 - 3) Detailed procedure for routine maintenance and cleaning.
 - 4) Detailed procedures for repairs such as dents, scratches and staining.
 - 5) Parts identification manual and maintenance manuals for each piece of finish hardware.

B. Informational Submittals

1. Test Reports: Submit for approval certified independent laboratory test reports for BHMA certification program and certification tests for each type of product specified.
2. Qualification Data:
 - a. Installer.
 - b. Architectural Hardware Consultant.

1.05 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:

1. Deliver all items of finish hardware in manufacturer's original, undamaged packages, bearing accurate representation of the item within each package.
2. Pack each piece of finish hardware separately, complete with screws, keying, instructions, and templates, tagged to correspond with items submitted on approved Shop Drawings and as specified.

B. Storage and Protection:

1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
2. Provide secure storage area for finish hardware items, secured by locks and accessible only to finish hardware installer, Engineer and Contractor.
3. Store finish hardware in manufacturers' original packages.

C. Acceptance at Site:

1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to equipment or components. Items that arrive in a damaged condition shall be removed from the Site and not offered again for acceptance. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

1.06 COORDINATION

- A. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

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1.07 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of operators and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period: 3 years from date of Substantial Completion, except as follows:
 - a. Exit Devices: 2 years from date of Substantial Completion.
 - b. Manual Closers: 10 years from date of Substantial Completion.

1.08 MAINTENANCE

- A. Maintenance Service
 - 1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
 - 2. Maintenance Service: Beginning at Substantial Completion, provide 6 months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door hardware operation. Provide parts and supplies same as those used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.01 SYSTEM PERFORMANCE

- A. Design Criteria:
 - 1. Where the finish, shape, size, fire-resistance-rating, frequency of use, or function of a member receiving finish hardware is such as to prevent, or make unsuitable, the types of finish hardware specified, furnish similar types having as nearly as practicable the same operation but of type or kind more appropriate to the design intension and requirements of governing authorities having jurisdiction at the Site. Clearly identify and highlight to Engineer all such required modifications on Shop Drawings submitted for approval.
 - 2. If finish hardware for any location is not specified, provide finish hardware equal in design and quality to adjacent finish hardware specified for comparable openings at no additional cost to Owner.
 - 3. Furnish finish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements, as necessary for proper installation and function.
 - 4. Unless otherwise specified, comply with DHI, Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames and Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames.

2.02 DETAILS OF CONSTRUCTION

- A. General:

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1. Hand of Door: The Drawings show the swing or hand of each door leaf (left, right, reverse bevel, etc.). Furnish each item of finish hardware for proper installation and operation of the door swing as shown.
2. Manufacturer's Name Plate: Do not use manufacturer's products which have manufacturer's name or trade name displayed in a visible location (omit removable nameplates), except in conjunction with labels required by governing authorities having jurisdiction at the Site.
3. Base Metals: Produce finish hardware units of the basic metal and forming method specified, using the manufacturer's standard metal alloy, composition, temper and hardness. Do not substitute materials or forming methods for those specified.
4. Fasteners: Manufacture door finish hardware to conform to published templates, generally prepared for machine screw installation. Do not provide finish hardware, which has been prepared for self-tapping sheet metal screws, except as specifically indicated.
5. Furnish screws for installation, with each finish hardware item. Provide Phillips flat-head screws except as otherwise specified. Finish exposed (exposed under any condition) screws to match the hardware finish or, if exposed in surfaces on other Work, to match the finish of such other Work as closely as possible, including "prepared for paint" in surfaces to receive painted finish.
6. Provide fasteners which are compatible with both the unit fastened and the substrate, and which will not cause corrosion or deterioration of finish hardware, base material or fastener.
7. Provide concealed fasteners for finish hardware units, which are not exposed when the door is closed, except to the extent no standard manufacturer units of the type specified are available with concealed fasteners. Do not use through bolts for installation where the bolt head or the nut on the opposite face is exposed in other Work under any condition, except where it is not possible to adequately reinforce the Work and use machine screws or concealed fasteners of another standard type to satisfactorily avoid the use of through bolts.
8. Tools for Maintenance: Furnish two complete sets of specialized tools as required for Owner's continued adjustment, maintenance, removal and replacement of finish hardware.

2.03 HARDWARE TYPES

- A. Continuous Hinges:
 1. Templates and Screws: Provide only template-produced units.
 2. Base Metal: Except as otherwise specified, fabricate hinges from stainless steel and finish to match the latch and lock set.
 3. Hinge Size: Except as otherwise specified or as required to comply with UL and NFPA, provide hinges of the following sizes:
 - a. Exterior Doors, Maximum 36-Inches Wide: Full length of door height.
 5. Types of Hinges: Provide continuous geared hinge with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4-inches. Hinges are non-handed, reversible and fabricated to template screw locations.
 7. Conform to ANSI/BHMA A156.26.
 8. Comply with UL, List of Inspected Fire Protection Equipment and Materials and NFPA 80 requirements.
 9. Products and Manufacturers: Provide one of the following:
 - a. FM_HD Full Mortise Hinge by Pemko Products, an ASSA ABLOY Architectural Door Accessories company.
 - b. Bommer Industries
 - c. Ives, an Allegion company
 - d. or Equal

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B. High-Security Mortise Locks:

1. Strikes: Provide manufacturer's standard wrought box strike, for each location and use shown. Provide stainless steel curved lip strikes, unless otherwise recommended by manufacturer, finished to match lock or latch set trim.
2. Lock Throw: Provide minimum of 3/4-inch anti-friction latch bolt and 1-inch dead bolt throw. Comply with UL requirements for throw of latch bolts and deadbolts on fire-resistance-rated openings.
3. Materials: Provide the following features and materials:
 - a. Latch Bolt: Two-piece; mechanical; anti-friction, stainless steel.
 - b. Dead Bolt: One-piece, stainless steel with two enclosed hardened-steel roller armor pins.
 - c. Case: Wrought steel, zinc dichromatized.
 - d. Cylinders: High-security; brass; pick- and drill-resistant; ANSI/BHMA A156.5 - E09211A.
 - e. Armor Front: 8-inches by 1-1/4-inches wide, minimum; steel.
 - f. Escutcheon: 8-inches by 2-1/2-inches wide by 3/16-inches thick, minimum; stainless steel, US 32D.
 - g. Hubs: Sintered steel, copper infiltrated.
 - h. Lever with Stop Pin: Brass, plated to match stainless steel, with additional built-in stop to prevent over-torquing of lever.
 - i. All components shall be of marine quality, wherever possible.
4. Backset: 2-3/4-inches.
5. Modify specified locks and latches to comply with UL, Building Materials Directory, and List of Inspected Fire Protection Equipment and Materials and NFPA 80 requirements.
6. Latches and Locks for Means of Egress Doors: Comply with NFPA 101.
7. Finish: US 32D satin.
8. Conform to ANSI/BHMA A156.13, Series 1000, Security Grade 1.

C. Panic Exit Devices:

1. Strikes: Provide manufacturer's standard wrought stainless steel latch to allow independent opening and closing of each leaf of double doors with panic exit devices; complying with UL List of Inspected Fire Protection Equipment and Materials and NFPA 80 requirements.
2. Lock Throws: Provide minimum of 3/4-inch latch bolt throw complying with UL List of Inspected Fire Protection Equipment and Materials and NFPA 80 requirements.
3. Provide rim type exit device for single swing doors and pairs of doors with removable mullions as specified.
4. Provide the following features and materials:
 - a. Latch Bolt: Two-piece; mechanical; anti-friction, stainless steel.
 - b. Dead Bolt: One-piece, stainless steel with two enclosed hardened-steel roller armor pins.
 - c. Case: Wrought steel, zinc dichromatized.
 - d. Cylinders: High-security; brass; pick- and drill-resistant; ANSI/BHMA A156.5 - E09211A.
5. Backset: Provide minimum backset of 2-3/4-inches.
6. Finish: US 32D satin.
7. ANSI/BHMA: A156.3, Type 3 and Type 8, Grade 1; F08, entrance by lever, key locks or unlocks lever for entrances shown as accessible to people with disabilities as required by ADAAG; and F05, entrance by thumb piece, key locks or unlocks thumb piece.
8. Exit Devices for Means of Egress Doors: Comply with NFPA 101. Exit devices shall not require more than 15 lbf to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.

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9. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
 10. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.
 11. Products and Manufacturers: Provide one of the following:
 - a. 6100ED Series Exit Device with Keyed Removable Mullion (KRM200), with Escutcheon Lever Trim (626F Classroom Function) and Augusta - AU Lever Handles by Yale Commercial Locks and Hardware, an ASSA ABLOY Group company. Inactive door leaf shall receive 620F Escutcheon Trim.
 - b. ED5200 Series Rim Exit Device and CR900 Series removable mullion; with Escutcheon Trim and Newport – N4M Lever Handles and D Grip T7M Thumb piece/Handle/Cylinder Unit by Corbin Russwin Architectural Hardware, an ASSA ABLOY Group company.
 - c. 98/99 Series Push Pad and keyed removable mullion by Von Duprin, an Allegion company.
 - D. Or equal.
- D. Keyed Removable Mullion:
1. Steel mullion for use with wide stile exit device. Designed for simple removing when an unobstructed large opening is required and easy replacement and locking to maintain the integrity of the opening.
 2. Easy cylinder installation. Mullion automatically relocks when reinstalled without the use of the cylinder key.
 2. Size: 7'-2". May be Field cut to fit opening.
 3. Finish: Red primer finish, paint.
 4. Cylinder Features: Mortise cylinder and collar, Large Format (LFIC) Seven-pin, high-security, removable core.
 5. Products and Manufacturers:
 - a. KRM200, panic rated. Tubular steel, 2" x 3", by Yale Commercial Locks and Hardware, an ASSA ABLOY Group company.
 - b. CR900 Series keyed removable mullion; by Corbin Russwin Architectural Hardware, an ASSA ABLOY Group company.
 - c. Or equal.
- E. Cylinders and Keying System:
1. Review the keying system with Owner's smart key system and provide the type required to integrate with Owner's existing system.
 2. Furnish all locks with manufacturer's cylinders for interchangeable-core pin tumbler inserts. Furnish only temporary inserts for the construction period, and remove these before Substantial Completion. Construction control keys and cores shall not be part of Owner's permanent keying system. Permanent cores and keys shall be furnished to Owner prior to Substantial Completion.
 3. Comply with the Owner's instructions for master keying and, except as otherwise specified, provide individual change key for each lock which is not designated to be keyed alike with a group of related locks.
 4. Permanent keys and cores shall be stamped with the applicable key mark for identification. These visual key control marks or codes shall not include the actual key cuts. Permanent keys shall also be stamped "DO NOT DUPLICATE".
 5. Cylinder Material: Brass, bronze or Series 300 stainless steel.
 6. Cylinder Features: Large Format (LFIC) Seven-pin, high-security, removable core.
 7. Key Material: Nickel silver.
 8. Key Quantity: Furnish three keys for each lock.
 9. Housing: Yale
 10. Cores: Multilock 1210

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11. Rim Type Doors: Housing 1212 / K840

F. Overhead, Surface-Mounted, Door Closers:

1. Provide all doors, unless specially shown or specified as being provided with floor-mounted or concealed overhead closers, with surface-mounted overhead door closers. Provide both active and inactive door leafs with closers.
2. Size of Units: Except as otherwise specified, comply with the manufacturer's recommendations for size of door control unit, depending upon size of door, exposure to weather, and anticipated frequency of use.
3. Where parallel arms are specified, and for closers on exterior doors, provide closer unit one size larger than recommended for use with standard arms.
4. Use parallel arm arrangement for doors that would otherwise have the door closer appearing in finished corridors or entries.
5. Comply with UL, Building Materials Directory, and List of Inspected Fire Protection Equipment and Materials, and NFPA 80. Modify closers specified as required. UL 10C and UBC 7-2c positive pressure requirements for fire-rated openings.
6. Provide hold open feature for all non-fire-resistant-rated doors, unless otherwise specified.
7. Provide offset bracket mounting on exterior doors. Select all arms to clear weather-stripping, and overhead door holders.
8. Provide long arm to allow door to swing 180 degrees where long arm will eliminate floor-mounted stops.
9. Provide closers with spring power adjustment feature capable of increasing spring power 15 percent minimum in all closer sizes.
10. Provide individual regulating valves for closing and latching speeds, and separate adjustable back check valve.
11. Provide delayed closing action feature on all door closers. Position valve at top of closure.
12. Provide the following materials and features:
 - a. Full Metal Cover: Aluminum.
 - b. Case: Cast-iron.
 - c. Arms: Plated to match full metal covers.
 - d. Other Parts: Steel.
 - e. Extreme temperature fluid.
 - f. Security torx machine screws.
 - g. Ten-year warranty.
 - h. Provide manufacturer's optional corrosion protection.
13. Finishes: US 26D satin chrome. Color coordinate all arms and other accessories.
14. Highly Corrosive Atmospheres: Provide all closers with specified manufacturer's optional corrosion protection.
15. ANSI/BHMA: A156.4, Grade 1.
16. Products and Manufacturers: Provide one of the following:
 - a. 8501 (689 Aluminum) CLP8501R by Norton Rixson
 - b. DC8000 Series by Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
 - c. 4040 Series by LCN Closers, an Ingersoll Rand Company.
 - d. Or equal.

G. Heavy-Duty, Concealed Overhead Holders and Stops:

1. Provide heavy-duty, concealed overhead holders and stops on all exterior and all interior doors, Comply with UL and NFPA requirements for hold-open feature.
2. Provide the following features and materials:
 - a. Shock Absorber Spring: Heavy tempered steel.
 - b. Channel: Heavy-gauge brass.
 - c. All other Parts: Stainless steel.
 - d. Adjustment: Degree of hold-open and stop shall be adjustable after installation.

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3. Finish: US 32D satin.
 4. Coordinate placement of concealed overhead holder and stop with overhead closers.
 5. ANSI/BHMA: A156.8, C51511.
 6. Products and Manufacturers: Provide one of the following:
 - a. Heavy-Duty 100H (ADJ) Series Concealed Holders and Stops by Glynn-Johnson, an Ingersoll-Rand Company.
 - b. 11000 Series Heavy Duty Concealed Holders and Stops by Rockwood Manufacturing Company, an ASSA ABLOY Group company.
 - c. Or equal.
- H. Weatherstrip Gasketing:
1. Provide perimeter weatherstrip at all exterior doors. Provide stripping and seals for interior doors where scheduled in the Finish Hardware Schedule, at end of Part 3.
 2. Continuity of Gasketing: Except as otherwise specified, stripping at each opening shall be continuous and without unnecessary interruptions at door corners and hardware.
 3. Replaceable Seal Strips: Resilient or flexible seal strip of every unit shall be easily replaceable and readily available from stocks maintained by the manufacturer.
 4. Provide bumper-type weatherstrip at jambs and head, including a resilient insert and metal retainer strip, surface-applied, of the following metal, finish and resilient bumper material:
 - a. Housing: Extruded aluminum with dark bronze anodized finish; 0.062-inch minimum thickness of main walls and flanges.
 - b. Dimensions: 1-3/8-inches by 7/8-inches, stop-mounted.
 - c. Seals: Closed-cell extruded silicone.
 - d. ANSI/BHMA: A156.22, R3E264.
 - e. Products and Manufacturers: Provide one of the following:
 - 1) No. 350DSPK and 2891 DPK (for parallel arms) by Pemko Manufacturing Company.
 - 2) No. 770D Compress-O-Matic and No. 429A (for parallel arms) by Zero International.
 - 3) Or equal.
 5. Provide heavy-duty, surface-mounted, automatic drop-seal door-bottom unit of manufacturer's standard design, with operating seal bar of the following material, retained in an extruded metal bar and capable of operating to close a 3/4-inch gap (from door bottom to floor or threshold). House mechanism and operating bar in the following metal housing, for mounting in doors as follows:
 - a. Housing: Extruded aluminum, 0.062-inch thick, with mill aluminum finish.
 - b. Seal: Neoprene.
 - c. Mounting: Surface-mounted.
 - d. ANSI/BHMA: A156.22, R3E344.
 - e. Products and Manufacturers: Provide one of the following:
 - a) No. 4301 DPKL by Pemko Manufacturing Company.
 - b) No. 367 D by Zero International.
 - c) Or equal.
- I. Thermal Barrier Thresholds:
1. All exterior doors shall be provided with thermal barrier thresholds.
 2. Metal: Extruded aluminum.
 3. Surface Pattern: Fluted tread, manufacturer's standard.
 4. Provide countersunk stainless steel screws and expansion shields.
 5. Width: 5 1/8-inches wide and of length sufficient to span full width of rough openings, coped and scribed neatly at and around door frames.
 6. Construction:

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- a. Two-piece, with rigid vinyl key complying with manufacturer's recommendations.
 7. Profile: Provide manufacturer's unit, which conforms to the minimum size and profile requirements specified.
 - a. For doors equipped with panic hardware, including floor bolts, provide profile with stop bar of proper size and shape to function as the strike plate for the floor bolts.
 8. Thickness: 1/2-inch.
 9. ANSI/BHMA: A156.21, J12100.
 10. Products and Manufacturers: Provide one of the following:
 - a. 252X2AFG by Pemko Manufacturing Company.
 - b. 625 A by Zero International.
 - b. Or equal.
- J. Silencers:
1. Provide silencers for all door frames.
 2. Provide pneumatic design that, once installed, forms an air pocket to reduce noise.
 3. Provide minimum of three per strike side of door jambs.
 4. ANSI/BHMA: A156.16, BHMA 6.5, L03011.
 5. Products and Manufacturers: Provide one of the following:
 - a. SR64 by IVES Hardware, an Ingersoll-Rand Company.
 - b. Series 307D by Hager Companies.
 - c. Or equal.
- K. Sealants: Provide elastomeric sealant complying with FS TT-S-00227, Type 2 (non-sag) Class A for use with thresholds.

2.04 HARDWARE FINISHES

- A. Provide matching finishes for finish hardware units at each door or opening, to the greatest extent possible in compliance with NIST U.S. Standards or ANSI/BHMA A156.18.
- B. Reduce differences in color and textures as much as commercially possible where the base metal or metal forming process is different for individual units of finish hardware exposed at the same door or opening. In general, match all items to the manufacturer's standard finish for the latch and lock set for color and texture.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine the substrate to receive finish hardware, and the conditions under which the Work will be performed, and notify Engineer, in writing, of unsatisfactory conditions. Do not proceed with the finish hardware Work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

3.02 PREPARATION

- A. Templates: Furnish finish hardware templates to each fabricator of doors, frames and other Work to be factory-prepared for the installation of finish hardware. Check the Shop Drawings of such other Work, to confirm that adequate provisions are made for the proper installation of the finish hardware.
- B. Prepare Work to receive finish hardware Work in compliance with ANSI/DHI A115.1.

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- C. Surface-Applied Door Hardware: NFPA 80: Drill and tap doors and frames according to ANSI A250.6.

3.03 INSTALLATION

- A. Installer shall check and approve the installation before operation. Installer shall assure that the system operates to the Owner's satisfaction.
- B. Mount finish hardware units at heights recommended in, Door and Hardware Institute, "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames" and "Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames", except as otherwise specified or required to comply with governing authorities having jurisdiction at the Site, HMMA 830 and ADAAG requirements.
- C. Install each finish hardware item in compliance with the manufacturer's instructions and recommendations and approved Shop Drawings. Wherever cutting and fitting is required to install finish hardware onto or into surfaces that are later to be painted or finished in another way, install each item completely, then remove, and store in a secure place during the finish application. After completion of the finishes, re-install each item. Do not install surface-mounted items until finishes have been completed on the substrate.
- D. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- E. Drill and countersink units that are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- F. Cut and fit threshold and floor covers to profile of door frames, with mitered corners and hair-line joints. Join units with concealed welds or concealed mechanical joints. Cut smooth openings for spindles, bolts and similar items, if any.
- G. Screw thresholds to substrate with No. 10 or larger screws, of the proper type for permanent anchorage and of bronze or stainless steel that will not corrode in contact with the threshold metal.
- H. Set thresholds in a bead of elastomeric sealant to completely fill concealed voids and exclude moisture from every source. Do not plug drainage holes or block weeps. Remove excess sealant before sealant cures to a firm set.
- I. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Lubricate moving parts with the type lubrication recommended by manufacturer (graphite-type if no other recommended). Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.
- J. Final Adjustment: Where finish hardware installation is made more than one month prior to Substantial Completion, return to the Work during the week prior to acceptance or occupancy, and make a final check and adjustment of all finish hardware items in each space and area. Clean and re-lubricate operating items as necessary to restore proper

SECTION 08710 – DOOR HARDWARE

function and finish of finish hardware and doors. Adjust door control devices to compensate for final operating of heating and ventilating equipment.

- K. Provide manufacturer's authorized representative to instruct and train Owner's personnel in proper adjustment and maintenance of finish hardware during the final adjustment of finish hardware.
- L. Finish hardware, which is blemished or defective, will be rejected even though it was set in place before defects were discovered. Remove and replace with new finish hardware. Repair all resultant damage to other Work.
- M. Continued Maintenance Service: Approximately six months after the acceptance of finish hardware in each area, the installer, accompanied by the representative of the latch and lock manufacturer and Architectural Hardware Consultant, shall return to the Project and re-adjust every item of hardware to restore proper function of doors and finish hardware. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures. Clean and lubricate operational items wherever required. Replace finish hardware items that have deteriorated or failed due to faulty design, materials or installation of finish hardware units.

3.04 FIELD QUALITY CONTROL

- A. Provide a written field report, prepared by installer's Architectural Hardware Consultant, identifying actual condition, location, manufacturer, and product designation for each item of finish hardware actually present on each door at the Site, including whether finish hardware is adjusted and operating properly, compared with each item referenced to approved Shop Drawings and Contract requirements.
- B. Installer's Architectural Hardware Consultant shall provide opinions to, and assist Engineer in determining, acceptability of installation as Work proceeds. All comments and discussions, conversations and meetings with Engineer shall be included in written field report for submission to Engineer for review and approval at completion of finish hardware installation.
- C. As part of written field report to be submitted to Engineer for approval, recommend remedial actions for Work not in compliance with these Specifications. No payment for Work will be made until remedial recommendations and actions have been approved by Engineer and incorporated into the Work.

3.05 DOOR FINISH HARDWARE SCHEDULE

- A. Scheduled items for each door are generic and rely on information specified above. The listing of hardware functions and types provided are only a general guideline for the final Door Finish Hardware Schedule. Submit a Door Finish Hardware Schedule acceptable to all governing authorities having jurisdiction at the Site.
- B. Provide the following finish hardware items:
 - 1. Exterior Single Egress Doors and Frames
 - a. Continuous hinges.
 - b. High-security mortise panic exit devices.
 - c. Keyed Removable Mullions.
 - d. Overhead, surface-mounted, door closers.
 - e. Stripping and seals.
 - f. Thresholds.
 - g. Silencers.
 - h. Floor or overhead holders and stops.

SECTION 08710 – DOOR HARDWARE

END OF SECTION 08710

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope:

1. Provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and apply paint systems.
 - a. Contractor is responsible for surface preparation and painting of all new and existing interior and exterior items and surfaces throughout the Project areas included under this and other Sections.
 - b. Extent of painting includes the Work specified below. Refer to Article 2.2 of this Section where all surfaces of generic types are specified for preparation and painting according to their status, intended function, and location, using the painting system for that surface, function, and location as specified, unless specifically identified on the Drawings as a surface not to receive specified painting system.
 - 1) All new items except where the natural finish of the material is specified as a corrosion-resistant material not requiring paint; or is specifically indicated in the Contract Documents as a surface not to be painted. Where items or surfaces are not specifically mentioned, paint them the same as adjacent similar materials or areas.
 - 2) Mechanical and process items to be painted include:
 - (a) Piping, pipe insulation, pipe hangers, and supports, including electrical conduit.
 - (b) Ductwork and insulation.
 - (c) Motors, mechanical equipment, and structural supports.
 - (d) Odor Control Ductwork supports.
 - (e) Accessory items.
 - 3) Surface preparation and painting of all new items, both interior and exterior, and other surfaces, including items furnished by Owner, are included in the Work, except as otherwise shown or specified.
 - 4) Approved stepped-down mock-ups for all painting systems showing all components of the surface preparation and paint system application before start of Work. Check all dry film thicknesses; demonstrate methods of surface preparation, and methods of application, and obtain Engineer's approval of colors and textures to be used in the Work.

B. Coordination:

1. Review installation, removal, and demolition procedures under other Sections and coordinate them with the Work specified in this Section.
2. Coordinate painting of areas that will become inaccessible once equipment, and similar fixed items have been installed.
3. Coordinate primers with finish paint materials to provide primers that are compatible with finish paint materials. Review other Sections where primed surfaces are provided, to ensure compatibility of total painting system for each surface. Contractor is responsible for coordinating compatibility of all shop primed and field painted items in other Sections.
4. Furnish information to Engineer on characteristics of finish materials proposed for use and ensure compatibility with prime coats used. Provide barrier coats over incompatible primers or remove and repaint as required. Notify Engineer in writing of anticipated problems using specified painting systems with surfaces primed by others. Reprime equipment primed in factory and other factory-primed items that are damaged or scratched.

C. Related Sections:

1. Section 07920, Joint Sealants.
2. Section 15052, Exposed Pipe Installation.
3. Section 15061, Ductile Iron Pipe.

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- D. Work Not Included: The following Work is not included as painting Work, or are included under other Sections:
1. Shop Priming: Shop priming of structural metal, miscellaneous metal fabrications, other metal items and fabricated components such as shop-fabricated or factory-painted process equipment, plumbing equipment, heating and ventilating equipment, electrical equipment, and accessories shall conform to applicable requirements of this Section but are included under other Sections.
 2. Pre-finished Items:
 - a. Items furnished with such finishes as baked-on enamel, porcelain, and polyvinylidene fluoride shall only be touched up at Site by Contractor using manufacturer's recommended compatible field-applied touchup paint.
 - b. Items furnished with finishes such as chrome plating or anodizing.
 - c. Concealed Surfaces: Non-metallic wall or ceiling surfaces in areas not exposed to view, and generally inaccessible areas.
 - d. Concrete floors, unless specifically shown as a surface to be painted.
 - e. Face brick, and prefaced concrete unit masonry.
 - f. Corrosion-Resistant Metal Surfaces: Where the natural oxide of item forms a barrier to corrosion, whether factory- or Site-formed, including such materials as copper, bronze, muntz metal, terne metal, and stainless steel.
 - g. Operating Parts and Labels:
 - 1) Do not paint moving parts of operating units, mechanical and electrical parts such as valve and damper operators, linkages, sensing devices, interior of motors, and fan shafts.
 - 2) Do not paint over labels required by governing authorities having jurisdiction at Site, or equipment identification, performance rating, nameplates, and nomenclature plates.
 - 3) Cover moving parts and labels during the painting with protective masking. Remove all protective masking upon completion of Work. Remove all paint, coatings, and splatter that comes in contact with such labels.
 - h. Structural and miscellaneous metals covered with concrete need not receive primers, intermediate, or finish coats of paint, except in the case of dissimilar materials or otherwise noted.
 - i. Existing structures, equipment, and other existing surfaces and items unless otherwise shown or specified.
- E. Description of Colors and Finishes:
1. Color Selection:
 - a. A maximum of ten different colors will be selected by Owner in addition to color-coding of pipelines, valves, equipment, ducts, and electrical conduit.
 - b. Color Coding of Pipelines, Valves, Equipment, and Ducts:
 - 1) In general, color-coding of pipelines, valves, equipment and ducts shall comply with applicable standards of ANSI A13.1, ANSI Z535.1 and 40 CFR 1910.144. Specifically, provide color-coding for pipelines per Table 09900-B, Pipeline Color Table following below. Colors shall be brilliant, distinctive shades matching the existing colors. Paint colors are provided as a standard of quality; equivalent colors matching these colors will be acceptable to Engineer. Provide Engineer with direct color comparisons of colors available from Manufacturer submitted at time of Shop Drawing submission.
 - 2) The color of the final coats shall match as closely as possible, without custom blending, the color of the specific pipeline service.
 - 3) For equipment on roofs or exposed to view, the color shall be selected by Engineer.
 - c. After approval by Engineer of colors and Shop Drawing submittals and prior to beginning painting Work, Engineer will furnish color schedules and samples for surfaces to be painted listed in Article 2.1, Painting Systems.

SECTION 09900 – PAINTING

TABLE 09900-A
TABLE OF STANDARD COLORS

Color	Designation*
Aqua	Aqua Sky; 10GN
Black	Black; 35GR
Blue	True/Safety Blue; 11SF
Brown	Terra Cotta; 07RD
Charcol	Deep Space; GR34
Dark Blue	Old Glory Blue; 78BL
Dark Brown	Medium Bronze; 85BR
Dark Gray	Blackthorn; GR31
Gray	Gray-ANSI 61; 33GR
Green	Spearmint/Safety Green; 09SF
Light Blue	Fontainebleau; 25BL
Light Brown	Twine; 68BR
Light Gray	Light Gray; 32GR
Light Green	Misty Jade; GB38
Olive	Clover; 110GN
Orange	Tangerine/Safety Orange; 04SF
Red	Candy Apple/Safety Red; 06SF
White	White; 11WH
Yellow	Lemon/Safety Yellow; 02SF

*Color designations are provided per Tnemec company, inc. Paint color numbers and are provided as a standard of quality; equivalent colors matching these colors are acceptable. Provide with shop drawing submittal direct color comparisons of color numbers available from manufacturer submitted.

- d. General Color Code: Unless otherwise specified, use the following color code:

TABLE 09900-B
PIPELINE COLOR TABLE

PIPELINE	COLOR
WATER	
Building Heating Water	Blue/Red Bands
Circulating Water	Blue
City Water	Blue

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Cold Water	Blue
Dangerously Hot Water	Charcoal
Domestic Hot Water	Blue/Red Bands
Drinking Water	Light Blue
Engine Jacket Water	Blue
Engine Cooling Water	Blue
Fire Water	Red
Hot Water Return	Blue/Red Bands
Hot Water Supply	Blue/Red Bands
Non-Potable Water	Blue/Red Bands
Plant Water	Gray
Potable Water	Dark Blue
Waste Water	Gray
AIR AND GAS	
Fuel Gas	Red
Natural Gas	Red/Black Bands
FUELS AND LUBRICANTS	
Diesel Fuel Oil	Yellow
Engine Oil	White
Fuel Oil	Yellow
Fuel Oil Fill	Yellow
High Pressure Lube Oil	White
Hydraulic Fluid	White
Gasoline	Yellow
Grease	White
Lube Oil	White
Lube Oil Fill	White
Waste Oil	White
PROCESS	
Floor Drains	Gray
Sewage	Dark Gray
Sewage Sampling Lines	Dark Gray
Storm Drains	Gray
Sump Drains	Gray

- d. Color of final coats shall match as closely as possible, without custom blending, color tabulated for specific pipeline service.

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- 1) After approval by Engineer of colors and Shop Drawings and prior to commencing painting Work, Engineer will furnish color schedules for surfaces to be painted.

F. Abbreviations and Symbols:

1. Abbreviations and symbols used in painting systems are explained in Article 2.2 of this Section and provide information on generic composition of required materials, manufacturers, number of coats and dry mil film thickness per coat (DMFTPC), and coverage for determining required number of gallons for the Work.

1.02 REFERENCES

A. Referenced Standards: Standards referenced in this Section or referenced in Product Performance Standards are:

1. ANSI A13.1, Scheme for Identification of Piping Systems.
2. ANSI Z535.1, Safety Color Code.
3. ANSI/NSF Standard 60, Drinking Water Treatment Chemicals - Health Effects.
4. ANSI/NSF Standard 61, Drinking Water System Components – Health Effects.
5. ASTM D16, Terminology for Paint, Related Coatings, Materials and Applications.
6. ASTM D2200, Pictorial Surface Preparation Standards for Painting Steel Surfaces.
7. ASTM D4258, Practice for Surface Cleaning Concrete for Coating.
8. ASTM D4259, Practice for Abrading Concrete.
9. ASTM D4262, Testing Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
10. ASTM D4263, Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
11. ASTM D4285, Test Method for Indicating Oil or Water in Compressed Air.
12. ASTM D4417, Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel.
13. ASTM D4541, Test Methods for Pull-Off Strength of Coatings Using Portable Adhesion-Testers.
14. ASTM E329, Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
15. Green Seal, Inc. Paint, (GS-11).
16. GLUMRB, Recommended Standards for Wastewater Facilities.
17. 17. National Association of Piping Fabricators, NAPF 500-03, Surface Preparation Standard For Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings And/or Special Internal Linings.
18. Ozone Transport Commission, (OTC), OTC Model Rule for Architectural and Industrial Maintenance Coatings.
19. SSPC PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.
20. SSPC SP 1, Solvent Cleaning.
21. SSPC SP 3, Power Tool Cleaning.
22. SSPC SP 6, Commercial Blast Cleaning.
23. SSPC SP 10, Near-White Blast Cleaning.
24. SSPC VIS 1, Visual Standard for Abrasive Blast Cleaned Steel.
25. SSPC Volume 2, Systems and Specifications.

1.03 DEFINITIONS

A. Standard coating terms defined in ASTM D16 apply to this Section, including:

1. Paint: Pretreatment and all painting system materials, such as primer, emulsion, enamel, organic/inorganic polymer coating, stain sealer and filler, and other applied materials whether used as prime, filler, intermediate, or finish coats.
2. Exposed: All items not covered with cement plaster, concrete, or fireproofing. Items covered with these materials shall be provided with specified primer only, except where specified as a surface not to be painted. Exposed-to-view surfaces include areas visible

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after permanent or built-in fixtures, convactor covers, ceiling tile, covers for finned tube radiation, grilles, and similar covering products are in areas scheduled to be painted.

3. Low VOC: All interior and exterior field-applied coatings that have maximum VOC content as listed in OTC Model Rule for Architectural and Industrial Maintenance Coatings.
4. OTC: Ozone Transport Commission, which recommends standard VOC content levels in several Northeastern and Mid-Atlantic states.

1.04 QUALITY ASSURANCE

- A. Applicator Qualifications:
 1. Engage a single applicator that regularly performs installation of paint materials, with documented skill and successful experience in installing types of products required and that agrees to employ only trained, skilled tradesmen who have successful experience in installing types of products specified.
 2. Submit name and qualifications to Engineer along with following information for at least three successful, completed projects:
 - a. Names and telephone numbers of owner and design professional responsible for project.
 - b. Approximate contract cost of paint products.
 - c. Amount of area painted.
 - d. Submit to Engineer proof of acceptability of applicator by manufacturer.
- B. Testing Agency Qualifications: Provide an independent testing agency for testing specified in this Section. Testing agency shall be selected by Owner and paid for by Contractor. To qualify for approval, submit documentation demonstrating to satisfaction of Engineer, that testing agency has experience and capability to satisfactorily conduct testing required without delaying the Work, in accordance with ASTM E329.
- C. Source Quality Control:
 1. Obtain materials from manufacturers that will provide services of a qualified manufacturer's representative at Site at commencement of painting Work, to advise on products, mock-ups, installation, and finishing techniques and, at completion of Work, to advise Engineer on acceptability of completed Work and during the course of the Work as may be requested by Engineer.
 2. Certify long-term compatibility of all coatings with surfaces.
 3. Do not submit products that decrease number of coats, surface preparation, or generic type and formulation of coatings specified. Products exceeding VOC limits and chemical content specified will not be approved.
 4. Engineer may review manufacturers' recommendations concerning methods of installation and number of coats of paint for each painting system. Contractor shall prepare construction costs based on painting systems, number of coats, coverage's and installation methods specified.
 5. Submit "or equal" products, when proposed, with direct comparison to products specified, including information on durability, adhesion, color and gloss retention, percent solids, VOC's grams per liter, and recoatability after curing.
 6. "Or equal" manufacturers shall furnish same color selection as manufacturers specified, including intense chroma and custom pigmented colors in all painting systems.
 7. Color Pigments: Provide pure, non-fading, applicable types to suit surfaces and services to be painted. Comply with:
 - a. Lead and Chromate: Lead and chromate content shall not exceed amount permitted by authorities having jurisdiction.
 - b. Areas subject to hydrogen sulfide fume exposure will be identified by Engineer. Through Contractor, paint manufacturer shall notify Engineer of colors that are not suitable for long-term color retention in such areas.
 - c. Manufacturer shall identify colors that meet the requirements of authorities having jurisdiction at Site for use in locations subject to contact with potable water or water being prepared for use as potable water.

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- d. Comply with paint manufacturer's recommendations on preventing coating contact with levels of carbon dioxide and carbon monoxide that may cause yellowing during application and initial stages of curing of paint.
 - e. Obtain each product from one manufacturer. Multiple manufacturing sources for the same system component are unacceptable.
 - f. Certify product shelf life history for each product source for materials manufactured by the same manufacturer, but purchased and stored at different locations or obtained from different sources.
 - g. Constantly store materials to be used for painting Work between 60 degrees F and 90 degrees F, and per paint manufacturer's written recommendations, for not more than six months. Certify to Engineer that painting materials have been manufactured within six months of installation and have not, nor will be, subjected to freezing temperatures.
- D. Regulatory Requirements:
- 1. Comply with VOC content limits of OTC Model Rule for Architectural and Industrial Maintenance Coatings:
 - a. Industrial Maintenance Coatings: 340 grams per liter.
 - b. Interior and Exterior Non-Flat Coatings: 250 grams per liter.
 - c. Comply with the following:
 - 1) 29 CFR 1910.144, Safety Color Code for Marking Physical Hazards.
 - 2) 40 CFR, Subpart D-2001, National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - 3) Resource Conservation and Recovery Act of 1976 (RCRA).
 - 4) SW-846, Toxic Characteristic Leaching Procedure (TCLP).
 - d. Comply with authorities having jurisdiction at Site for blast cleaning, confined space entry, and disposition of spent abrasive and debris.

1.05 SUBMITTALS

- A. Action Submittals:
- 1. Shop Drawings: Submit the following:
 - a. Copies of manufacturer's technical information and test performance data, including paint analysis, VOC and chemical component content in comparison to maximum allowed by the Contact Documents, and application instructions for each product proposed for use.
 - b. Submit proof of acceptability of proposed application techniques by paint manufacturer selected.
 - c. Copies of Contractor's proposed protection procedures in each area of the Work explaining methods of protecting adjacent surfaces from splatter, for confining application procedures in a manner that allows other work adjacent to surface preparation and painting Work to proceed safely and without interruption, and for maintaining acceptable application, curing, and environmental conditions during and after painting systems application.
 - d. List each material and cross-reference to the specific painting system and application, including a list of site-specific surfaces to which painting system will be applied. Identify by manufacturer's catalog number and general classification. State number of gallons of each product being purchased for delivery to Site and square foot area calculated to be covered by each painting system specified based on theoretical loss of 20 percent. Where actual area to be covered by paint system exceeds area submitted to Engineer for that system, proof of additional material purchase shall be provided to Engineer. Calculated coverage shall be as specified for each component of each painting system specified. This requirement does not take precedence over Contractor's responsibility to provide dry film thickness required for each component of each painting system.

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- e. Identify maximum exposure times allowable for each paint system component before next coat of paint can be applied. Submit proposed methods for preparing surfaces for subsequent coats if maximum exposure times are exceeded.
 - f. Information on curing times and environmental conditions that affect curing time of each paint system component and proposed methods for accommodating variations in curing time. Identify this information for each painting system in the Work.
 - g. Specification for spray equipment with cross-reference to paint manufacturer's recommended equipment requirements.
 - h. Samples: Submit the following:
 - 1) Original copies of manufacturer's complete color charts for each coating system.
 - 2) Mock-ups specified for the Site.
- B. Informational Submittals:
- 1. Certificates: Submit the following:
 - a. Certificate from paint manufacturer stating that materials meet or exceed Contract Documents requirements.
 - b. Evidence of shelf life history for all products verifying compliance with the requirements of the Contract Documents.
 - c. Contractor shall provide notarized statement verifying that all painting systems are compatible with surfaces specified. All painting systems components shall be reviewed by an authorized technical representative of paint manufacturer for use as a compatible system. Verify that all painting systems are acceptable for exposures specified and that paint manufacturer is in agreement that selected systems are proper, compatible, and are not in conflict with paint manufacturer's recommended specifications. Show by copy of transmittal form that a copy of letter has been transmitted to paint applicator.
 - d. Test Reports: Submit the following:
 - 1) Certified laboratory test reports for required performance and analysis testing in compliance with ASTM E329.
 - 2) Adhesion testing plan and procedures.
 - 3) Results of adhesion testing on existing surfaces containing paints or other coatings to be topcoated with paint systems specified. Prior to adhesion testing, submit a testing plan establishing methods, procedures and number of tests in each area where existing coatings are to remain and become substrate for painting Work. Based on results of adhesion testing, recommend methods, procedures, and painting system modifications, if necessary, for proceeding with Work.
 - 4) Locations of and test methods for soil sampling before beginning Work and after Substantial Completion.
 - 5) Proposed methods for testing, handling, and disposal of waste generated during Work.
 - 6) Results of alkalinity and moisture content tests performed in accordance with ASTM D4262 and ASTM D4263.
 - 7) Results of tests of film thickness, holidays, and imperfections.
 - e. Manufacturer's Instructions: Provide paint manufacturer's storage, handling, and application instructions prior to commencing painting Work at Site.
 - f. Manufacturer's Site Reports: Provide report of paint manufacturer's representative for each visit to Site by paint manufacturer's representative.
 - g. Special Procedure Submittals: Submit the following:
 - 1) Proposed protection procedures for each area of Work, explaining methods of protecting adjacent surfaces from splatter, for confining application procedures in a manner that allows other work adjacent to surface preparation and painting Work to proceed safely and without interruption.
 - 2) Site-specific health and safety plan.
 - 3) Procedures for maintaining acceptable application, curing and environmental conditions during and after painting systems application.

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- 4) Procedures for providing adequate lighting, ventilation, and personal protection equipment relative to painting Work.
- h. Qualifications: Submit qualifications data specified in Article 1.4 of this Section for the following:
 - 1) Applicator.
 - 2) Testing laboratory
- C. Closeout Submittals:
 - 1. Maintenance Manual: Upon completion of the painting Work, furnish Engineer five copies of detailed maintenance manual including the following information:
 - a. Complete and updated product catalog of paint manufacturer's currently available products including complete technical information on each product. Identify product names and numbers of each product used in the painting Work.
 - b. Name, address, e-mail address and telephone number of manufacturer, local distributor, applicator and technical representative.
 - c. Detailed procedures for routine maintenance and cleaning.
 - d. Detailed procedures for light repairs such as dents, scratches and staining.
 - e. Statement of Application: Upon completion of the painting Work, submit a notarized statement to Engineer signed by Contractor and painting applicator stating that Work complies with requirements of the Contract Documents and that application methods, equipment, and environmental conditions were proper and adequate for conditions of installation and use.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Product Delivery Requirements: Deliver products to Site in original, new, and unopened packages and containers, accurately and legibly and accurately labeled with the following:
 - 1. Container contents, including name and generic description of product.
 - 2. Manufacturer's stock number and date of manufacture.
 - 3. Manufacturer's name.
 - 4. Contents by volume, for major pigment and vehicle constituents.
 - 5. Grams per liter of volatile organic compounds.
 - 6. Thinning instructions, where recommended.
 - 7. Application instructions.
 - 8. Color name and number.
- B. Product Storage Requirements:
 - 1. Store acceptable materials at Site.
 - 2. Store in an environmentally controlled location as recommended in paint manufacturer's written product information. Keep area clean and accessible. Prevent freezing of products.
 - 3. Store products that are not in actual use in tightly covered containers.
 - 4. Comply with health and fire regulations of authorities having jurisdiction at Site.
- C. Product Handling Requirements:
 - 1. Handle products in a manner that minimizes the potential for contamination, or incorrect product catalyzation.
 - 2. Do not open containers or mix components until necessary preparatory work has been completed and approved by Engineer and painting Work will start immediately.
 - 3. Maintain containers used in storing, mixing, and applying paint in a clean condition, free of foreign materials and residue.

1.07 SITE CONDITIONS

- A. Site Facilities:
 - 1. Supplemental heat sources, as required to maintain both ambient and surface temperatures within range recommended by paint manufacturer for paint system application, are not available at Site.

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2. Provision of supplemental heat energy sources, power, equipment, and operating, maintenance and temperature monitoring personnel is responsibility of Contractor.
 3. Do not use heat sources that emit carbon dioxide or carbon monoxide into areas being painted. Properly locate and vent such heat sources to exterior such that paint systems are unaffected by exhaust.
- B. Environmental Requirements:
1. Apply water-base paints when the temperature of surfaces to be painted and ambient air temperatures are between 55 degrees F and 90 degrees F, unless otherwise permitted by paint manufacturer's published instructions.
 2. Surfaces to be painted shall be at least 5 degrees F above dew point temperature and be dry to the touch. Apply paint only when temperature of surfaces to be painted, paint products, and ambient air temperatures are between 65 degrees F and 95 degrees F, unless otherwise permitted by paint manufacturer's published instructions.
 3. Apply paint system within shortest possible time consistent with manufacturer's recommended curing instructions for each coat. If chemical, salt, or other contamination contacts paint film between coats, remove contamination per SSPC SP 1 and restore surface before applying paint.
 4. Do not paint tanks or pipelines containing fluid without specific permission of Engineer and only under conditions where "sweating" of outside surface of vessel being painted is not likely to occur within 24 hours of paint application.
 5. Do not apply epoxy paints if ambient temperature is expected to go below 50 degrees F within twelve hours of application. Follow manufacturer's instructions when manufacturer's published recommendations require a higher minimum ambient temperature.
 6. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent. Do not apply paint to damp or wet surfaces or when surfaces will reach dew point due to falling or rising temperatures and humidity conditions during course of paint application, unless otherwise permitted by paint manufacturer's published instructions.
 7. Do not paint unacceptably hot or cold surfaces until such surfaces can be maintained within temperature and dew point ranges acceptable to paint manufacturer. Arrange for surfaces to be brought within acceptable temperature and dew point ranges as part of painting Work.
 8. Moisture content of surfaces shall be verified to Engineer as acceptable prior to commencement of painting using methods recommended by paint manufacturer.
 9. Painting may be continued during inclement weather only if areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer for application and drying.
 10. Provide adequate illumination and ventilation where painting operations are in progress.
- C. Protection:
1. Cover or otherwise protect finished work of other trades and surfaces not being painted concurrently, or not to be painted.
 2. During surface preparation and painting, facility shall remain in operation. Use procedures that prevent contamination of process or cause or require facility shutdown.
 3. Coordinate and schedule surface preparation and painting to avoid exposing employees of Contractor, Owner, Engineer and others not involved with surface preparation and painting, to hazards associated with painting Work. Provide required personnel safety equipment per requirements of authorities having jurisdiction at Site.
 4. Submit protection procedures to be employed by Contractor to Engineer. Do not begin surface preparation and painting Work in any area until Engineer accepts protection techniques proposed by Contractor.
 5. When working with flammable materials, provide fire extinguishers and post caution signs warning against smoking and open flame.

1.08 MAINTENANCE

- A. Extra Materials: Furnish, tag, and store an additional one percent by volume of all coatings and colors installed. Provide a minimum of one gallon of each coating and color. Store in unopened containers as specified until turned over to Owner.

PART 2 - PRODUCTS

2.01 PAINTING SYSTEM MANUFACTURERS

- A. Products and Manufacturers: Where referenced under painting systems provide products manufactured by the following:
 - 1. Tnemec Company, Inc. (TCI).
 - 2. The Carboline Company, part of StonCor Group, an RMP Company (TCC).
 - 3. PPG Protective & Marine Coatings (PPG PMC).
 - 4. Pittsburgh Architectural Finishes (PPG PAF)
 - 5. Benjamin Moore & Company (BMC).
 - 6. ICI Paints (ICI).
 - 7. 7. Righter Group Inc. (RGI)
 - 8. 8. Duron Inc. (DI)

2.02 PAINTING SYSTEMS

- A. Cast-In-Place Concrete Underside of Roof Slabs and Beams, Non-Submerged, Interior:
 - 1. Surface Preparation: Refer to Paragraphs 1.7.B., 3.2.A., 3.2.B.3., 3.2.B.5., 3.2.B.6. and 3.2.B.7.
 - 2. Filler, Surfacer and Patching Compound:
 - a. Generic Components:
 - 1) Minimum 38 percent solids, vinyl acrylic block filler; 61 grams per liter VOC, maximum.
 - 2) Products and Manufacturers: Provide one of the following:
 - (a) Speedhide Latex Block Filler 6-7 (PPG PAF); Latex Block Filler M88 (BMC); Prep and Prime Block Filler 3010 (ICI); One coat 7.0 to 14.5 dry mils.
 - b. Primer:
 - 1) Generic Components:
 - (a) Minimum 30 percent solids, 100 percent acrylic; 50 grams per liter VOC, maximum.
 - 2) Products and Manufacturers: Provide one of the following:
 - (a) Pure Performance Acrylic Primer 9-900 (PPG PAF); Eco Spec Interior Latex Primer Sealer 231 (BMC); Devflex 4020 PF (ICI); One coat, 0.8 dry mils.
 - c. Finish: Semi-Gloss:
 - 1) Generic Components:
 - (a) Minimum 36 percent solids, 100 percent acrylic latex, gloss; 50 grams per liter VOC, maximum.
 - 2) Products and Manufacturers: Provide one of the following:
 - (a) Pure Performance Acrylic Semi-Gloss 9-500 (PPG PAF); Pristine Eco Spec Latex Enamel, 224 (BMC); Dulux Lifemaster 2000-9200 (ICI): Two coats, 1.4 dry mils, per coat.
- B. Ferrous Metals, Structural Steel, Miscellaneous Ferrous Metals, Exterior Surfaces of Valves, Exterior Surfaces of Ferrous Piping, and Exterior Surfaces of All Ferrous Metal; Non-submerged, Interior:
 - 1. Surface Preparation: Refer to Paragraphs 1.7.B., 3.2.A., 3.2.C.1., 3.2.C.2.
 - 2. Shop Primer:
 - a. Generic Components:
 - 1) Minimum 66 percent volume solids, build, two-component, cycloaliphatic amine-catalyzed epoxy or polyamido-amine epoxy coating; 300 grams per liter VOC, maximum.

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- 2) Products and Manufacturers: Provide one of the following:
 - (a) Amercoat 370 (PPG PMC); Series N69 Hi-Build Epoxoline (TCI); Carboguard 954 HB (TCC): One coat, 4.0 to 6.0 dry mils.
- b. Field Primer and Touch-Up:
 - 1) Generic Components:
 - (a) Minimum 100 percent volume solids, high-build, two-component, polyamide-catalyzed epoxy; 8 grams per gallon VOC, maximum.
 - 2) Products and Manufacturers: Provide one of the following:
 - (a) Amerlock Sealer (PPG PMC); Series N69 Hi-Build Epoxoline (TCI); Carboguard 954 HB (TCC); Cor-Cote HP (SWC): One coat.
- c. Finish: Gloss:
 - 1) Generic Components:
 - (a) Minimum 80 percent volume solids, high-build, chemical-resistant, high-gloss, modified, polyamine- or polyamidoamine-catalyzed epoxy finish; 180 grams per liter VOC, maximum.
 - 2) Products and Manufacturers: Provide one of the following:
 - (a) Amerlock 2/400 Series (PPG PMC); Series 104 H.S. Epoxy (TCI); Carboguard 890 LT (TCC); Cor-Cote HP (SWC):
 - (1) Horizontal Surfaces: One coat, 6.0 to 12.0 dry mils.
 - (2) Vertical Surfaces: One coat, 4.0 to 8.0 dry mils.
- C. Ferrous Metals, Non-Ferrous Metals and Exterior Surfaces of Piping; Submerged or Intermittently Submerged, including up to 4.0 feet above liquid surface; Interior and Exterior:
 1. Surface Preparation: Refer to Paragraphs 1.7.B., 3.2.A., 3.2.C.1., 3.2.C.2., and 3.2.E.
 2. Factory Primer:
 - a. Generic Components:
 - 1) Minimum 66 percent solids, two-component, cycloaliphatic amine- catalyzed epoxy or polyamido-amine epoxy; 334 grams per liter VOC, maximum.
 - 2) Products and Manufacturers: Provide one of the following:
 - (a) Amercoat 370 (PPG PMC); Series N69 Hi-Build Epoxoline (TCI); Carboguard 954 HB (TCC); Macropoxy HS Epoxy (SWC): One coat, 4.0 dry mils.
 - b. Shop Prime/Touch-Up/Finish, Satin:
 - 1) Generic Components:
 - (a) Minimum 80 percent volume solids, high-build, two-component, polyamide-catalyzed epoxy or polyamido-amine epoxy; 180 grams per gallon VOC, maximum.
 - 2) Products and Manufacturers: Provide one of the following:
 - (a) Amerlock 2/400 Series (PPG PMC); Series N69 Hi-Build Epoxoline (TCI); Carboguard 890 LT (TCC); Dura-Plate UHS (SWC): Three coats, 4.0 to 15.0 dry mils, per coat.
 - D. Galvanized Metal, and Fiberglass; Non-submerged, Interior:
 1. Surface Preparation: Refer to Paragraphs 1.7.B., 3.2.A., 3.2.D., 3.2.E. and 3.2.F.
 2. Primer:
 - a. Generic Components:
 - 1) Minimum, 39 percent volume solids single-component, self-cross linking acrylic primer-sealer, 140 grams per liter VOC, maximum.
 - 2) Products and Manufacturers: Provide one of the following:
 - (a) Pitt Tech EDF 90-812 Series (PPG PMC); Series 115 Uni-Bond DF (TCI); Galoseal Wash Primer (TCC); One coat, 2.0 to 4.0 dry mils.
 - b. Finish: Satin:
 - 1) Generic Components:
 - (a) Minimum, 41 percent volume solids, single component, self-cross linking acrylic; 208 grams per liter VOC, maximum.
 - 2) Products and Manufacturers: Provide one of the following:

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- (a) Pitt Tech EDF 90-812 Series (PPG PMC); Series 116 Uni-Bond (TCI); Carbocrylic 3359 (TCC); One coat, 2.0 to 4.0 dry mils.
- E. Aluminum in Contact with Dissimilar Materials:
 - 1. Surface Preparation: Refer to Paragraphs 1.7.B., 3.2.A. and 3.2.D.
 - 2. Primer/Finish:
 - a. Generic Components:
 - 1) Minimum 80 percent volume solids, high-build, two-component, polyamido-amine or polyamine epoxy; 180 grams per gallon VOC, maximum.
 - 2) Products and Manufacturers: Provide one of the following:
 - (a) Amerlock 2/400 Series (PPG PMC); Series N69 Hi-Build Epoxoline 100 (TCI); Carboguard 954 HB (TCC); Dura-Plate UHS (SWC): Two coats, 4.0 to 15.0 dry mils, per coat.
- F. Exterior Surfaces of Ductile Iron Pipe; Buried Exterior:
 - 1. Refer to Section 15061, Ductile Iron Pipe.
- G. Pipe and Duct Insulation, Cloth, Paper and Canvas Jacketed; Non-submerged, Interior:
 - 1. Surface Preparation: Refer to Paragraphs 1.7.B., 3.2.A. and 3.2.G.
 - 2. Primer:
 - a. Generic Components:
 - 1) Minimum 38 percent volume solids single-component, self-cross linking acrylic primer-sealer; 159 grams per liter VOC, maximum.
 - 2) Products and Manufacturers: Provide one of the following:
 - (a) Series 115 Uni-Bond DF (TCI); Sanitile 120 (TCC); (PPG PMC); One coat, 2.0 to 4.0 dry mils.
 - b. Finish: Satin:
 - 1) Generic Components:
 - (a) Minimum 37 percent volume solids, single component, self-cross linking acrylic; 226 grams per liter VOC, maximum.
 - 2) Products and Manufacturers: Provide one of the following:
 - (a) Series 1029 Enduratone (TCI); Carbocrylic 3358 (TCC); (PPG PMC); One coat, 2.0 to 4.0 dry mils.
- H. PVC and CPVC Piping and Fiberglass Insulation Covering; Non-submerged, Interior/Exterior:
 - 1. Surface Preparation: Refer to Paragraphs 1.7.B., 3.2.A. and 3.2.F.
 - 2. Primer:
 - a. Generic Components:
 - 1) Minimum 37 percent volume solids single-component, self-cross linking acrylic primer-sealer or polyamido-amine epoxy coating; 226 grams per liter VOC, maximum.
 - 2) Products and Manufacturers: Provide one of the following:
 - (a) Series N69 Hi-Build Epoxoline (TCI); Sanitile 120 (TCC); One coat, 2.0 to 4.0 dry mils.
 - b. Intermediate:
 - 1) Generic Components:
 - (a) Minimum 37 percent volume solids single-component, self-cross linking acrylic primer-sealer or polyamido-amine epoxy coating; 226 grams per liter VOC, maximum.
 - 2) Products and Manufacturers: Provide one of the following:
 - (a) Series N69 Hi-Build Epoxoline (TCI); Carbocrylic 3359 (TCC); One coat, 2.0 to 4.0 dry mils.
 - c. Finish: Semi-Gloss/Gloss:
 - 1) Generic Components:
 - (a) Minimum 59 percent volume solids, single component, Aliphatic Acrylic Polyurethane; 340 grams per liter VOC, maximum.
 - 2) Products and Manufacturers: Provide one of the following:

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- (a) Series 1075U Endura-Shield II (TCI); Carbothane 130 (TCC); One coat, 2.0 to 4.0 dry mils.

I. Masonry Block walls

1. Surface Preparation - Remove all loose mortar, mortar splatter and mortar protrusions. Ensure all surfaces are dry and free of dust and other construction residues. Allow curing for 28 days.
2. Block Filler – Series 130 Envirofill, 60-80 sf/gal or or S-W Cement-Plex 875 Cementitious Acrylic WB Block Filler, 50-100 sf/gal.
3. Finish (2 coats) – Series 280 Tneme-Glaze at 7-10 mils or Dura-Plate UHS at 7-10 mils each. Finish surface shall be uniformly smooth to the touch, free of voids, holidays, and cleanable.

J. Concrete walls, interior

1. Surface Preparation - Prepare all surfaces in accordance with SSPC-SP13 / NACE No.6 removing all loose material, laitance, curing compounds, hardeners, sealers and other contaminants. Establish surface profile in accordance with ICRI 310.2R CSP 3 – 5. Level all protrusions and fill all voids, bug holes or other cavities with a filler or surfacer approved by the coating manufacturer. Allow curing for 28 days.
2. Field Primer – Series 201 Epoxoprime at 5-7 mils or Corobond 100 Epoxy Primer at 5-6 mils in finish color.
3. Finish (2 coats) – Series 280 Tneme-Glaze at 7-12 mils or Dura-Plate UHS at 7-10 mils each. Finish surface shall be uniformly smooth to the touch, free of voids and cleanable.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Contractor shall examine areas and conditions under which painting Work is to be performed and notify Engineer in writing of conditions detrimental to proper and timely completion of Work. Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.
- B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film capable of performing in accordance with claims made in paint manufacturer's product literature for surfaces and conditions encountered.

3.02 SURFACE PREPARATION

A. General:

1. Test for moisture content of surfaces before commencement of painting Work. Test for moisture in concrete in compliance with ASTM D4263. Report results to Engineer before commencing Work.
2. Perform preparation and cleaning procedures as specified herein and in strict accordance with paint manufacturer's approved instructions for each surface and atmospheric condition.
3. Contractor shall provide effective surface-applied protection for in place items that do not require painting prior to surface preparation and painting operations.
4. Contractor shall remove as necessary items that must be field-painted where adjacent surfaces cannot be completely protected from splatter or overspray. Following completion of painting of each space or area, the removed items shall be reinstalled by workers skilled in the trades involved.
5. Clean surfaces to be painted before applying painting system components. Remove oil and grease with clean cloths and cleaning solvents prior to mechanical cleaning.
6. Prepare surfaces that were improperly shop-painted and abraded or rusted shop-painted surfaces as specified.

B. Cast-In-Place Concrete:

1. Prepare surfaces of concrete unit masonry to be painted by removing all efflorescence, chalk, dust, dirt, grease, oils, and other contamination using soap and water. Surfaces shall be clean and dry at time of paint system application.

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2. Concrete unit masonry that cannot be adequately cleaned using soap and water shall be acid etched with a commercial solution of 15 percent muriatic acid.
 3. Prepare and clean cast-in-place concrete and precast concrete surfaces per ASTM D4259 to provide a uniform and continuous anchor profile of approximately one mil. Provide mechanical abrading and abrasive blasting per ASTM D4259. Use 40 to 80-mesh abrasive and clean, dry, compressed air. Compressed air cleanliness shall be per ASTM D4285. Pressure at blasting nozzle shall not exceed 80 pounds per square inch. Do not concentrate blast on surface; instead, move at a fairly rapid rate to provide a surface free of laitants and contaminants. Provide post-surface preparation cleaning per ASTM D4258 to remove loose material. Surface preparation shall open all surface air holes by removing laitance shoulders surrounding air holes. Vacuum surfaces to remove dust and sand, and wash with potable water.
 4. Where paint system is for chemical containment barrier protection, repair cracks and expansion joints in concrete and provide 2-inch radiused cove base fillets at equipment pads and containment walls as part of complete chemical containment paint system Work. Use materials and techniques recommended by manufacturers of the paint and concrete repair products.
 5. Remove from cast-in-place concrete fins, projections, and other surface irregularities that would protrude above level of finished intermediate fillers and surfacers. Remove by chipping and scarification by mechanical abrasion.
 6. Using specified filler and surfacer, patch cast-in-place concrete and precast concrete surfaces as required to completely fill surface air holes and honeycombing. Level all protrusions, grind filler and surfacing compounds smooth, and level with adjacent surfaces.
 7. Perform tests per ASTM D4262 and ASTM D4263 to verify alkalinity and moisture content of surfaces to be painted, and report findings to Engineer. If, in Engineer's opinion, surfaces are sufficiently alkaline to cause blistering and burning of paint, correct the condition before applying paint. Provide suitable testing materials for alkalinity and moisture tests. Do not paint surfaces where the moisture content exceeds eight percent.
 8. Where a concrete unit masonry block filler is specified, spot patch holes and cracks with a putty knife using specified block filler. Apply to large surfaces by airless spray and backroll uniformly using a roller with a synthetic nap cover. Follow with a rubber squeegee to provide a smooth finish.
- C. Ferrous Metals:
1. Ferrous Metals except Ductile and Cast Iron:
 - a. Comply with paint manufacturer's recommendations for type and size of abrasive to provide a surface profile that meets manufacturer's painting system requirements for type, function, and location of surface. Verify that paint manufacturer-recommended profiles have been achieved on prepared surfaces. Report profiles to Engineer using Test Method C of ASTM D4417.
 - b. Clean non-submerged ferrous surfaces including structural steel and miscellaneous metal to be shop-primed, of all oil, grease, dirt, mill scale, and other contamination by commercial blast cleaning complying with SSPC SP 6 at time of paint system application, using SSPC VIS 1 as a standard of comparison.
 - c. Clean submerged ferrous surfaces including structural steel and miscellaneous metal to be shop-primed of all oil, grease, dirt, mill scale, and other contamination by near-white blasting complying with SSPC SP 10 at time of painting system application, using SSPC VIS 1 as a standard of comparison.
 - d. Clean non-submerged, ferrous surfaces that have not been shop-coated of all oil, grease, dirt, loose mill scale, and other contamination by commercial blasting complying with SSPC SP 6 at the time of painting system application, using SSPC VIS 1 as a standard of comparison.
 - e. Clean submerged ferrous surfaces that have not been shop-coated or that have been improperly shop-coated of all oil, grease, dirt, mill scale, and other contamination by

SECTION 09900 – PAINTING

- near-white blasting complying with SSPC SP 10 at time of painting system application, using SSPC VIS 1 as a standard of comparison.
- f. Touch-up shop-applied prime coats that have damaged or have bare areas with primer recommended by paint manufacturer after commercial blasting complying with SSPC SP 6 at the time of painting system application, using SSPC VIS 1 as a standard of comparison, to provide a surface profile of not less than one mil.
 - g. Power tool-clean per SSPC SP 3 to remove welding splatter and slag.
 - h. Ductile and Cast Iron:
 - 1) Comply with paint manufacturer's recommendations and NAPF 500-03 for type and size of abrasive to provide a surface profile meeting paint manufacturer's requirements for type, function and location of surface. Verify that paint manufacturer-recommended profiles are achieved on prepared surfaces.
 - 2) Clean submerged and non-submerged ductile and cast iron surfaces to be shop-primed of all oil, grease, dirt, mill scale, and other contamination by solvent cleaning and abrasive blasting complying with NAPF 500-03-01, NAPF 500-03-04, and NAPF 500-03-05 at time of paint system application.
 - 3) Clean submerged ductile and cast iron that have not been shop-coated or that have been improperly shop-coated of all oil, grease, dirt, mill scale, and other contamination by solvent cleaning and abrasive blasting complying with NAPF 500-03-01, NAPF 500-03-04, and NAPF 500-03-05 at time of paint system application.
 - 4) Touch-up shop-applied prime coats that are damaged or have bare areas with primer recommended by paint manufacturer, after power tooling complying with NAPF 500-03 at the time of painting system application.
 - D. Non-Ferrous Metal Surfaces: Prepare non-ferrous metal surfaces for painting by light whip blasting or by lightly sanding with 60- to 80-mesh sandpaper.
 - E. Galvanized (Zinc-Coated) Surfaces: Prepare galvanized surfaces for painting by lightly sanding with 60- to 80-mesh sandpaper or by light whip blasting.
 - F. PVC and CPVC Piping and Fiberglass: Lightly sand and clean surfaces to be painted. Fiberglass surfaces shall be prepared by solvent washing to remove wax and other contaminants, before abrading surfaces with 60- to 80-mesh sandpaper to provide an anchor pattern with scratches no further apart than 1/16-inch.
 - G. Covering on Pipe Insulation:
 - 1. Remove all oil and surface contaminants as recommended by paint and insulation cover manufacturer for surface and application required.
 - 2. Do not cut or damage insulation and covering.

3.03 PROTECTION OF PROPERTY AND STRUCTURES

- A. Protect property and structures adjacent to the Work from waste residues resulting from cleaning, surface preparation and paint application.
- B. Use shrouding, vacuum blasting, or other approved methods for cleaning and surface preparation of exterior surfaces.
- C. During blast cleaning and surface preparation of interior and exterior surfaces, control discharge of dust and grit, using shrouding, negative-pressure containment/dust collection systems, or other means to protect adjacent property and structures and prevent dust/grit from escaping. Similarly control removal and temporary storage of residues to protect adjacent property and structures.
- D. For painting of exterior surfaces, use rollers, shrouding or other approved methods as required to protect adjacent property and structures from wind-blown paint residues.
- E. Submit proposed procedures for cleaning, surface preparation and paint application describing methods for protecting adjacent property and structures from residues. Do not proceed with cleaning, surface preparation or painting until proposed procedures are approved by Engineer.

3.04 MATERIALS PREPARATION

- A. General:
 - 1. Mix and prepare paint products in strict accordance with paint manufacturer's product literature.
 - 2. Do not mix painting materials produced by different manufacturers, unless otherwise permitted by paint manufacturer's instructions.
 - 3. Where thinners are required, they shall be produced by paint system manufacturer unless otherwise permitted by paint manufacturer's product literature and submitted to and accepted by Engineer with Shop Drawings.
- B. Tinting:
 - 1. Where multiple coats of the same material are to be provided, tint each undercoat a lighter shade to facilitate identification of each coat of paint.
 - 2. Tint undercoats to match color of finish coat of paint, but provide sufficient difference in shade of undercoats to distinguish each separate coat. Provide a code number to identify material tinted by manufacturer.
- C. Mixing:
 - 1. For products requiring constant agitation, use methods in compliance with manufacturer's product literature to prevent settling during paint application.
 - 2. Mix in containers placed in suitably sized non-ferrous or oxide resistant metal pans to protect floors from slashes or spills that could stain the floor or react with subsequent finish floor material.
 - 3. Mix and apply paint in containers bearing accurate product name of material being mixed or applied.
 - 4. Stir products before application to produce a mixture of uniform density and as required during the application. Do not stir into the product film that forms on surface; instead, remove film and, if necessary, strain product before using.
 - 5. Strain products requiring such mixing procedures. After adjusting mixer speed to break up lumps and after components are thoroughly blended, strain through 35 to 50-mesh screen before application.

3.05 APPLICATION

- A. General:
 - 1. Apply paint systems by brush, roller, or airless spray per manufacturer's recommendations and in compliance with Paint Application Specifications No. 1 in SSPC Volume 2, where applicable. Use brushes best suited for type of paint applied. Use rollers of carpet, velvet back, or high pile sheeps wool as recommended by paint manufacturer for product and texture required. Use air spray and airless spray equipment recommended by paint manufacturer for specific painting systems specified. Submit a list of application methods proposed, listing paint systems and location.
 - 2. Paint dry film thicknesses required are the same regardless of the application method. Do not apply succeeding coats until previous coat has completely dried.
 - 3. Apply additional coats when undercoats, stains, or other conditions show through final coat of paint, until paint film is uniform finish, color, and appearance, particularly for intense chroma primary colors. Ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a film thickness equivalent to that of flat surfaces.
 - 4. Surfaces of items not normally exposed-to-view do not require the same color as other components of system of which they are part, but require the same painting system specified for exposed surfaces of system.
 - 5. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint before final installation of registers or grilles.
 - 6. Paint backs of access panels and removable or hinged covers to match exposed surfaces.
 - 7. Paint aluminum parts in contact with dissimilar materials with specified paint system.
 - 8. Paint tops, bottoms, and side edges of doors the same as exterior surfaces.

SECTION 09900 – PAINTING

9. Omit field-applied primer on metal surfaces that have been primed in the shop. Touch-up paint shop-primed coats and pre-finished items only when approved by Engineer using compatible primers and manufacturer's recommended compatible field-applied finishes.
 10. Welds shall be stripe-coated with intermediate or finish coat of paint after application of prime coat.
- B. Minimum/Maximum Paint Film Thickness:
1. Apply each product at not less than, nor more than, manufacturer's recommended spreading rate, and provide total dry film thickness as specified.
 2. Apply additional coats of paint if required to obtain specified total dry film thickness.
 3. Maximum dry film thickness shall not exceed 100 percent of minimum dry film thickness, except where more stringent limitations are recommended by paint manufacturer for a specific product.
- C. Scheduling Surface Preparation and Painting:
1. As soon as practical after preparation, apply first-coat material to surfaces that have been cleaned, pretreated, or otherwise prepared for painting. Apply first-coat material before subsequent surface deterioration due to atmospheric conditions existing at time of surface preparation and painting. Surfaces that have started to rust before first-coat application is complete shall be brought back to required standard by abrasive blasting.
 2. Allow sufficient time between successive coats to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure and application of another coat of paint does not cause lifting or loss of adhesion to undercoat.
 3. Scarify primers and other painting system components by brush-blasting if paint has been exposed for lengths of time or under conditions beyond manufacturer's written recommendations for painting systems required, intended use, or method of application proposed for subsequent coats of paint.
 4. Schedule cleaning and painting so that dust and other contaminants from cleaning process do not fall on wet, newly painted surfaces.
- D. Prime Coats: Recoat primed and sealed walls and ceilings where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects caused by insufficient sealing.
- E. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage.
- F. Brush Application:
1. Brush out and work all brush coats onto surfaces in an even film. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections are unacceptable. Neatly draw all glass and color break lines.
 2. Brush-apply primer or first coats, unless otherwise permitted to use mechanical applicators.
- G. Mechanical Applicators:
1. Use mechanical methods for paint application when permitted by governing ordinances, manufacturer, and approved by Engineer.
 2. Limit roller applications, if approved by Engineer, to interior wall finishes for second and third coats. Apply each roller coat to provide the equivalent hiding as brush-applied coats.
 3. Where spray application is used, apply each coat to provide equivalent hiding of brush-applied coats. Do not double back with spray equipment for purpose of building up film thickness of multiple coats in one pass.
- H. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint Work not in compliance with specified requirements as required by Engineer.

3.06 FIELD QUALITY CONTROL

- A. Engineer may invoke the following material testing procedure at any time, and any number of times, during field painting Work:

SECTION 09900 – PAINTING

1. Contractor shall engage service of an independent testing laboratory to sample paints used, as designated by Engineer. Samples of products delivered to the Site shall be obtained, identified, sealed, and certified as to being products actually applied to the surfaces in each area, in the presence of Contractor.
2. A testing laboratory selected by Owner and paid for by Contractor shall perform appropriate tests for any or all of the following:
 - a. Abrasion resistance.
 - b. Apparent reflectivity.
 - c. Flexibility.
 - d. Washability.
 - e. Absorption.
 - f. Accelerated weathering.
 - g. Dry opacity.
 - h. Accelerated yellowness.
 - i. Recoating.
 - j. Skinning.
 - k. Color retention.
 - l. Alkali resistance.
 - m. Quantitative materials analysis.
 - n. If the test results show that the products being used do not comply with the specified requirements, Contractor may be directed to stop painting Work and remove non-complying paint, and shall prepare and repaint surfaces coated with the rejected paint with material complying with the Contract Documents.
- B. Notify Engineer after completing each coat of paint. After inspection and checking of film thickness, holidays, and imperfections, and after acceptance by Engineer, proceed with succeeding coat. Perform testing using testing instruments specified in Article 2.4 of this Section.
 1. Engineer will witness all testing and shall be notified of scheduled testing at least twenty-four hours in advance.
 2. Apply additional coats, if required, to produce specified film thickness and to correct holidays and to completely fill all surface air holes.
- C. For magnetic substrates, measure thickness of dry film nonmagnetic coatings following recommendations of SSPC PA-2. These procedures supplement manufacturers' approved instructions for manual operation of measurement gauges and do not replace such instructions.
- D. Record time, location, number of coats, dry film thickness, holidays, and other imperfections and submit testing results to Engineer.

3.07 PROTECTION OF NEW FINISHES

- A. Provide signs that read, "Wet Paint" as required to protect newly painted finishes. Remove temporary wrappings provided for protection of the Work and work of other contractors after completion of painting.

3.08 ADJUSTING AND CLEANING

- A. Correct damages to work of other trades through cleaning, repairing or replacing, and repainting, as acceptable to Engineer.
- B. During progress of Work, remove from Site all discarded paint materials, rubbish, cans, and rags at end of each workday.
- C. Upon completion of painting, clean paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, while avoiding scratching or otherwise damaging finished surfaces.
- D. At completion of work of other trades, touch-up and restore damaged or defaced painted surfaces as determined by Engineer.

END OF SECTION

SECTION 09900 – PAINTING

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SECTION 10155 – TOILET COMPARTMENTS

PART 1 - GENERAL

1.01 – SECTION INCLUDES

- A. Toilet compartment, compartment doors and related accessories.

1.02 - SUBMITTALS

- A. Submit samples of hardware, fastenings, 12 inch long pilaster section, and finish.
- B. Submit shop drawings showing details of construction, hardware, fittings, and fastenings.

1.03 – SYSTEM DESCRIPTION

- A. Compartments shall be the floor anchored overhead braced type with uniform flush front appearance.

PART 2 - PRODUCTS

2.01 - MANUFACTURERS

- A. METPAR CORP.; Product - Luxor (FP-500).
- B. Or approved equal.

2.02 - MATERIALS

- A. Bathroom compartments: Type 304 stainless steel with #4 satin finish that is formed and cemented under pressure to a double faced honeycomb paper core. Doors and panels: 1-inch thick. Pilasters: 1-1/4-inch thick with 3-inch high stainless steel trim shoe to cover bottom mountings. Hardware: chrome plated die-cast zamac. Head rails: brite anodized 1-inch wide x 1-3/4-inch high aluminum extrusion.
- B. Exposed hardware and fittings shall be tamper-resistant Type 304 Stainless Steel, with satin finish and shall include hinges, privacy latch, coat hook and bumper, and attaching devices.

2.03 - FABRICATION

- A. All components shall be factory-finished after fabrication.
- B. Corners of doors, panels and pilasters shall be square and neat.

PART 3 - EXECUTION

3.01 - ERECTION

- A. Erect partitions in accordance with manufacturer's standard recommendations and the following:
 - 1. All parts shall be erected in a rigid substantial manner, straight, level and plumb.
 - 2. No evidence of drilling, cutting, or patching shall be visible in the finished work.
 - 3. Clearance at vertical edges of doors shall be uniform, top to bottom, and shall not exceed 3/16-inch in width.

SECTION 10155 – TOILET COMPARTMENTS

4. Doors shall not be out of plumb with hardware carefully adjusted and in perfect working order.
5. Provide at least two points of support for each side of panels. Use hex bolts where practicable instead of tapped machine screws. Bolts to wall construction shall be appropriate for the type of construction and shall otherwise match the bolts used at other locations. All screw heads shall be one way. Do not use sheet metal screws.
6. Post or pilasters shall be floor mounted and overhead braced and fastened by concealed devices permitting adjustment and adjusted to be level with floor or other construction.
7. Finished surfaces shall be cleaned and left free from imperfections.

3.02 - TOLERANCES

- A. Maximum Variation in Plan Dimensions: 1/8-inch horizontal distance.
- B. Maximum Variation from Plumb: Not to exceed 1/8-inch.

END OF SECTION 10155

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provide Louvers and all associated louver accessories and components in accordance with the Contract Documents and as required to provide a complete and first class installation. The work of this section shall include, but not be limited to the following:
 - 1. Fixed metal louvers and frames.
 - 2. Fixed acoustical metal louvers.
 - 3. Bird and insect screening.
 - 4. Combination metal louvers with integral dampers.

1.02 RELATED SECTIONS

- A. Caulking and Sealants: Section 07920.
- B. Mechanical: Division 15.

1.03 REFERENCES

- A. AMCA 500 (Air Movement Control Association) - Test Method for Louvers.
- B. ASTM B221 – Aluminum Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.
- C. SMACNA – Architectural Sheet Metal Manual.

1.04 PERFORMANCE REQUIREMENTS

- A. Design and fabricate units to withstand wind lateral loads and snow loads.

1.05 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, tolerances; head, jamb and sill details; blade configuration, screens and frames.
- C. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.
- D. Samples: Submit two (2) samples, 2" x 2" in size illustrating finish and color of exterior and interior surfaces.
- E. Submit two samples of manufacturer's full line of powder coating color chips. Color to be selected by Owner.
- F. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.
- G. Equals will only be accepted if they meet or exceed the performance of specified louvers.

1.06 QUALITY ASSURANCE

- A. Perform work in accordance with AMCA Certification for louvers and dampers.

1.07 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings and instructed by the manufacturer.

1.08 COORDINATION

- A. Coordinate the Work with installation of flashings.
- B. Coordinate the Work with installation of mechanical ductwork.

PART 2 - PRODUCTS

2.01 ACCESSORIES

- A. Fasteners and Anchors: Stainless steel type.
- B. Head and Sill Flashings: Roll formed to required shape, single length in one piece per location. Flashings: Of same material as louver frame.
- C. Screens: Install screen mesh in shaped frame, reinforce corner construction, shop install to louver with fasteners. Screen shall be easily removed from the building interior.
- D. Sealants: Type specified in Section 07920.

2.02 FIXED LOUVERS

- A. Louvers shall be fabricated to provide a minimum of (57%), 9.09 square feet of free area for a 48" x 48" size louver and bear the AMCA certified ratings program seal for air performance and water penetration. The rating shall show a beginning point of water penetration at .01 ounces per square foot of free area at a free area velocity of 886 feet per minute, with .125 inches of water gauge pressure drop for air intake. Louvers shall have a full width sill with head and blades contained within jambs. Louver shall be approximately 4" deep.
- B. Louvers shall be provided with an aluminum bird or insect screen, as called for on the schedules.
- C. Material: Extruded Aluminum 6063 – T6/T52 Alloy.
- D. Louver finish shall be Kynar, color as selected by Owner.
- E. Louvers shall be Type EA-400 by Arrow United or approved equal.

2.03 FIXED ACOUSTICAL LOUVERS

- A. Louvers shall be 6" deep acoustical louvers with 6" blade spacing. Louver shall provide a minimum free area of 4.23 square feet for a 48" x 48" size louver, with a beginning point of water penetration at 0.01 ounces per square foot of free area at a free area velocity of 858 feet per minute, with 0.08 inches of water gauge pressure drop for air intake at this velocity, as tested to AMCA standard 500-L.
- B. Louvers shall be provided with an aluminum bird or insect screen, as called for on the schedules.
- C. Frame material shall be 14-gauge aluminum.

- D. Blade material shall be 16-gauge aluminum airfoil exterior with 22-gauge perforated aluminum interior surface.
- E. Blades shall be insulated with eco-sound insulation.
- F. Sound attenuation (dB) at zero feet from the louver, for the first through eighth octave bands, shall be 10, 10, 8, 10, 14, 18, 14, 15, respectively. Attenuation measured at other distances, as well as transmission loss data, shall be available in the manufacturer's literature.
- G. Louver finish shall be Kynar, color as selected by Owner.
- H. Louvers shall be Type AC482-6-6 by Arrow United or approved equal.

2.04 OPERABLE LOUVERS

- A. Louvers shall be adjustable type with blades on 4" centers. Louvers shall be provided with a motorized actuator for blade operation. Linkage to be concealed in channel out of air stream.
- B. Louvers shall be fabricated to provide a minimum of (44%), of free area and bear the AMCA certified ratings program seal for air performance and water penetration. The rating shall show a beginning point of water penetration at .01 ounces per square foot of free area at a free area velocity of 974 feet per minute, with .14 inches of water gauge pressure drop for air intake for a 48x48 test size unit. Louvers shall have a full width sill with head and blades contained within jams. Louver shall be approximately 4" deep.
- C. Louvers shall be provided with an aluminum bird or insect screen, as called for on the schedules.
- D. Material: Extruded Aluminum 6063 – T6.
- E. Louver finish shall be Kynar, color as selected by Owner.
- F. Louvers shall be Type EA-450-D as manufactured by Arrow United Industries or approved equal.

2.05 DAMPERS

- A. Dampers shall be arrow-foil parallel blade type constructed of extruded aluminum. Low leakage damper shall bear the AMCA Certified Ratings Seal for air leakage and air performance. Leakage through a 60"x36" damper at 4" water gauge pressure differential shall be equal to Class I leakage.
- B. Frames and blades to be a minimum 12 ga (.081") extruded aluminum. Blades to be a single unit arrow-foil design, 6" wide with the pin-lock an integral section within the blade core.
- C. Blades shall have extruded silicone rubber seal at blade edge. A blade overlap shall be present when damper is in the closed position. Silicone seals shall fit into ribbed groove insert in blades with a formed stainless steel, spring steel seal at the jamb.
- D. Frames shall be extruded aluminum channel with reinforcing bosses and groove inserts for silicone seals.
- E. Axle shafts to be ½" diameter extruded aluminum, pin-lock design interlocking into blade section. Axle bearings shall be designed so that there is no metal-to-metal or metal-to-bearing riding surfaces.

- F. Linkage shall be contained within the jamb of the damper frame. Damper frame shall have extruded aluminum stops at the top and bottom.
- G. A complete damper assembly shall have blades no wider than 60 inches and no higher than 72 inches. Where required damper width or height exceeds manufacturer's maximum recommended single panel size, the assembly shall be made of a combination of sections. Dampers shall be sized for the scheduled air velocity and pressure classification.
- H. Louvers shall be Arrow-Foil Damper Model AFD-20 as Manufactured by Arrow United Industries or approved equal.

2.06 MOTORIZED DAMPER ACTUATORS

- A. Fast-acting, two-position actuators shall be of the power open, spring return direct coupled type for on/off damper control.
- B. Actuator shall fail normally closed, unless called for otherwise on the Drawings.
- C. Die-cast aluminum housing shall allow for flush mounting to damper.
- D. Timing at rated torque and voltage:
 - 1. Drive Open: 15 seconds
 - 2. Spring Close: 15 seconds
- E. Motorized actuators shall be 24V, Model MS8120F1200 as Manufactured by Honeywell or approved equal.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that prepared openings and flashings are ready to receive work and opening dimensions are as indicated on shop drawings and instructed by the manufacturer.

3.02 INSTALLATION

- A. Install louver assembly in accordance with manufacturer's instructions.
- B. Install louvers level and plumb.
- C. Install flashings and align assembly to ensure moisture shed from flashings and diversion of moisture to exterior.
- D. Secure louvers in opening framing with concealed fasteners.
- E. Install screens and frame to interior of louver where indicated.
- F. Install perimeter sealant and backing rod in accordance with Section 07920.
- G. Install motorized damper in accordance with manufacturer's instructions.

3.03 ADJUSTING AND CLEANING

- A. Adjust work under provisions of Section 01750.
- B. Clean work under provisions of 01740.

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- C. Test operable louvers and adjust as needed to produce fully functioning units that comply with the requirements.
- D. Clean exposed louver surfaces that are not protected by temporary covering to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- E. Before final inspection, clean exposed surfaces in accordance with manufacturer's directions.
- F. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Engineer, remove damaged units and replace with new units.
- G. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION

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SECTION 10400 – IDENTIFICATION DEVICES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope:
 - 1. Provide all labor, materials, tools, equipment and in-cidentals as shown, specified and required to furnish and install identification devices.
 - 2. Extent of identification devices is shown and, where indicated, as specified.
 - 3. Types of products required include the following:
 - a. Room identification, information, entry and directional signs.
 - b. Health, safety, warning, and fire extinguisher location signs.
 - c. Stainless steel fasteners, supports, very-high-bond high-performance mounting tape, primers and other accessories.
 - 4. Coordination:
 - a. Review installation procedures under other Sections and coordinate the installation of items that must be installed with, or before, the identification devices.
 - b. Coordinate adhesives and fasteners with mounting surfaces. Review other Sections in order to ensure compatibility of identification device mounting accessories for the various surfaces.
 - 5. Related Sections:
 - a. Section 09900, Painting.

1.02 REFERENCES

- A. Standards referenced in this Section or referenced in Product Performance Standards are listed below:
 - 1. AA SAA-46 - Stan-dards for Anodized Architectural Aluminum.
 - 2. AA DSA-45 - Designation System For Aluminum Finishes.
 - 3. ANSI A13.1 - Scheme for the Identification of Piping Systems.
 - 4. ANSI A117.1 - Accessible And Usable Buildings And Facilities.
 - 5. ANSI Z535.1 - Safety Color Code.
 - 6. ANSI Z535.2 - Environmental And Facility Safety Signs.
 - 7. ANSI Z535.3 - Criteria For Safety Symbols.
 - 8. ANSI Z535.4 - Product Safety Signs And Labels.
 - 9. ANSI Z535.5 - Accident Prevention Tags (For Temporary Hazards).
 - 10. ASTM E527 - Practice For Numbering Metals And Alloys (UNS).
 - 11. CAS - Registry Numbers for Specific Chemical Identity.
 - 12. CDA - Properties of Cast Copper Alloys.
 - 13. NFPA 704 - Standard System for the Identification of the Hazards of
 - 14. Materials for Emergency Response.
 - 15. OSHA 1970 - Title 29, Code of Federal Regulations Part 1910.1200, Hazard Communication Standard.
 - 16. OSHA 1970 - Title 29, Code Of Federal Regulations Part 1910, Subpart Z, Toxic And Hazardous Substances.
 - 17. OSHA 1970 - Title 29, Code Of Federal Regulations Part 1910.144, Safety Color Code For Marking Physical Hazards.
 - 18. OSHA 1970 - Title 29, Code Of Federal Regulations Part 1910.145, Specification For Accident Prevention Signs And Tags.

1.03 QUALITY ASSURANCE

- A. Identification Devices Manufacturers:
 - 1. Engage firms specializing in the production of the types of products specified, in compliance with specified standards, with a documented record of successful in-service performance, and who can provide sufficient production capacity to avoid delaying the Work.
 - 2. Submit name and experience record of manufacturers to Engineer.
 - 3. Component Supply and Compatibility:

SECTION 10400 – IDENTIFICATION DEVICES

- a. Obtain each separate type of identification device from a single supplier and from a single manufacturer.
- b. Colors shall be brilliant, distinctive shades, matching the safety colors specified in ANSI Z535.1 and OSHA 1910.144.
4. Requirements of Regulatory Agencies:
 - a. All accident prevention signs and tags shall comply with OSHA 1910.145.
 - b. All health, safety and warning signs shall comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3 and OSHA 1910.144 and 1910.145, unless otherwise specified. The colors shall be those of opaque glossy samples as specified in Table 1 of ANSI Z535.1. Safety symbol pictograms shall be incorporated into each sign, in addition to text.
5. Codes: Comply with applicable requirements of International Building Code.

1.04 SUBMITTALS

- A. Samples: Submit the following:
 1. Each color and finish of exposed materials and accessories required for identification devices.
 2. Actual full-size sample of each type of permanent room identification sign and informational and directional sign incorporating all features specified; pipeline identification sign and mounting accessories; equipment and structure nameplate; and right-to-know signs, labels and tags. Information on the type of coding system will be furnished to Contractor by Engineer.
 3. Engineer's review of samples will be for color and texture only. Compliance with all other requirements is the responsibility of Contractor.
 4. List of spare parts recommended by the manufacturer. The list shall describe each part, the quantity recommended, and the unit price of each part.
 5. Shop Drawings: Submit the following:
 - a. Copies of manufacturer's technical data for each product specified including fabrication and erection information for all identification devices. Show anchorages and accessory items. Furnish location template drawings for items supported or anchored to permanent construction.
 - b. Complete selection of each specified manufacturer's standard and custom colors, alphabetic styles, graphic layouts and pictograms.
 - c. Coordinate mounting position, method, and proposed mounting accessories and fasteners with actual Project conditions. Indicate required mounting accessories on plans showing locations of all required exit signs based on measurements taken at the Site. Show final location and identify type of mounting surface for each exit sign. Coordinate location of exit signs for non-interference with other Work and as required by governing authorities having jurisdiction at the Site.
 - d. Complete, camera-ready, color graphic layouts based on specified requirements and recommendations from manufacturer

1.05 PROJECT CONDITIONS

- A. Field Measurements:
 1. Verify dimensions in areas of installation. Take measurements at the Site before fabrication and indicate dimensions on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 2. Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating units without field measurements. Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to dimensions established for identification devices Work.
 3. Scheduling: Coordinate the delivery of templates, instructions and directions for installation of anchorage devices with other Work to avoid delay.

PART 2 - PRODUCTS

2.01 SYSTEM PERFORMANCE

- A. Performance Criteria: Details for identification devices shown, such as alphabet representation, letter spacing, borders designs, and other graphic features, are generic and intended to establish text, general positions and symbols only.
- B. Allowable Tolerances: Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16-inch measured diagonally.

2.02 HEALTH, SAFETY, WARNING, AND FIRE EXTINGUISHER LOCATION SIGNS

- A. Product Description: Provide aluminum signs with fade-resistant embedded graphics.
- B. Size and Thickness: 0.125-inches thick; 10-inches by 14-inches, unless otherwise specified.
- C. Graphics and Alphabet: Standard Helvetica Medium alphabet and matching arrow type-face; upper and lower case 1-inch high capitals.
- D. Exposure: Recommended by the manufacturer for both indoor and outdoor use and with a upper service temperature limit of 190F. Average durability for outdoor use shall be 15 years.
- E. Safety Instruction Signs: Standard color of the background shall be white; and the panel, green with white letters. All letters used against the white background shall be black.
- F. Caution Signs: Standard color of the background shall be yellow; and the panel, black with yellow letters.
- G. Danger Signs: Standard color of the background shall be white; and the panel black with red insert containing white letters. All letters used against the white background shall be black.
- H. Warning Signs: Standard color of the background shall be orange; and the panel black with orange insert containing black letters. All letters used against the orange background shall be black.
- I. Notice Signs: Standard color of the background shall be white; the panel shall be blue with white letters. All letters used against the white background shall be black.
- J. No Smoking Signs: Standard color of the background shall be white. All letters used against the white background shall be red.
- K. Biohazard Signs: Standard color of the background shall be white; and the panel black with white letters. Incorporate red international biohazard pictogram on white background.
- L. Floor Loading Signs: Standard color of the background shall be white; and the panel blue with white letters. All letters used against the white background shall be black.
- M. Fire Extinguisher Location Signs (surface-mounted units only): Standard color of the background shall be red with white letters. Each sign shall incorporate an international fire extinguisher pictogram and a directional arrow indicating location of fire extinguisher.
- N. Mounting Brackets: Provide manufacturer's standard mounting brackets for hanging, projected or double-sided signs.
- O. Products and Manufacturers: Provide one of the following:
 - 1. Graphic Blast Word and Picture Series by Best Manufacturing Sign Systems, Incorporated.
 - 2. ASI Signs Systems, Inc.
 - 3. Or equal.

2.03 EQUIPMENT NAMEPLATES

- A. Description:
 - 1. Provide equipment nameplates for equipment furnished under the Contract, and for other equipment items indicated to receive nameplates as directed by the Engineer. Equipment nameplates specified in this Article are in addition to equipment manufacturer's standard

SECTION 10400 – IDENTIFICATION DEVICES

- nameplate with manufacturer name, model number, serial number, and similar information.
2. Install equipment nameplates as indicated in Part 3 of this Section. Mechanically fasten equipment nameplates to the associated equipment item.
- B. Products and Manufacturers: Provide one of the following:
1. Brady-Etch Stainless Steel ID Tags (B-748) custom engraved, by Brady Worldwide, Inc.,
 2. Custom Screenprinted Nameplates – Stainless Steel, by Seton Identification Products, a Tricor Direct Company
 3. Or equal.
- C. Equipment Nameplates:
1. Material: Type 304 or Type 316 stainless steel with 0.0015-inch thick black enamel background or black screenprinted background, 26-gage thick with rounded corners. Provide nameplates with screenprinted background installed outdoors with acrylic overcoat. Suitable for temperatures ranging from -40 to 89 degrees C.
 2. Provide each equipment nameplate with not less than two holes, each approximately 3/16-inch diameter, for mechanically fastening nameplate to the associated equipment. Provide appropriate stainless steel fasteners.
 3. Nameplate Size: Size shall be as required for required text, and shall be not less than one-inch by four inches.
 4. Text Engraved on Nameplates:
 - a. Text Size: Equipment nameplate titles shall have text as large as possible to fit on nameplate; text shall be not less than 1/2-inch high. All text on a given nameplate shall be one size.
 - b. Text and symbols shall be Standard Helvetica Medium, all upper-case.
 - c. Left-justify multiple lines of text
 - d. Where more than one item of the same type of equipment is furnished, consecutively number each associated equipment nameplates as shown or indicated; for example "Pump No. 1", "Pump No. 2", "Pump No. 3", and so on.
- D. Operating Stands for Valves and Gates:
1. Nameplate material, size, and text requirements are the same as indicated above for other equipment nameplates.
 2. Operating stands for valves and gates shall carry the respective legends "V. No. ____" or "S.G. No. ____," with the appropriate equipment number to be indicated by Engineer.
 3. Background and text color of nameplates for valve and gate operators shall be the same colors specified above for other equipment nameplates.
 4. Background and text color of nameplates for valves and gates shall be the same as for the associated pipe markers.

2.04 AUXILIARY MATERIALS

- A. Very-High-Bond High-Performance Bonding Tape:
1. Provide all surface-mounted identification devices with very-high-bond foam tape backing except where specifically specified as requiring mechanical fasteners.
 2. Provide a very-high-bonding pressure sensitive joining system consisting of double-coated conformable acrylic foam tape and release liners:
 3. Thickness: 0.045-inch.
 4. Tape Width: 1-1/2-inches.
 5. Color: Dark grey.
 6. Bonding Adhesive: Acrylic; very-high-bond, solvent and shear resistance.
 7. Primer: High-performance tape manufacturers recommended acrylic primer.
 8. Products and Manufacturers: Provide one of the following:
 - a. Scotch Brand (Very-High-Bond) 4942 VHB Double Coated Acrylic Foam Tape and No. 94 Acrylic Primer by 3M Industrial Tape and Specialties Division.
 - b. Or equal.

SECTION 10400 – IDENTIFICATION DEVICES

9. Mounting Brackets: Provide manufacturer's standard mounting brackets for hanging, projected or double-sided signs.
 - a. Furnish inserts, and mechanical and adhesive anchoring devices as specified for the installation of identification devices.
10. Fasteners: Provide fasteners of non-magnetic stainless steel of size and type required and recommended by individual identification device manufacturers.
11. Anchors and Inserts: Use nonferrous metal or hot-dipped galvanized anchors and inserts. Use toothed stainless steel or lead expansion bolts for drilled-in-place anchors.

2.05 FABRICATION

- A. Shop Assembly:
 1. Fabricate and preassemble items in the shop to the greatest extent possible.
 2. Disassemble units only to the extent necessary for shipping and handling limitations.
 3. Clearly mark units for reassembly and coordinated installation.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine the substrates and conditions under which the identification devices are to be installed and notify Engineer, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

3.02 INSTALLATION

- A. General:
 1. Install identification devices and components as directed by Engineer, securely mounted with concealed very-high-bond acrylic foam tape or mechanical/chemical fasteners where specified. Attach signs to surfaces in accordance with the manufacturer's instructions, unless otherwise shown.
 2. Mount exit signs in locations shown. Surface mount signs above all exit doors, unless otherwise shown.
 3. Lightly mark and locate the position of all identification devices. Obtain Engineer's approval of all locations before mounting. Install level, plumb, and at the proper height. Repair or replace damaged units as directed by Engineer.
 4. Install very-high-bond acrylic foam tape on back of identification devices using a full perimeter of specified tape. Leave no gaps in tape perimeter at back of identification devices; peel off second release liner and press onto surfaces.
 5. Install level, plumb, and at the specified height.
 6. Information Signs:
 - a. Where permanent identification is provided for rooms and spaces, install signs on the wall adjacent to the latch side of the door.
 - b. Where there is no wall space on the latch side of the door, including at double leaf doors, install signs on the nearest adjacent wall.
 - c. Mounting height shall be 5 feet - 0 inches above the finish floor to the centerline of the sign. Mount such signage so that a person may approach within 3-inches of the sign without encountering protruding objects or, when reading sign, be forced to stand within the swing of a door.
 7. Equipment Identification Signs, Name-plates and Tags:
 - a. Signs on large valves shall be located on or adjacent to the valve itself. Tags for smaller valves shall be attached to bonnet or flange bolts. Do not attach tags or signs to handwheels of valves.
 - b. Locate nameplates on equipment bases and on structures at readily visible levels in such positions relative to the equipment and structures as to prevent damage to the nameplate.
 8. Right-To-Know Signs, Labels and Tags:

SECTION 10400 – IDENTIFICATION DEVICES

- a. Locate tags at 20 feet maximum center to center distance along chemical pipelines and fill pipelines and on each side of all locations where pipes emerge from penetrations with other materials.
- b. Install tank signs on all tanks shown to receive signage at quarter-points on tank circumference, 5 foot - 0 inches above finished floor.

3.03 PROTECTION AND CLEANING

- A. After installation, clean soiled identification device surfaces according to manufacturer's instructions.
- B. Protect units from damage until Final Completion by Owner.

3.04 SCHEDULE

- A. In addition to signs shown on drawings, provide the following signs.
- B. SCHEDULE OF SIGNS

Type	Pictogram	Message	Quantity	
No Smoking Signs	Yes	NO SMOKING IN THESE PREMISES UNDER PENALTY OF FINE OR IMPRISONMENT OR BOTH, BY ORDER OF THE FIRE COMMISSIONER	2	11"W x 15" H Paragraph 2.3 J
Floor Diagram Exit Sign	Map of Room	EVACUATION PLAN	0	12" W x 16" H Paragraph 2.2
Danger	Yes	DANGER: HIGH VOLTAGE	2	Note 1 Paragraph 2.3 G
Danger	Yes	DANGER: CONFINED SPACE ENTRY BY PERMIT ONLY	1	Note 1 Paragraph 2.3 G
Warning	Yes	To be determined by Owner	3	Note 1 Paragraph 2.3 H
Caution	No	CAUTION: THIS EQUIPMENT STARTS AND STOPS AUTOMATICALLY	2	Note 1 Paragraph 2.3 F
Caution	Yes	CAUTION: AUTHORIZED PERSONNEL ONLY	2	Note 1 Paragraph 2.3 F
Caution	Yes	CAUTION: NON-POTABLE WATER – DO NOT DRINK	0	Notes 1 & 2 Paragraph 2.3 F
Notice	Yes	NOTICE: MAXIMUM ALLOWABLE LOAD: 250 PSF LIVE LOAD	0	Note 1 Note 3 Paragraph 2.3 L
Notice	Yes	NOTICE: MAXIMUM ALLOWABLE LOAD: H20	0	Notes 1 & 3 Paragraph 2.3 L
General Safety	No	SAFETY FIRST: REMEMBER WEAR SAFETY EQUIPMENT	2	Note 1 Paragraph 2.3 E
Emergency Message	Yes	To be determined by Owner	0	8" x 8" Paragraph 2.3 M

SECTION 10400 – IDENTIFICATION DEVICES

Stair Identification Signs	No	STAIR 'A'	0	12" W x 10" H Paragraph 2.2
Floor Level Signs	No	FLOOR LEVEL '1'	0	12" W x 10" H Paragraph 2.2
Directional Arrow Signs	Yes	To be determined by Owner	0	14"W x 10" H Note 1 Paragraph 2.2

1. Notes:
2. See specification for sign sizes, unless noted otherwise.
3. See plumbing drawings for location.
4. See structural drawings for locations and to confirm floor loading information.

3.05 CONTRACTOR SHALL ALLOW FOR 4 ADDITIONAL SIGNS OF ENGINEER'S CHOICE WITH REGARD TO SIZE AND MESSAGE.

END OF SECTION

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SECTION 10522 – PORTABLE FIRE PROTECTION EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope:
 - 1. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install all portable fire protection equipment Work.
 - 2. Extent of portable fire protection equipment Work is shown and specified.
 - 3. Types of portable fire protection equipment Work required includes:
 - a. Dry chemical extinguishers.
 - b. Carbon dioxide extinguishers.
 - c. Mounting accessories and miscellaneous fasteners.
- B. Coordination: Review installation procedures under other Sections and coordinate installation of items that must be installed with or before portable fire protection equipment

1.02 REFERENCES

- A. Standards referenced in this Section are:
 - 1. UL Fire Classification Rating.

1.03 QUALITY ASSURANCE

- A. Component Supply and Compatibility:
 - 1. Provide portable fire protection equipment products from one manufacturer.
- B. Regulatory Requirements: Provide portable fire extinguishers approved and labeled by UL.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Submit the following:
 - a. Manufacturer's technical data, certification of UL rating, and installation instructions for portable fire protection equipment.

PART 2 - PRODUCTS

2.01 FIRE EXTINGUISHERS

- A. General: Provide manufacturer's standard mounting brackets for portable fire extinguishers size as specified.
- B. Multi-Purpose Dry Chemical Fire Extinguishers:
 - 1. Ten-pound capacity, enameled steel container with pressure-indicating gauge, for Class A, Class B, Class C fires, UL rating 4A-60 BC.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Cosmic Model 10E by J.L. Industries.
 - b. Or equal.
- C. Carbon Dioxide Fire Extinguishers:
 - 1. Ten-pound enameled steel container capacity, for Class B and Class C fires UL rating.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Sentinel Model 10 by J.L. Industries.
 - b. Pro 460 Model by Kidde Commercial Division
 - c. Or equal.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine substrates and conditions under which portable fire protection equipment will be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with Work until unsatisfactory conditions have been corrected in manner acceptable to Engineer.

3.02 INSTALLATION

- A. When exact locations of portable fire protection equipment are not shown on Drawings, locate as directed by Engineer.
- B. Securely fasten products to structure, square and plumb, per Supplier's instructions. Mounting heights shall be:
 - 1. Install fire extinguishers with gross weight greater than 40 pounds with top of fire extinguisher no more than 3.5 feet above finished floor.
 - 2. Install fire extinguishers with gross weight less than 40 pounds with top of fire extinguisher no more than 4.0 feet above finished floor.
 - 3. Clearance between bottom of fire extinguisher and finished floor shall be at least four inches.
- C. Identification Devices: Provide signs level and plumb directly above surface mounted portable fire extinguishers, securely mounted, attached to substrate per sign manufacturer's instructions. Signage shall be per Section 10400, Identification Devices.
- D. Recharge fire extinguishers provided under this Contract so that most recent inspection date coincides as nearly as possible with date of Substantial Completion. Inform Owner in writing of next required inspection and recharging date.

END OF SECTION

SECTION 10800 – TOILET AND BATH ACCESSORIES

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Scope:
 - 1. Provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all toilet and bath accessories Work.
 - 2. Extent of toilet and bath accessories is shown.
 - 3. Types of products required include the following:
 - a. Paper towel dispensers.
 - b. Toilet tissue dispensers.
 - c. Mirrors.
 - d. Grab bars.
 - e. Soap dispensers.
 - f. Miscellaneous fasteners, accessories and trim as required for a complete and functioning installation.
- B. Coordination:
 - 1. Furnish inserts and anchoring devices which must be set in concrete for the installation of toilet accessories. Coordinate delivery with other work to avoid delay.
 - 2. Refer to concrete Sections of these Specifications for installation of inserts and anchorage devices.
- C. Related Sections:
 - 1. Section 10155 – Toilet Compartments

1.02 REFERENCES

- A. Standards referenced in this Section are listed below:
 - 1. Americans with Disabilities Act of 1990 (ADA) Title II ADAAG.
 - 2. ANSI A 117.1, Guidelines for accessible and useable buildings and facilities providing accessibility and useability for physically handicapped people (ICC/ANSI A 117.1).2.
 - 3. ASTM A 167, Specification for Stainless Steel and Heat-Resisting Chromium-Nickel; Steel Plate, Sheet and Strip.
 - 4. ASTM A 366, Specification for Commercial Steel Sheet, Carbon, Cold Rolled.
 - 5. ASTM A 386, Specification for Zinc Coating (Hot-Dip) on Assembled Steel Products.
 - 6. ASTM B 456, Specification for Electro Deposited Coatings of Nickel Plus Chromium.
 - 7. FS DD-G-451, Glass (Laboratory).
 - 8. FS WW-P-541, Plumbing Fixtures (Land Use).
 - 9. NFPA 70, National Electric Code.
 - 10. UL Certifications Directory.

1.03 QUALITY ASSURANCE

- A. Component Supply and Compatibility:
 - 1. Provide products of the same manufacturer for each type of bath accessory unit and for units exposed in the same areas.
 - 2. Stamped names or labels on exposed faces of units will not be permitted.
- B. Provide locks with the same keying for each type of bath accessory units in the Project, wherever possible. Furnish two keys for each lock.

SECTION 10800 – TOILET AND BATH ACCESSORIES

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Requirements of Regulatory Agencies:
 - 1. Codes: Comply with applicable provisions of the International Building Code.
 - 2. ANSI A117.1, Accessible and Usable Buildings and Facilities.
 - 3. Americans with Disabilities Act of 1990 (ADA) Title II ADAAG.

1.04 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Setting Drawings, templates, instructions and directions for installation of anchorage devices in other work.
 - 2. Product Data:
 - a. Copies of manufacturer's technical data and installation instructions for each toilet accessory.

1.05 SEQUENCING

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Stainless Steel, ASTM A 167: Type 302/304 with polished No. 4 finish, unless otherwise specified.
- B. Chromium Plating, ASTM B 456: Nickel and chromium electro-deposited on metal, Type SC2.
- C. Tempered Mirror Glass, FS DD-G-451: Polished tempered glass, 1/4-inch thick, with silver coating hermetically sealed by electroplating with a copper protective coating. Provide backed mirrors-finished with a non-metallic, waterproof paint coating.
- D. Provide manufacturer's recommended installation accessories for each toilet and bath accessory.

2.02 SURFACE-MOUNTED PAPER TOWEL DISPENSER

- A. Size to dispense not less than 400 c-fold towels with interchangeable paper drop. With cabinet and door not less than 22 gauge stainless steel, No. 4 satin finish all welded construction without mitered corners. Hang door with a concealed, full-length stainless steel piano hinge and install a tumbler-lockset.
- B. Products and Manufacturers: Provide one of the following:
 - 1. B-262 by Bobrick Washroom Equipment, Incorporated.
 - 2. No. 0210 by American Specialties, Incorporated.
 - 3. Or equal.

SECTION 10800 – TOILET AND BATH ACCESSORIES

2.03 TOILET TISSUE DISPENSERS

- A. General: Provide toilet tissue dispensers at each water closet.
- B. Multi-roll Toilet Tissue Dispenser and Utility Shelf: Fabricate shelf of not less than 18 gauge stainless steel, to store and dispense not less than two 4-1/2-inch by 4-1/2-inch core tissue rolls. Fabricate flange from a single piece, with seamless construction.
- C. Products and Manufacturers: Provide one of the following:
 - 1. B-2840 by Bobrick Washroom Equipment, Incorporated.
 - 2. No. 0697-GAL by American Specialties, Incorporated.
 - 3. Model 5263 by Bradley Corporation.
 - 4. Or equal.

2.04 MIRRORS

- A. Accessible Tilt Mirrors:
 - 1. General: Provide accessible tilt mirror above each accessible lavatory.
 - 2. Stainless Steel Frame: Fabricate frame from 20 gauge, Type 304L stainless steel, welded and ground smooth, no shelf. Mirrors shall be 18-inches by 36-inches, with tilting frame tapered from 1-1/2-inches at bottom to 4-1/2-inches at top.
 - 3. Products and Manufacturers: Provide one of the following:
 - 1. B-293 by Bobrick Washroom Equipment, Incorporated.
 - 2. No. 0535-B by American Specialties, Incorporated.
 - 3. Model 740-1836 by Bradley Corporation.
 - 4. Or equal.

2.05 GRAB BARS

- A. General: Provide grab bars where shown. Provide custom specials where required or specified.
- B. Stainless Steel Grab Bars: Provide stainless steel knurled grab bars, 1-1/2-inch outside diameter, 16 gauge.
 - 1. Mounting: Concealed, with manufacturer's standard flanges and anchorages for type of installation.
 - 2. Provide custom dimensions specified.
- C. Products and Manufacturers: Provide one of the following:
 - 1. B-6806x36 by Bobrick Washroom Equipment, Incorporated.
 - 2. 3200 P Series 36-inch leg by American Specialties, Incorporated
 - 3. Model 812-2, Type 059 by Bradley Corporation.
 - 4. Or equal.

2.06 SURFACE-MOUNTED HORIZONTAL LIQUID SOAP DISPENSER/SHELVES

- A. General: Provide surface-mounted liquid soap dispensers, one per lavatory; 17.5-inches long by 3-1/4-inches high by 5-1/4-inches deep, with one liquid soap dispensing valve.
- B. Liquid Soap Dispenser: Fabricate units from 20 gauge stainless steel, with pin-type tumbler locking device. Provide 20 gauge stainless steel shelf using one-piece construction, with integral sides. Dispense liquid soap in measured quantity by pump action with stainless steel internal springs, ABS piston, stainless steel push button and internal parts. Cabinet shall have no exposed fastening devices.
 - 1. Capacity: 80 fluid ounces.
 - 2. Locking: Pin-type tumbler lock with ten extra keys.

SECTION 10800 – TOILET AND BATH ACCESSORIES

- C. Products and Manufacturers: Provide one of the following:
 - 1. Model 661 by Bradley Corporation.
 - 2. No. 0318 by American Specialties, Incorporated.
 - 3. B-2014 by Bobrick Washroom Equipment, Incorporated.
 - 4. Or equal.

2.07 MISCELLANEOUS ITEMS

- A. Undersink Guards:
 - 1. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
 - 2. Material and Finish: Antimicrobial, molded plastic, white.
 - 3. Product and Manufacturer; Provide one of the following:
 - a. HANDY SHIELD-MAXX by Plumberex Specialty Products, Incorporated.
 - b. Truebro Lav Guard 2 by IPS Corporation.
 - c. Or equal.
- B. Coat Hooks:
 - 1. Description: Surface-mounted hook with concealed mounting bracket that is secured to a concealed, 16-gauge wall plate with a stainless steel setscrew. Hook shall be 12 gauge welded to the support arm.
 - 2. Material and Finish: 18-8, type 304 stainless steel, Satin-finish.
 - 3. Mounting Height: Recommended mounting height shall be 38-inches to 40-inches off finished floor.
 - 4. Product and Manufacturer; Provide one of the following:
 - a. B-6827 Surface-Mounted Hat and Coat Hook by Bobrick Washroom Equipment, Inc.
 - b. 7312 Double Robe Hook by ASI American Specialties, Inc.
 - c. Or equal.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Examine areas and conditions under which toilet accessories are to be installed and notify Engineer, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

3.02 INSTALLATION

- A. Install items required to meet accessibility codes in accordance with ANSI A117.1 and the International Building Code.
- B. Determine that substrates are completed and ready to accept surface-mounted or recessed accessories. Refer to Section 10155, Toilet Compartments, and Section 13122, Precast Concrete Building.
- C. Use concealed fastenings wherever possible.
- D. Provide anchors bolts, fasteners and other necessary anchorages, and attach accessories securely to walls, floors and partitions in locations as shown.
- E. Install concealed mounting devices and fasteners fabricated of the same material as the accessories as recommended by manufacturer.

SECTION 10800 – TOILET AND BATH ACCESSORIES

- F. Install exposed mounting devices and fasteners finished to match the accessories.
- G. Provide theft-resistant fasteners for all accessory mountings.
- H. Secure and install toilet room accessories in accordance with the manufacturer's instructions for each item and each type of substrate construction.
- I. Lock grab bars to concealed mounting plate installed in wall.
- J. Coordinate the installation of accessories on toilet compartments.

3.03 ADJUSTMENT AND CLEANING

- A. Adjust accessories for proper operation.
- B. After completion of installation, clean and polish all exposed surfaces.
- C. Deliver keys and instruction sheets to Owner.

END OF SECTION 10800

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish, install, test and place in satisfactory operation, as shown on the Plans and specified herein, submersible sewage pumps with integrated variable speed control systems plus spares complete with all appurtenances and accessories to produce a complete and workable pumping station installation at the Knott Drive and Viola Drive Pump Stations in Glen Cove, NY. The Knott Drive and Viola Drive Pump Stations will require the installation of two (2) pumps plus providing one (1) spare pump at each location.

1.02 REFERENCES

- A. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
 - 1. ASTM A48 - Gray Iron Castings.
 - 2. NFPA 70 – National Electric Code
 - 3. Hydraulic Institute Standards
 - 4. National Electrical Manufacturers Association
 - 5. Institute of Electrical and Electronic Engineers
 - 6. American National Standards Institute
 - 7. NEMA ICS 1 - General Standards for Industrial Control and Systems.
 - 8. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers and Assemblies.
 - 9. NEMA ICS 3 - Industrial Systems.
 - 10. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

1.03 SERVICE CONDITIONS

- A. All components of the system shall be designed for continuous duty.
- B. Provisions shall be made for lubrication, adjustments, or replacement of all parts. Corresponding parts of multiple units shall be interchangeable.

1.04 SUBMITTALS

- A. Submit information in accordance with the requirements in Section 01300.
- B. Submit the following:
 - 1. Pump curve for the units supplied, showing Total Dynamic Head, Pump Efficiency, Brake Horsepower, Power Input to Electric Drive Motor of Pumping Unit for the various conditions under which the units are to operate including min., max., and design capacity along with descriptive data and specifications describing in detail the construction of the complete units.
 - 2. Shop drawings, showing all weights and dimensions necessary for the installation of foundations, anchor bolts, piping and valve connections.
 - 3. Electrical data sheet for pump motor.
 - 4. Control panel layout and components.
 - 5. Control panel wiring diagram.
 - 6. Control panel nameplates materials, list of names and sizes of nameplates and lettering.
 - 7. Field-wiring diagram for pump motor and control wiring.
 - 8. Catalog cuts and/or engineering data for each accessory item specified to be provided herein and a written description of each spare part.

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9. Storage, handling and installation instructions.
10. Warranty Certificate in the form specified herein.
11. Certified pump curve for each pump after the pump is constructed and before shipment to the project site. The plot shall be prepared in accordance with the standards of the Hydraulic Institute.
12. Manufacturer Startup Report (MSR's).
13. Submit an operation and maintenance manual in accordance with the requirements in Section 01782.

1.05 QUALITY ASSURANCE

- A. The pump and accessories specified herein shall be furnished by one single supplier (manufacturer). This requires the supplier to be responsible for the development, design, fabrication, assembly, and delivery of the pumping systems.
- B. The submersible sewage pumps specified herein and as shown to be installed on the Contract Drawings, are manufactured by Xylem/FLYGT, Rye Brook, NY. The specified unit provides a standard of quality, specification dimensions and performance required for this project.
- C. Any proposed substitutions from manufacturers will require full compliance with the requirements of Article GC17 – Materials and Equipment, Approvals, Substitutions and Deviations.
- D. After the bid opening, consideration will only be given to other alternate manufacturers/suppliers who can demonstrate to the Engineer that their equipment complies with these Specifications and has had successful and documented experience with the size, quality, performance and reliability to that specified consideration for any other alternate manufacturer shall include the proposed equipment's application and ability to provide equal service and performance as intended by these specifications. All modifications to structures, piping, valves, equipment layout, electrical connections, wiring (runs, wire sizes, service circuit sizes) and coordination with ancillary or interconnected systems or equipment necessitated by a substitution shall be reviewed and approved by the Engineer at the cost of the Contractor.
- E. The manufacturer shall have a minimum of five (5) installations of the exact pump and motor model proposed to be furnished for this project. Installations must be in operation for a minimum of five years and shall list the pump model, motor model and horsepower, date of installation, duty point, and contact information including telephone number. A list of these installations shall be furnished to the Engineer with submittals.
- F. The system shall be designed, furnished, and installed to achieve the conditions of service specified herein.
- G. The manufacturer shall have at least ten (10) years of experience in the design and manufacturing of raw sewage, non-clog, and submersible pumps.
- H. The cost for any construction modifications shall be included in the cost as bid and no additional cost shall be paid by the Owner for acceptance of alternate equipment and any required installation modifications.

1.06 FIELD SERVICES

- A. Provide the following field services as a minimum:
 1. Two (2) days of field service shall be provided by an authorized, factory trained representative of the pump manufacturer. Services shall include, but not be limited to, inspection of the completed pump station installation to ensure that it has been performed in accordance with the manufacturer's instructions and recommendations, and supervision of all field-testing. The testing shall demonstrate to the satisfaction of the Owner that the equipment meets all specified performance criteria, is properly installed and anchored, and operates smoothly without exceeding the full load amperage rating of the motor. The Contractor shall be responsible for coordinating the required field services with the Pump Manufacturer. During one of these trips, and before substantial completion, provide operation and maintenance

SECTION 11316 – VARIABLE SPEED SEWAGE PUMPS

instruction to the Owner's operating personnel. A complete review of the Operations and Maintenance Manual shall be presented to the operating personnel at this time.

1.07 WARRANTY

- A. Provide a warranty certificate typed on manufacturer's letterhead and signed by an officer of the manufacturer. The certificate shall be witnessed by a notary public in the state in which the company headquarters is located.
- B. The pump manufacturer's standard five (5) year warranty on the pump and motor shall apply. The initial year from start-up and acceptance of the equipment by the Engineer shall be covered 100% for parts and labor. The following years 2 through 5 shall be covered 50% for parts and labor. The warranty shall not be limited by hours of running time.
- C. In addition, the manufacturer shall guarantee all components of the equipment specified to be furnished under this Section to be free from defects in design, materials and workmanship for a period of one (1) year commencing on the date of the Manufacturer's Startup Report. That being the day that the pump was placed into permanent, automatic, and consistent, fault free operation and accepted by the Engineer.
- D. During the guarantee period, if any part or equipment component is defective or fails to perform when operating at design conditions and if the equipment has been installed and is being operated and maintained in accordance with the written instructions provided by the manufacturer(s), the supplier shall repair or exchange, at the discretion of the Owner, such defective part(s) free of any and all charges. The cost of labor and all other expenses resulting from the repair or replacement of the defective part(s) and from installation of part(s) furnished by this Warranty shall be borne solely by the supplier.
- E. The manufacturer shall guarantee clog-free operation to the Owner for a period of 12 months from the date of start-up of the pumps by the local authorized factory representative. A certificate shall be provided to the Owner on the day of start up with the local contact information and effective date. Should the impeller clog with typical solids and debris normally found in domestic wastewater during this period, an authorized representative shall either travel to the jobsite remove the pump, clear the obstruction and reinstall the pump at no cost or reimburse the Owner for reasonable cost to provide this service. A written report shall be provided to the Owner detailing the service call with pictures for verification purposes.
- F. The control panels and accessories shall be warranted for a minimum of 2 years from the date of acceptance by the Engineer

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Sewage pumps shall be manufactured by Xylem/FLYGT, Rye Brook, NY or approved equal.

2.02 MANUFACTURED UNITS

	Knott Drive Pump Station	Viola Drive Pump Station
Pump Model	Concertor DP N80-1000	Concertor DP N80-7800
Design flow	80 gpm	328 gpm
TDH @ design flow	23 ft	81 ft
Static head (incl. in TDH)	19 ft	50 ft
Approx pump shutoff head	164 ft	164 ft
Motor hp	3 hp	10 hp
Electrical supply	240V, 3 ph, 60 hz	480V, 3 ph, 60 hz
Speed	800 – 2,098 rpm	800 – 3,230 rpm

2.03 MATERIALS

A. General Requirements:

1. Each pump shall be equipped with a submersible, electric motor capable of operating on the electrical supply for the respective location listed in section 2.02. Each pump shall be supplied with submersible cable (SUBCAB) suitable for submersible pump applications. The power cable shall be sized according to NEC and ICEA standards and have P-MSHA Approval.
2. Major pump components shall be of gray cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts or bolts shall be AISI type 316 stainless steel construction. All metal surfaces coming into contact with the pump, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.

B. Stainless steel nameplates shall be attached to each pump and motor giving pertinent design data, horsepower, voltage, phase, running amps, model, serial numbers, and manufacturer's name. Provide one spare duplicate nameplate for each pump.

C. Volute:

1. Pump volute(s) shall be single-piece gray cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller.
2. The volute shall have a replaceable suction cover insert ring in which are cast spiral-shaped, sharp-edged groove(s). The spiral grooves shall provide trash release pathways and sharp edge(s) across which each impeller vane leading edge shall cross in each rotation to maintain an unobstructed opening.
3. Clearance between volute groove edges and impeller leading edges shall be adjustable.

D. Impeller:

1. Impellers shall be of Hard-Iron™ (ASTM A-532 (Alloy III A) 25% chrome cast iron), dynamically balanced, semi-open, multi-vane, back-swept, screw-shaped, non-clogging designs. The impeller leading edges shall be mechanically self-cleaned during rotation, maintaining an unobstructed leading edge. The leading edges of the impeller shall be hardened to Rc 60 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden wastewater. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw.
2. Impellers shall be locked to the shaft, held by an impeller bolt, and shall be coated with alkylid resin primer.
3. Mass moment of inertia calculations shall be provided by the pump manufacturer upon request.

E. Wear Rings: An insert ring made of Hard-Iron™ (ASTM A-532 (Alloy III A) 25% chrome cast iron integral with the volute shall provide effective sealing between the multi-vane semi-open impeller and the volute housing.

F. Pump Shaft: Pump and motor shaft shall be the same unit. The pump shaft shall be an extension of the motor shaft. The pump shall be AISI type 420 stainless steel.

2.04 MOTORS

- A. The pump shall be equipped with submersible synchronous electric motor meeting the electrical requirements of section 2.02.
- B. The pump shall be capable to operate without any limitation between 50% and 150% of the Best efficiency point (B.E.P) of the performance curve.

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- C. The pump the motor and the integrated control system shall be submersible a minimum of 65 feet (20m) according to IEC 60034 and protection class IP 68.
- D. The motor shall be capable to operate the pump at continuous duty (S1) in an ambient temperature up to 104°F.
- E. The pump shall be operated by a synchronous motor and an integrated control system and be capable to run at constant power at any point of the performance field without being overloaded. Motor shall utilize a permanent magnet rotor to maintain synchronous speed.
- F. The motor shall withstand at least 60 starts per hour.
- G. The discharge flange of the pump shall have a nominal inside diameter of three (3) inches “and drilled according to ANSI B16.1-89; tab.5.
- H. An integrated pump control system installed in the pump/motor housing shall start the pump by gradually increasing the pump speed. The starting current shall not be higher than the rated current.
- I. An integrated pump control system installed in the pump/motor housing shall secure that the direction of the impeller rotation is always correct. There shall be no need for any human intervention to ensure that the impeller is rotating in the correct direction within the volute. The integrated control system shall be inside the motor and encapsulated to protect it against moisture ingress, and vibration.
- J. The motor and the pump control system shall receive sufficient cooling from the pumped liquid to operate the pump at continuous duty in a liquid with a temperature with 104°F. Operational restrictions on the liquid temperature below 104°F or the demand of auxiliary cooling systems like fans or blowers are not acceptable. The Stator shall be inverter duty rated in accordance with NEMA MG1, Part 31 and be insulated according to class H (356°F).
- K. Motor, pump, and control system shall be designed and supplied by the pump manufacturer.
- L. The control system shall continuously monitor the leakage sensor in the stator housing and the temperature of the motor. It shall be impossible to overload the motor. If the motor temperature is too high, the pump shall continue to operate at reduced power until conditions are normalized. External trips or overload devices for motor protection shall not be required.
- M. The operator shall be able to modify the setting of the control system to decide if the active leakage signal shall stop or not stop the pump.
- N. The pump shall incorporate a “pump-cleaning” function to remove debris from the impeller. The cleaning function shall be initiated when the integral control system senses an increase in current draw due to debris in the pump. The cleaning function shall consist of forced stopping, reversal and forward runs timed to allow for debris to fall from the impeller. After cleaning cycle is complete, the pump shall resume to automatic operation. If the pump impeller/volute does not clear itself after the programmed number of attempts, the control shall initiate and alarm to notify that the pump inlet / volute is blocked by large debris.
- O. It shall be possible to access and adjust the pump system with a Human Machine Interface (HMI) ranging from basic monochrome displays to full-color touch screen units and smartphone or tablet. It shall enable the operator to view and control entire pump system and logged operational data like number of starts, avoided clogging instances, pump run-time, motor power, motor current, power factor, temperature, pump leakage etc.
- P. The shaft shall rotate on two bearings. The motor bearings shall be sealed and permanently grease lubricated with high temperature grease. The upper motor bearing shall be a single row ball bearing to handle radial loads. The lower bearing shall be a double row angular contact ball bearing to handle the thrust and radial forces. Single row lower bearings are not acceptable. The minimum L10 bearing life shall be 50,000 hours at any usable portion of the pump performance field.
- Q. The shaft shall be sealed by a tandem mechanical shaft seal system consisting of two seals, each having an independent spring system. The seals shall require neither maintenance nor

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adjustment and shall be capable of operating in either clockwise or counterclockwise direction of rotation without damage or loss of seal function.

- R. Where a seal cavity is present in the seal chamber, the area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action
- S. The Materials of construction shall be as follows:
 - 1. Pump housing: ASTM A-48, Class 35B
 - 2. Impeller and insert ring: A 532 ALLOY III A (25% chrome)
 - 3. Stator housing: GD-AL SI 12 or ASTM B85A 413
 - 4. Shaft: ASTM A479 S43100-T.
 - 5. Shaft seal: Pump side: - Corrosion resistant Tungsten carbide WCCR
 - 6. Shaft seal Motor side: - Corrosion resistant Tungsten carbide WCCR
- T. The motor shall be equipped with 30 feet of screened cable S3x6+3x6/3+S(4x0,5) suitable for submersible pump applications. The power cable shall be sized according to NEC and ICEA standards. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.

2.05 FACTORY TESTS

- A. Each completed and assembled pump/motor unit shall undergo the following factory tests at the manufacturer's plant prior to shipment:
 - 1. Hydraulic performance test
 - 2. No-Leak seal integrity test

2.06 PUMP CONTROL PANELS

- A. The pump control panel for the Knott Drive Pumping Station shall be a duplex pump control panel in a NEMA 4X 316 stainless steel enclosure for 3 phase, 240 volt, 60 hz, 4 wire power.
- B. The pump control panel for the Viola Drive Pumping Station shall be a duplex pump control panel in a NEMA 12 steel enclosure for 3 phase, 480 volt, 60 hz, 4 wire power. This panel shall be located in the control building.
- C. The pump control panel for the Knott Drive Pumping Station shall have a 25 W min. panel heater with adjustable thermostat.
- D. Transient Voltage Surge Suppression Device (TVSS): A surge protection device shall be included and wired to protect motors and control equipment from lightning or other induced line surges. All TVSSs shall be UL approved and installed per manufacturer's requirements. The TVSS shall be attached to the load side of the main breaker and integrally mounted in the panel enclosure.
- E. Pump motors shall be supplied with a circuit breaker and an across the line NEMA rated motor starters with 3 phase overload protection.
- F. A time delay shall be included in the pump controls so that the two pumps in the pump station will not start simultaneously on return to power after a power failure irrespective of what the liquid level is in the wet well.
- G. A control transformer shall provide separate single phase 120-volt control circuits to power the pump controls and liquid level controller.
- H. The pump control panel shall provide lead-lag automatic pump alternation and high and low water alarms.
- I. Pumps shall be provided with H-O-A. selector switches and run lights on the face of the panel.
- J. The level control system for the Knott Drive Pumping Station shall include a pressure level

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transmitter as specified in spec Section 13420 for primary level sensing. Two redundant mechanical floats shall be provided for secondary level sensing as specified in Section 13420 and indicated on the Contract Drawings.

- K. The control panel for the Viola Drive Pumping Station shall include a bubbler level sensing system for primary level sensing as specified in subsection 2.08 below. Two redundant mechanical floats shall be provided for secondary level sensing as specified in Section 13420 and indicated on the Contract Drawings.
- L. The pump controller shall be wired to receive all input signals from the primary and secondary level control sensors. The controller shall also control the connected pumps in alternating duplex configuration and shall be capable of properly receiving all pump failure signals such as seal failure, overheat etc. and relaying the required alarm signals to the remote SCADA panel.
- M. Pumps shall be provided with running time meters on the face of the panel.
- N. The pump control panel shall be provided with Flygt Corp. C.A.S. relays, or approved equal, to detect pump seal failure and over temperature. Alarm lights shall be mounted on the face of the panel. Both alarms shall activate remote alarm transmission. The seal failure alarm shall not shut down the pump. The overtemperature alarm shall shut down the pump.
- O. The pump control panel shall be provided with a phase monitoring system. The system shall sense under and over voltage, voltage unbalance, phase, loss of phase and phase reversal. Upon sensing any of the above conditions the control panel shall activate the alarm light, alarm horn, and close the alarm contact. The system shall not permit the pumps to operate until the incoming power has returned to normal. The voltage monitoring system shall be PLMU series as manufactured by ABB Inc.
- P. The control panel shall provide for automatic by-pass of the primary level sensor in the event that the back-up low level or high level floats are activated. While primary level controls are bypassed, operation of the pumps shall be with the floats. The by-pass of the primary level sensors shall continue until a manual reset button has been pressed releasing the control panel to return to normal operation. If the pump control panel is using the back-up float system, an independent amber indicator light shall activate showing that the control panel is currently using the bypass system.
- Q. All indicator lights shall be LED type with Push-to-Test circuits.
- R. The panel face shall include indicator lights to display the following:
 - 1. Pump run for each pump (red)
 - 2. Pump over-temperature (amber)
 - 3. Pump seal leak detection (amber)
 - 4. High wet well water level alarm (amber)
 - 5. High - high wet well water level alarm (float switch activated) (amber)
 - 6. Low wet well water level alarm (amber)
 - 7. Low - low wet well water level alarm (float switch activated) (amber)
 - 8. Bubbler system common alarm (Viola Drive Pumping Station) (amber)
 - 9. Power on (white)
- S. The controller shall permit changes to:
 - 1. Pump start and stop levels
 - 2. Pump start and stop delays
 - 3. Probe sensitivity
 - 4. Seal monitor sensitivity.

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T. The pump controller shall accept inputs from:

1. Pressure level transmitter
2. Two level floats
3. Pump seal sensors
4. Pump over temperature sensors.

20.8 BUBBLER LEVEL SENSING SYSTEM

- A. A fully automatic bubbler level sensing system shall be incorporated into the pump control panel at the Viola Drive Pumping Station. The bubbler system shall be Model LDBCS as manufactured by PCS Pump and Process or approved equal. The bubbler system shall pump regulated air (flow controlled) down a tube that has one end submerged in the pump station wet well. Liquid level shall be determined using a pressure transducer that measures the pressure required to force air through the bubbler tube.
- B. The bubbler system shall operate on a 120 volt power supply and shall transmit a 4 to 20 ma signal to the pump control system.
- C. The bubbler system shall be a dual air compressor system with, air tank, bubbler line purge, air tank moisture drain (automatic), system status indications, tank air pressure indication, level indication, alarm outputs as well as tank air pressure signal output and level signal output.
- D. In addition to using air from the internal air compressors, the system shall be able to use air from an external pump station air compressor. Manual and automatic alternation of the internal compressors shall be provided.
- E. Provide automatic bubbler line purge and air tank drain cycle performed on a field adjustable time cycle.
- F. Provide pushbuttons for manual purge and alarm reset.
- G. Provide a graphical display terminal for displaying system operation status, adjustments of setpoints, and alarm indication. Provide relay output signals for compressor malfunction alarms. Air tank low pressure alarm, wet well high and low level alarms, and a bubbler system common fault alarm.
- H. Bubbler tubing to the pumping station wet well shall be 3/8 inch, schedule 80, 316 stainless steel tubing. The bubbler tube shall extend in the wet well to an elevation as shown on the plans. After installation, the bubbler tubing shall be tested for leaks at 20 psi pressure in the presence of the Engineer

2.09 PUMP DISCHARGE CONNECTION AND GUIDE RAILS

- A. Each pump shall be supplied with a mating cast iron discharge connection. The pumps shall be automatically and firmly connected to the discharge connection, guided by no less than two stainless steel guide bars extending from the top of the station to the discharge connection to ensure pump stability when installing or removing the machine. There shall be no need for personnel to enter the wet well to access the pump. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. o portion of the pump shall bear directly on the wet well floor.
- B. The guide rail system shall consist of two parallel 2" guide bars, supported by pump manufacturer supplied upper guide rail brackets. Guide bars and guide brackets shall be type 304 Stainless Steel.
- C. Each pump shall be fitted with stainless steel lifting chain. Lifting chain shall be connected to the lifting handle of the pump and be long enough to reach the top elevation of the station. Lifting chain shall be compatible with the Grip-Eye Pump Lift System. The working load of the lifting system shall be 50% greater than the pump unit weight.
- D. One pump lift system Grip-Eye shall be provided for each pump station. The Grip-Eye shall allow for utilizing the hoist for lifting each pump from its installed position to above the top elevation of

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the station. The Grip-Eye device shall be configured to slide down the stainless-steel lifting chain and grip the lifting chain near pump handle. The retrieval system shall be appropriately sized for the weight of the pump to be lifted.

2.10 ACCESSORIES

- A. Cable Holder: Heavy duty, type 316 stainless steel.

2.07 FINISHES

- A. Primer and Finish Paint-Shop apply epoxy coating to all exterior ferrous surfaces of the pump and motor.
 - 1. Surface Preparation - Prepare all surfaces to receive coating system. Surfaces shall be free from dust, grease, rust, scale, and other coatings
 - 2. Primer and Finish Paint - Shop apply to all exterior ferrous surfaces of the pump and motor a single coat of two component epoxy. Coating shall be resistant to sewage of normal pH and contain no more than 3.5 pounds per gallon of VOCs.
 - 3. Finish Coat Color: Grey.

2.08 SOURCE QUALITY CONTROL

- A. Pump Shop Tests: Shop Test all pumps provided under this Section.
 - 1. Hydrostatically test pump bodies per ANSI/HI 1.6, to the greater of: twice specified pump discharge head at the full speed design point, or 1.5 times pump's shutoff head.
 - 2. Witnessed Factory Performance Test
 - a. Each pump shall be subject to a witnessed performance shop test to determine the head, capacity, speed, brake horsepower, and efficiency at each condition specified in the Design and Performance Criteria. Pump shall be tested in dry-pit operation.
 - b. Performance shop tests shall be witnessed by the Owner's representatives. Owner and Engineer shall be informed of the test dates a minimum of four weeks in advance. Presence of Owner's representatives during testing does not relieve Contractor from complying with the Contract Documents and does not indicate or imply acceptance of the equipment.
 - c. One Construction Manager and two additional representatives of the Owner shall attend the witness testing. Expenses and costs for witnessing shall be paid by Contractor, including the following:
 - i. Transportation of Owner and Engineer personnel to the factory test location and return via commercial airline and ground transportation to and from airports as required.
 - ii. Overnight accommodations (three single occupancy rooms) in a hotel in reasonable proximity to the factory testing location. Room quality to be standard business class.
 - iii. Ground transportation between the hotel and factory testing location.
 - iv. Meals for the duration of the testing. Meal allowance shall not be less than U.S. Internal Revenue Service guidelines.
 - d. Each pump shall be operated at the rated duty point. Results of the tests shall be shown on a plot of test curves showing head, flow, horsepower, efficiency, and current.
 - e. Operate each pump at full speed against a closed discharge valve for a minimum of two minutes. Inspect the wear rings for contact by removing the suction cover. Pumps exhibiting contact shall be rejected.
 - f. For a single pump, perform an extended pumping test at the full speed design point for a minimum of two hours to verify that the pump will operate at the rated capacity without loss of flow, head, or efficiency.

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- g. If equipment fails tests, retesting shall be scheduled as soon as possible. Repeat tests until results indicate compliance with the Contract Documents.
- h. Submit copies of all Shop Test results certified by a Professional Engineer and signed by an officer of the manufacturing corporation.
- i. Equipment shall not be shipped to the site until the Contractor has received written notification from the Engineer of their acceptance of the results.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install pumps plumb and level.
- B. Install pump in accordance with manufacturers installation instructions.
- C. Check the pump's rotation in the presence of the manufacturer's representative.

3.02 FIELD QUALITY CONTROL

- A. After the installation of the pumps, controls and all appurtenances, and when construction of other units of the pump station will permit, each complete pumping unit will be subject to field tests as specified herein under actual operating conditions.
- B. Field tests shall be conducted by the Contractor under the direct supervision of a qualified factory trained engineer, and in the presence of, and as directed by the Engineer. Provide, calibrate and install all temporary gauges and meters, make necessary tapped holes in the pipes, and install all temporary piping and wiring required for the field tests.
- C. The field tests shall determine the head, discharge flow and overall efficiency characteristics of each pumping unit and in addition, shall demonstrate that under all conditions of operation each unit:
 - 1. Has not been damaged by transportation or installation.
 - 2. Has been properly installed.
 - 3. Has no mechanical defect.
 - 4. Is in proper alignment.
 - 5. Has been properly connected.
 - 6. Is free of overheating of any parts.
 - 7. Is free of all-objectionable vibration and noise.
 - 8. Is free of overloading of any parts.
- D. Test each electric motor and record operating voltage and amperage. Have the manufacturer's representative record this information on the manufacturer's startup report (MSR).
- E. Submit the MSR for each pump startup for record purposes. Record the model number, serial number, and nameplate data on each MSR. Separate MSR's shall be provided for each pump.
- F. Review use of pump service cart during startup training for the installation.

+ + END OF SECTION + +

SECTION 11317 - CONSTANT SPEED SEWAGE PUMPS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish, install, test and place in satisfactory operation, as shown on the Plans and specified herein, submersible sewage pumps plus spares complete with all appurtenances and accessories to produce a complete and workable installation. The Morgan Park Pump Station will require the installation of two (2) pumps plus providing one (1) spare, the Roslyn Village Pump Station will require the installation of three (3) pumps plus providing one (1) spare.

1.02 REFERENCES

- A. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
 - 1. ASTM A48 - Gray Iron Castings.
 - 2. NFPA 70 – National Electric Code
 - 3. Hydraulic Institute Standards
 - 4. National Electrical Manufacturers Association
 - 5. Institute of Electrical and Electronic Engineers
 - 6. American National Standards Institute
 - 7. NEMA ICS 1 - General Standards for Industrial Control and Systems.
 - 8. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers and Assemblies.
 - 9. NEMA ICS 3 - Industrial Systems.
 - 10. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

1.03 SERVICE CONDITIONS

- A. All components of the system shall be designed for continuous duty.
- B. Power to the sewage pumps at the Roslyn Pump Station will be from variable frequency drives and the pumps will be controlled from the existing SCADA control panel and bubbler level sensing system.
- C. Power to the sewage pumps at the Morgan Park Pump Station will be from motor starters in the MCC and the pumps will be controlled from the existing SCADA control panel and bubbler level sensing system.

1.04 SUBMITTALS

- A. Submit information in accordance with the requirements in Section 01300.
- B. Submit the following:
 - 1. Pump curve for the units supplied, showing Total Dynamic Head, Pump Efficiency, Brake Horsepower, Power Input to Electric Drive Motor of Pumping Unit for the various conditions under which the units are to operate including min., max., and design capacity along with descriptive data and specifications describing in detail the construction of the complete units.
 - 2. Shop drawings, showing all weights and dimensions necessary for the installation of foundations, anchor bolts, piping and valve connections.
 - 3. Electrical data sheet for pump motor.
 - 4. Field-wiring diagram for pump motor and control wiring.
 - 5. Catalog cuts and/or engineering data for each accessory item specified to be provided herein and a written description of each spare part.
 - 6. Storage, handling and installation instructions.

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7. Warranty Certificate in the form specified herein.
8. Certified pump curve for each pump after the pump is constructed and before shipment to the project site. The plot shall be prepared in accordance with the standards of the Hydraulic Institute.
9. Manufacturer Startup Report (MSR's).
10. Submit an operation and maintenance manual in accordance with the requirements in Section 01782.

1.05 QUALITY ASSURANCE

- A. The pump and accessories specified herein shall be furnished by one single supplier (manufacturer). This requires the supplier to be responsible for the development, design, fabrication, assembly, and delivery of the pumping system. The pump, motor, and mechanical seals shall all be designed, manufactured, and warranted by the pump manufacturer.
- B. The submersible sewage pumps specified herein and as shown to be installed on the Contract Drawings, are manufactured by Xylem/FLYGT, Rye Brook, NY. The specified unit provides a standard of quality, specification dimensions and performance required for this project.
- C. Any proposed substitutions from manufacturers other than those listed will require full compliance with the requirements of Article GC17 – Materials and Equipment, Approvals, Substitutions and Deviations.
- D. After the bid opening, consideration will only be given to other alternate manufacturers/suppliers who can demonstrate to the Engineer that their equipment complies with these Specifications and has had successful and documented experience with the size, quality, performance and reliability to that specified consideration for any other alternate manufacturer shall include the proposed equipment's application and ability to provide equal service and performance as intended by these specifications. All modifications to structures, piping, valves, equipment layout, electrical connections, wiring (runs, wire sizes, service circuit sizes) and coordination with ancillary or interconnected systems or equipment necessitated by a substitution shall be reviewed and approved by the Engineer at the cost of the Contractor.
- E. The manufacturer shall have a minimum of five (5) installations of the exact pump and motor model proposed to be furnished for this project. Installations must be in operation for a minimum of five years and shall list the pump model, motor model and horsepower, date of installation, duty point, and contact information including telephone number. A list of these installations shall be furnished to the Engineer with submittals.
- F. The system shall be designed, furnished, and installed to achieve the conditions of service specified herein.
- G. The manufacturer shall have at least ten (10) years of experience in the design and manufacturing of raw sewage, non-clog, and submersible pumps.
- H. The cost for any construction modifications shall be included in the cost as bid and no additional cost shall be paid by the Owner for acceptance of alternate equipment and any required installation modifications.

1.06 FIELD SERVICES

- A. Supply and credit to the Owner field services
- B. Provide the following field services as a minimum:
 1. Two (2) days of field service shall be provided by an authorized, factory trained representative of the pump manufacturer. Services shall include, but not be limited to, inspection of the completed pump station installation to ensure that it has been performed in accordance with the manufacturer's instructions and recommendations, supervision of all field-testing and activation of the Pump Manufacturer's Warranty. The test shall demonstrate to the satisfaction of the Owner that the equipment meets all specified performance criteria, is properly installed and anchored, and operates smoothly without exceeding the full load

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amperage rating of the motor. The Contractor shall be responsible for coordinating the required field services with the Pump Manufacturer. During one of these trips, and before substantial completion, provide operation and maintenance instruction to the Owner. A complete review of the Operations and Maintenance Manual shall be presented at this time.

1.07 WARRANTY

- A. Provide a warranty certificate typed on manufacturer's letterhead and signed by an officer of the manufacturer. The certificate shall be witnessed by a notary public in the state in which the company headquarters is located.
- B. The manufacturer's standard five (5) year warranty on the pump and motor shall apply. The initial year from start-up of the equipment shall be covered 100% for parts and labor. The following years 2 through 5 shall be covered 50% for parts and labor. The warranty shall not be limited by hours of running time.
- C. In addition, the manufacturer shall guarantee all components of the equipment specified to be furnished under this Section to be free from defects in design, materials and workmanship for a period of one (1) year commencing on the date of the Manufacturer's Startup Report. That being the day that the pump was placed into permanent, automatic, and consistent, fault free operation.
- D. During the guarantee period, if any part or equipment component is defective or fails to perform when operating at design conditions and if the equipment has been installed and is being operated and maintained in accordance with the written instructions provided by the manufacturer(s), the supplier shall repair or exchange, at the discretion of the Owner, such defective part(s) free of any and all charges. The cost of labor and all other expenses resulting from the repair or replacement of the defective part(s) and from installation of part(s) furnished by this Warranty shall be borne solely by the supplier.
- E. The manufacturer shall guarantee clog-free operation to the Owner for a period of 12 months from the date of start-up of the pumps by the local authorized factory representative. A certificate shall be provided to the Owner on the day of start up with the local contact information and effective date. Should the impeller clog with typical solids and debris normally found in domestic wastewater during this period, an authorized representative shall either travel to the jobsite remove the pump, clear the obstruction and reinstall the pump at no cost or reimburse the Owner for reasonable cost to provide this service. A written report shall be provided to the Owner detailing the service call with pictures for verification purposes.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Sewage pumps shall be manufactured by Xylem/FLYGT, Rye Brook, NY or pre-approved equal.

2.02 MANUFACTURED UNITS

	Morgan Park Pump Station	Roslyn Village Pump Station
Pump Model	NP 3171 SH 3~ 275	NT 3202 SH 3~ 273
Design flow	498 gpm	760 gpm
TDH @ design flow	154 ft	221 ft
Static head (incl. in TDH)	130 ft	180 ft
Approx. pump shutoff head	265 ft	360 ft
Motor hp	35 hp	72 hp
Electrical supply	208V, 3 ph, 60 hz	480V, 3 ph, 60 hz
Speed	3,530 rpm	3,560 rpm

2.03 MATERIALS

A. General Requirements:

1. Each pump shall be equipped with a submersible, electric motor capable of operating on the electrical supply for the respective location listed in section 2.02. Each pump shall be supplied with submersible cable (SUBCAB) suitable for submersible pump applications. The power cable shall be sized according to NEC and ICEA standards and have P-MSHA Approval.
2. Major pump components shall be of gray cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts or bolts shall be AISI type 316 stainless steel construction. All metal surfaces coming into contact with the pump, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.

B. Stainless steel nameplates shall be attached to each pump and motor giving pertinent design data, horsepower, voltage, phase, running amps, model, serial numbers, and manufacturer's name. Provide one spare duplicate nameplate for each pump.

C. Volute:

1. Pump volute(s) shall be single-piece gray cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller.
2. The volute shall have a replaceable suction cover insert ring in which are cast spiral-shaped, sharp-edged groove(s). The spiral grooves shall provide trash release pathways and sharp edge(s) across which each impeller vane leading edge shall cross in each rotation to maintain an unobstructed opening.
3. Clearance between volute groove edges and impeller leading edges shall be adjustable.

D. Impeller

1. Impellers shall be of Hard-Iron™ (ASTM A-532 (Alloy III A) 25% chrome cast iron), dynamically balanced, semi-open, multi-vane, back-swept, screw-shaped, non-clogging designs. The impeller leading edges shall be mechanically self-cleaned during rotation, maintaining an unobstructed leading edge. The leading edges of the impeller shall be hardened to Rc 60 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden wastewater. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw.
2. Impellers shall be locked to the shaft, held by an impeller bolt, and shall be coated with alkylid resin primer.
3. Mass moment of inertia calculations shall be provided by the pump manufacturer upon request.

E. Wear Rings: An insert ring made of Hard-Iron™ (ASTM A-532 (Alloy III A) 25% chrome cast iron integral with the volute shall provide effective sealing between the multi-vane semi-open impeller and the volute housing.

F. Pump Shaft: Pump and motor shaft shall be the same unit. The pump shaft shall be an extension of the motor shaft. The pump shall be AISI type 420 stainless steel.

2.04 MOTORS

A. Submersible Motors

1. The hydraulic of the pump shall be equipped with a semi open multi vane impeller designed to transport wastewater and municipal sludge up to 8% DS.
2. The impeller blades shall be self-cleaning upon each rotation as they pass across a sharp relief groove in the Insert ring and shall keep the impeller blades clear of debris. The

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clearance between the insert ring and the impeller leading edges shall be adjustable.

3. The impeller shall be wear resistant and made of high chromium cast iron with at least 24% chrome against sand and grit which is expected to enter the pump station with the sewage or the storm water. Impellers that have surface hardening (by thermal, coating, etc.) will not be allowed.
4. The pump shall be capable to operate without any limitation between 50% and 125% of the Best efficiency point (B.E.P) of the performance curve.
5. The impeller shall be mounted on the motor shaft.
6. The pump motor shall be induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. It shall be permanently submersible according to standard IEC 60034 and protection class IP 68.
7. The motor shall be capable of no less than 30 evenly spaced starts per hour and be able to operate throughout the entire pump performance curve from shut-off through run-out.
8. The stator windings shall be insulated with moisture resistant Class H insulation rated for 356°F.
9. It shall be possible to lift and lower the pumps on parallel guide bars and connect them to wet well mounted discharge connection. There shall be no need for personal to enter the wet well when removing or reinstalling the pumps.
10. The pump housing shall be prepared for the assembling of a sump mixing valve. The discharge flange of the pump housing shall be 4".
11. The junction chamber containing the terminal board shall be hermetically sealed from the motor by an elastomeric compression seal. Connection between the cable conductors and stator leads shall be made with threaded compression type binding posts permanently affixed to a terminal board. The motor and the pump shall be produced by the same manufacturer.
12. The motor shall be protected by 3 thermal switches embedded in the stator set to open at 284°F (140°C) and one leakage sensor floating type located in a leakage chamber below the main bearing. The sensor and the switches shall be connected to the control panel which shall stop the motor and send an alarm when the sensors are activated.
13. The pump shall be Explosion approved according to FM CLASS 1. DIV 1 "C" & "D"
14. The Materials of construction shall be as follows:
 - a. Pump housing: ASTM A-48, Class 35B
 - b. Impeller and insert ring: A 532 ALLOY III A (25% Chrome)
 - c. Cooling jacket: Stainless steel AISI 316
 - d. Stator housing: ASTM A-48, Class 35B
 - e. Shaft: ASTM A479 S43100-T.
 - f. Shaft seal: Pump side: - Corrosion resistant Tungsten carbide WCCR
 - g. Shaft seal Motor side: - Corrosion resistant Tungsten carbide WCCR
15. All castings must be blasted before coating. All wet surfaces are to be coated with two-pack oxyrane ester Duasolid 50. The total layer thickness should be at least 120 microns.
16. The motor shall be equipped with 50 feet of screened cable suitable for submersible pump applications. The power cable shall be sized according to NEC and ICEA. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.

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17. Each completed and assembled pump/motor unit shall undergo the following factory tests at the manufacturer's plant prior to shipment. The Manufacturer shall provide on demand a copy of his quality control plan for these tests and an ISO 9001 factory certificate:
 - a. Minimum 3-point hydraulic performance test
 - b. No-Leak seal integrity test
 - c. Electrical integrity test
- B. Bearings:
 1. The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated and have a nominal L10 lifetime of 50,000 hours. The upper bearing shall be a single deep groove ball bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Single row lower bearings are not acceptable.
- C. Cooling System
 1. The motor shall be provided with an integral motor cooling system. A stainless-steel cooling jacket shall encircle the stator housing, providing for dissipation of motor heat regardless of the type of pump installation. An impeller, integral to the cooling system and driven by the pump shaft, shall provide the necessary circulation of the cooling liquid through the jacket. The cooling liquid shall pass about the stator housing in the closed loop system in turbulent flow providing for superior heat transfer. The cooling system shall have one fill port and one drain port integral to the cooling jacket.
 2. The pump shall be capable of operating in a continuous condition in a liquid with a temperature up to 104°F even when the motor is not submerged.
- D. Mechanical Seals
 1. Each pump shall be provided with a positively driven dual, tandem mechanical shaft seal system consisting of two seal sets, each having an independent spring. The lower primary seal, located between the pump and seal chamber, shall contain one stationary and one positively driven rotating corrosion and abrasion resistant tungsten-carbide ring. The upper secondary seal, located between the seal chamber and the seal inspection chamber shall be a leakage-free seal. The upper seal shall contain one stationary and one positively driven rotating corrosion and abrasion resistant tungsten-carbide seal ring. The rotating seal ring shall have small back-swept grooves laser inscribed upon its face to act as a pump as it rotates, returning any fluid that should enter the dry motor chamber back into the lubricant chamber. All seal rings shall be individual solid sintered rings. Each seal interface shall be held in place by its own spring system. The seals shall not depend upon direction of rotation for sealing. Mounting of the lower seal on the impeller hub is not acceptable. Shaft seals without positively driven rotating members or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces are not acceptable. The seal springs shall be isolated from the pumped media to prevent materials from packing around them, limiting their performance. Any leakage passing the sealing shall not pass the bearings. Before it reaches the bearings the liquid shall create an alarm via the floating leakage sensor.
 2. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. Seal lubricant shall be non-hazardous.
 3. Where a seal cavity is present in the seal chamber, the area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral

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groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action.

- E. Power Cables: The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box, shown on the Contract Drawings, without the need of any splices. Provide fifteen (15) extra feet in addition to the length between pump motor and junction box for each cable. Coil and bundle excess cable and secure. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.
- F. Cable Entry Seal: The cable entry shall consist of dual cylindrical elastomer sleeves, flanked by washers, all having a close tolerance fit against the cable and the cable entry.

2.05 SUPPORT STAND FOR MORGAN PARK PUMPS

- A. Each pump shall be supplied with a mating cast iron discharge connection. The pumps shall be automatically and firmly connected to the discharge connection, guided by no less than two stainless steel guide bars extending from the top of the station to the discharge connection to ensure pump stability when installing or removing the machine. There shall be no need for personnel to enter the wet well to access the pump. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. Sealing off the discharge interface with a diaphragm, O-ring or profile gasket shall not be acceptable. No portion of the pump shall bear directly on the wet well floor.
- B. The guide rail system shall consist of two parallel 2" guide bars, supported by pump manufacturer supplied upper guide rail brackets. Guide bars and guide brackets shall be type 304 Stainless Steel.
- C. Each pump shall be fitted with stainless steel lifting chain. Lifting chain shall be connected to the lifting handle of the pump and be long enough to reach the top elevation of the station. Lifting chain shall be compatible with the Grip-Eye Pump Lift System. The working load of the lifting system shall be 50% greater than the pump unit weight.
- D. One pump lift system Grip-Eye shall be provided for each pump station. The Grip-Eye shall allow for utilizing the hoist for lifting each pump from its installed position to above the top elevation of the station. The Grip-Eye device shall be configured to slide down the stainless-steel lifting chain and grip the lifting chain near pump handle. The retrieval system shall be appropriately sized for the weight of the pump to be lifted.

2.06 SUPPORT STAND FOR ROSLYN VILLAGE PUMPS

- A. Each pump shall be supplied with a stand made of painted steel and a 90° suction elbow made of cast iron. The suction flange shall be 8"Ø and drilled according ANSI B16.1-89; tab.5.
- B. Each pump shall rest upon a reinforced concrete pedestal as shown on the contract drawings and the pump manufacturer's guidelines.
- C. The inlet elbow shall have an inspection hatch of at least 5".
- D. It shall be possible to rotate the pump housing in steps of 15° to adjust the discharge position infinitely relative to the inlet pipe.

2.07 ACCESSORIES

- A. Cable Holder: Heavy duty, type 316 stainless steel.

2.08 FINISHES

- A. Primer and Finish Paint-Shop apply epoxy coating to all exterior ferrous surfaces of the pump and motor.
 - 1. Surface Preparation - Prepare all surfaces to receive coating system. Surfaces shall be free from dust, grease, rust, scale, and other coatings

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2. Primer and Finish Paint - Shop apply to all exterior ferrous surfaces of the pump and motor a single coat of two component epoxy. Coating shall be resistant to sewage of normal pH and contain no more than 3.5 pounds per gallon of VOCs.
3. Finish Coat Color: Grey.

2.09 SOURCE QUALITY CONTROL

- A. Pump Shop Tests: Shop Test all pumps provided under this Section.
 1. Hydrostatically test pump bodies per ANSI/HI 1.6, to the greater of: twice specified pump discharge head at the full speed design point, or 1.5 times pump's shutoff head.
 2. Witnessed Factory Performance Test
 - a. Each pump shall be subject to a witnessed performance shop test to determine the head, capacity, speed, brake horsepower, and efficiency at each condition specified in the Design and Performance Criteria. Pump shall be tested in dry-pit operation.
 - b. Performance shop tests shall be witnessed by the Owner's representatives. Owner and Engineer shall be informed of the test dates a minimum of four weeks in advance. Presence of Owner's representatives during testing does not relieve Contractor from complying with the Contract Documents and does not indicate or imply acceptance of the equipment.
 - c. One Construction Manager and two additional representatives of the Owner shall attend the witness testing. Expenses and costs for witnessing shall be paid by Contractor, including the following:
 - i. Transportation of Owner and Engineer personnel to the factory test location and return via commercial airline and ground transportation to and from airports as required.
 - ii. Overnight accommodations (three single occupancy rooms) in a hotel in reasonable proximity to the factory testing location. Room quality to be standard business class.
 - iii. Ground transportation between the hotel and factory testing location.
 - iv. Meals for the duration of the testing. Meal allowance shall not be less than U.S. Internal Revenue Service guidelines.
 - d. Each pump shall be operated at the rated duty point. Results of the tests shall be shown on a plot of test curves showing head, flow, horsepower, efficiency, and current.
 - e. Operate each pump at full speed against a closed discharge valve for a minimum of two minutes. Inspect the wear rings for contact by removing the suction cover. Pumps exhibiting contact shall be rejected.
 - f. For a single pump, perform an extended pumping test at the full speed design point for a minimum of two hours to verify that the pump will operate at the rated capacity without loss of flow, head, or efficiency.
 - g. If equipment fails tests, retesting shall be scheduled as soon as possible. Repeat tests until results indicate compliance with the Contract Documents.
 - h. Submit copies of all Shop Test results certified by a Professional Engineer and signed by an officer of the manufacturing corporation.
 - i. Equipment shall not be shipped to the site until the Contractor has received written notification from the Engineer of their acceptance of the results.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install pumps plumb and level.
- B. Install motor and pump in accordance with manufacturers installation instructions.
- C. Check the pump's rotation in the presence of the manufacturer's representative.

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- D. The pump motors for the Roslyn Village and Morgan Park pump stations shall be wired to the existing pump control panel. The installation shall include new control relays inside the existing control panels as necessary for the proper operation of the new pumps.

3.02 FIELD QUALITY CONTROL

- A. After the installation of the pumps, controls, and all appurtenances, and when construction of other units of the pump station will permit, each complete pumping unit will be subject to field tests as specified herein under actual operating conditions.
- B. Field tests shall be conducted by the Contractor under the direct supervision of a qualified factory trained engineer, and in the presence of, and as directed by the Engineer. Provide, calibrate, and install all temporary gauges and meters, make necessary tapped holes in the pipes, and install all temporary piping and wiring required for the field tests.
- C. The field tests shall determine the head, discharge flow and overall efficiency characteristics of each pumping unit and in addition, shall demonstrate that under all conditions of operation each unit:
 - 1. Has not been damaged by transportation or installation.
 - 2. Has been properly installed.
 - 3. Has no mechanical defect.
 - 4. Is in proper alignment.
 - 5. Has been properly connected.
 - 6. Is free of overheating of any parts.
 - 7. Is free of all-objectionable vibration and noise.
 - 8. Is free of overloading of any parts.
- D. Test each electric motor and record operating voltage and amperage. Have the manufacturer's representative record this information on the manufacturer's startup report (MSR).
- E. Submit the MSR for each pump startup for record purposes. Record the model number, serial number, and nameplate data on each MSR. Separate MSR's shall be provided for each pump.
- F. Review use of pump service cart during startup training for the installation.

+ + END OF SECTION + +

SECTION 11317 - CONSTANT SPEED SEWAGE PUMPS

+ + NO TEXT ON THIS PAGE + +

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish, install, test and place in satisfactory operation, as shown on the Plans and specified herein, fiberglass grinder manholes, electric sewage grinders, and controls complete with all appurtenances and accessories to produce a complete and workable sewage grinder installation at the Morgan Park and Viola Drive Pump Stations in Glen Cove, NY. The Morgan Park and Viola Drive Pump Stations will require the installation of one (1) grinder manhole at each location.

1.02 REFERENCES

- A. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
1. American Society for Testing and Materials (ASTM) D3753-81: Fiber-Reinforced Polyester Manholes.
 2. American Society for Testing and Materials (ASTM) A36: Carbon Steel Plate
 3. American Society for Testing and Materials (ASTM) A536-84: Ferritic Ductile Iron Castings
 4. American Society for Testing and Materials (ASTM) A48-83: Grey Iron Casting
 5. American National Standards Institute (ANSI) B16.42-1979, Class 150 Flanges
 6. American Iron and Steel Institute (AISI) 303 Stainless Steel
 7. American Iron and Steel Institute (AISI) 304 Stainless Steel
 8. American Iron and Steel Institute (AISI) 316 Stainless Steel
 9. American Iron and Steel Institute (AISI) 4130 Heat Treated Alloy Steel
 10. American Iron and Steel Institute (AISI) 4140 Heat Treated Alloy Steel
 11. American Iron and Steel Institute (AISI) 8620 Heat Treated Alloy Steel
 12. American Iron and Steel Institute (AISI) 17-4 Stainless Steel
 13. Society of Automotive Engineers (SAE) 660 Bearing Bronze

1.03 SERVICE CONDITIONS

- A. All components of the system shall be designed for continuous duty.
- B. Provisions shall be made for lubrication, adjustments, or replacement of all parts. Corresponding parts of multiple units shall be interchangeable.

1.04 SUBMITTALS

- A. Submit information in accordance with the requirements in Section 01300.
- B. Submit the following:
1. Equipment descriptions
 2. Functional descriptions
 3. Dimensional and assembly drawings
 4. Electrical data sheet for the grinder motor
 5. Catalogue cuts and/or engineering data for each accessory item specified to be provided herein.
 6. Job specific drawings
 7. Storage, handling, and installation instructions
 8. Warranty Certificate in the form specified herein

SECTION 11330 – SEWAGE GRINDER MANHOLE

9. Manufacturer Startup Report (MSR's).
10. Submit and operation and maintenance manual in accordance with the requirements of section 01782.

1.05 QUALITY ASSURANCE

- A. The grinder manhole and accessories specified herein shall be furnished by one single supplier (manufacturer). This requires the supplier to be responsible for the development, design, fabrication, assembly, and delivery of the grinder manhole.
- B. Any proposed substitutions from manufacturers will require full compliance with the requirements of Article GC17 – Materials and Equipment, Approvals, Substitutions and Deviations.
- C. After the bid opening, consideration will only be given to other alternate manufacturers/suppliers who can demonstrate to the Engineer that their equipment complies with these Specifications and has had successful and documented experience with the size, quality, performance and reliability to that specified consideration for any other alternate manufacturer shall include the proposed equipment's application and ability to provide equal service and performance as intended by these specifications. All modifications to structures, piping, valves, equipment layout, electrical connections, wiring (runs, wire sizes, service circuit sizes) and coordination with ancillary or interconnected systems or equipment necessitated by a substitution shall be reviewed and approved by the Engineer at the cost of the Contractor.
- D. The manufacturer shall have a minimum of five (5) installations of the exact manhole and grinder motor model proposed to be furnished for this project. Installations must be in operation for a minimum of five years and shall list the manhole model, grinder motor model and horsepower, date of installation, and contact information including telephone number. A list of these installations shall be furnished to the Engineer with submittals.
- E. The manufacturer shall have at least ten (10) years of experience in the design and manufacturing of submersible sewage grinders.

1.06 FIELD SERVICES

- A. Provide the following field services as a minimum:
 1. One (1) day of field service shall be provided by an authorized, factory trained representative of the grinder manhole manufacturer. Services shall include, but not be limited to, inspection of the completed grinder manhole installation to ensure that it has been performed in accordance with the manufacturer's instructions and recommendations, and supervision of all field-testing. The testing shall demonstrate to the satisfaction of the Owner that the equipment meets all specified performance criteria, is properly installed and anchored, and operates smoothly without exceeding the full load amperage rating of the motor. The Contractor shall be responsible for coordinating the required field services with the grinder manhole manufacturer. During the trip, and before substantial completion, provide operation and maintenance instruction to the Owner's operating personnel. A complete review of the Operations and Maintenance Manual shall be presented to the operating personnel at this time.

1.07 WARRANTY

- A. Provide a warranty certificate typed on manufacturer's letterhead and signed by an officer of the manufacturer.
- B. The manufacturer shall guarantee all components of the equipment specified to be furnished under this Section to be free from defects in design, materials and workmanship for a period of two (2) years commencing on the date of the final acceptance by the Owner.
- C. During the guarantee period, if any part or equipment component is defective or fails to perform when operating at design conditions and if the equipment has been installed and is being operated and maintained in accordance with the written instructions provided by the manufacturer, the supplier shall repair or exchange, at the discretion of the Owner, such defective

SECTION 11330 – SEWAGE GRINDER MANHOLE

part(s) free of any and all charges. The cost of labor and all other expenses resulting from the repair or replacement of the defective part(s) and from installation of part(s) furnished under this Warranty shall be borne solely by the supplier.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Grinder Manhole shall be manufactured by JWC Environmental, 2850 Red Hill Ave., Suite 125, Santa Ana, CA 92705, or approved equal.

2.02 MANUFACTURED UNITS

	Morgan Park Pump Station	Viola Drive Pump Station
Manhole Model	M3	M3
Grinder Model	30005-0012-DI	30005-0008-DI
Rated Flow	550 GPM	350 GPM
Controller Model	PC2200	PC2200
Motor hp	5 hp	5 hp
Electrical supply	208V, 3 Ph, 60 Hz	480V, 3 Ph, 60 Hz
Speed	1,770 rpm	1,770 rpm

- A. Grinder shall provide peak shaft torque of 4,756 lb-in/hp (721 Nm/kW).
B. Grinder shall provide peak force at cutter tip of 2,051 lbf/hp (12,234 N/kW).

2.03 MANHOLE COMPONENTS

- A. Fiberglass barrel shall be 48 inches (121.92 cm) in diameter.
B. Inlet and outlet pipe stubs, 6 inch (15.24 cm), 8 inch (20.32 cm), 10 inch (25.4 cm), or 12 inch (30.48 cm) with corresponding slip flange bolting connections for connection to incoming and outgoing pipes shall be supplied.
C. Stainless steel (T-304) anchoring brackets (4) for anchoring manhole to concrete base shall be supplied.
D. A ½ inch (1.27 cm) thick expanded polystyrene bead board for placement on concrete slab under manhole shall be supplied.
E. Internally-mounted fiberglass ladder with non-slip traction surface (meet or exceed OSHA General Industry Standards, Part 1910.27 for "Fixed Ladders" shall be supplied.
F. Non-traffic areas above grade manhole shall have lockable fiberglass lid able to withstand 1000 lbs. (453.6 kg) topload.
G. Factory installed and tested internally-mounted 306 SS (316 SS optional) guide rails for grinder installation and removal shall be supplied.

2.04 MOTORS

- A. The grinder shall be equipped with non-ventilated submersible electric motor meeting the electrical requirements of section 2.02.
B. Motor shall be XPNV immersible – type, 5 hp (3.75 kW), 1770 rpm, 208 or 230/460 volt as specified above, 3 phase, 60 Hz.
C. Motor shall have a minimum service factor of 1.15, 91% minimum efficiency factor at full load, minimum 76% power factor at full load and rated at UL NEMA 6P (IP67+).

- D. Each motor shall be supplied with a 40' factory installed power cable suitable for submersible applications. The power cable shall be sized according to NEC and ICEA standards and have P-MSHA Approval.

2.05 GRINDER COMPONENTS

A. Wipes Ready Cutters and Spacers

1. Cutting stack shall be a nominal height of 12 inches.
2. Cutter shall be an individual disk constructed of alloy steel surface ground to thickness of .438-inches +.000/-.001" (11.13 mm +.000/-.025 mm).
3. Cutters shall be heat treated to produce a hardness of 45-53 Rockwell C.
4. Cutters shall be serrated have 17 cam shaped teeth. Tooth height shall not be greater than ½-inch (13 mm) above the root diameter of the cutter.
5. Spacers shall be an individual disk constructed of alloy steel surface ground to a thickness of .446-inches +.001/-.000" (11.3 mm +.025/-.000 mm).
6. Spacers shall have a hardness of 34-53 Rockwell C.
7. Spacers shall have a knurled outside diameter with no tooth profiles.

B. Shafts

1. Shafts shall be ASTM 4140 alloy steel with a minimum tensile strength of 149,000 PSI (1,027 kPA).
2. Shafts shall measure a nominal 2-inches (51 mm) across flats of hex.
3. Shafts shall be hardened to 38-42 Rockwell C.

C. Seal Cartridges

1. Seal cartridges shall be rated to a maximum of 90 PSI (620 kPA).
2. Seal cartridges shall not require flushing.
3. Dynamic and rotating seal faces shall be tungsten carbide with 6% nickel binder.
4. O-rings shall be constructed of Buna-N (Nitrile).
5. Radial and axial loads shall be borne by sealed, oversized, deep-groove ball bearings.

D. Housings and Covers

1. Top cover and end housings shall be ASTM A536-84 ductile iron.
2. Bottom cover shall be ASTM A36 steel.
3. End housing shall have integral bushing deflectors to guide solids away from seal cartridges.
4. End housings shall have directional flow arrows cast into the external side walls.

E. Side Rails

1. Side rails shall be ASTM A536-84 ductile iron.
2. Side rails shall have evenly-spaced horizontal slots to increase flow and decrease water head loss through the grinder. Slots shall only be located on the upstream or influent side of the rail and the effluent side of the rail shall be void of slots to allow for unobstructed flow.
3. Inside profile of the cutters shall be concave and follow the radial arc of the cutters.
4. Clearance between the outside diameter of cutters and concave arc of the side rail shall not exceed 5/16-inch (7.9 mm).

F. Speed Reducer

1. Reducer shall be manufactured by Sumitomo Machinery Corporation of America.
2. Reducer shall be internal planetary mechanism with trochoidal curved tooth profile.
3. Reducer shall be a vertically mounted with 29:1 single reduction.

4. Reducer shall be grease lubricated.

2.06 GRINDER CONTROL PANELS

- A. The controller shall provide control of the grinder motor. The controller shall have indicator lights, switches and other control devices.
- B. Enclosure shall be fiberglass reinforced polyester NEMA 4X .
- C. Enclosure shall house the control devices, motor starters, and PLC.
- D. Grinder ON-OFF/RESET-REMOTE three-position 22mm type, NEMA 4X selector switch:
 1. In the OFF/RESET position, the grinder shall not run.
 2. In the ON position, the grinder shall run continuously.
 3. In the REMOTE position, the grinder shall start and stop as controlled by an external device.
 4. Selector switch shall be the only method for resetting the controller after a failure.
- E. Pilot Lights
 1. Lights shall be LED type 22 mm, rated NEMA 4X.
 2. Lights shall indicate POWER ON, RUN, and FAIL.
- F. Programmable Logic Controller (PLC)
 1. PLC shall be manufactured by Panasonic.
 2. PLC shall have a minimum of 16K of memory.
- G. Motor Starter
 1. Starter shall be a full-voltage reversing type with 120 volt operating coils.
 2. Overload relays shall be adjustable and sized to full load amperes (FLA) of the motor.
- H. Control Transformer
 1. Control transformer shall be minimum 130 VA.
 2. Control transformer primary and secondary shall be fused for over current protection.
- I. Current Transducer
 1. Current transducer shall be manufactured by Veris Industries.
 2. Current transducer shall have adjustable set point from 1-135A with 200 ms or less response time.
- J. Fail Conditions
 1. When a grinder jam obstruction occurs, the controller shall stop the grinder and reverse the rotation to clear the obstruction. If the obstruction is cleared, the controller shall return the grinder to normal operation. If three (3) reverses occur within a 30 second interval, the controller shall stop the grinder motor in a jam condition and activate the grinder FAIL indicator and relay.
 2. When a power failure occurs while the grinder is operating, the grinder will resume operation once power is restored.
 3. When a power failure occurs while the grinder is in a fail condition, once power is restored the fail indicator shall reactivate and remain until reset.
 4. Reset of the grinder shall be accomplished from the controller only

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install grinder manhole plumb and level.

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- B. Install manhole in accordance with manufacturers installation instructions and in accordance with all OSHA, local, state, and federal codes and regulations.

3.02 FIELD QUALITY CONTROL

- A. After the installation of the grinder manholes, controls and all appurtenances, and when construction of other units of the pump station will permit, each complete grinder manhole shall be subject to field tests as specified herein under actual operating conditions.
- B. Field tests shall be conducted by the Contractor under the direct supervision of a qualified factory trained engineer, and in the presence of, and as directed by the Engineer.
- C. The field tests shall determine that under all conditions of operation each unit:
 - 1. Has not been damaged by transportation or installation.
 - 2. Has been properly installed.
 - 3. Has no mechanical defect.
 - 4. Has been properly connected and is in proper alignment.
 - 5. Is free of overheating of any parts.
 - 6. Is free of all-objectionable vibration and noise.
 - 7. Is free of overloading of any parts.
- D. Test each electric motor and record operating voltage and amperage. Have the manufacturer's representative record this information on the manufacturer's startup report (MSR).
- E. Submit the MSR for each grinder manhole startup for record purposes. Record the model number, serial number, and nameplate data on each MSR. Separate MSR's shall be provided for each grinder manhole.

+ + END OF SECTION + +

SECTION 11340 – PORTABLE HOISTS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish and install, as shown on the Plans and specified herein, one (1) portable hoist and two (2) hoist sockets at each of the Knott Drive, Morgan Park, and Viola Drive Pumping Stations.
- B. One (1) hoist socket shall be installed at the wet well and one (1) at the grinder manhole. One (1) portable hoist will be used for both locations.

1.02 RELATED WORK

- A. Section 11316 – Variable Speed Sewage Pumps
- B. Section 11317 – Constant Speed Sewage Pumps
- C. Section 11330 – Grinder Manhole

1.03 SUBMITTALS

- A. Submit information in accordance with the requirements in Section 01300.
- B. Submit the following:
 - 1. Shop drawings, showing all weights and dimensions necessary for the installation of anchor bolts.
 - 2. Storage, handling, and installation instructions.

1.07 WARRANTY

- A. The portable hoist shall be guaranteed against defects in material or materials and/or workmanship for a period of 3 years.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Portable hoists shall be Series DB as manufactured by Halliday Products, Orlando, Florida, or approved equal.
- B. Portable hoist socket shall be Model No. D1S as manufactured by Halliday Products, Orlando, Florida, or approved equal.

2.02 PORTABLE HOISTS

- A. Portable hoists shall be of type 316 stainless steel construction with marine grade stainless steel brake winch. The reach off the hoist shall be adjustable from 24" inches to 36" inches in 1" inch increments. Hoists shall have a minimum load capacity of 300 pounds for the Knott Drive and Viola Drive Pumping Stations. The hoist shall have a minimum load capacity of 1000 pounds for the Morgan Park Pumping Station.
- B. Hoists shall be provided with a minimum of 30 feet of 1/4" 304 stainless steel cable and a stainless-steel safety hook.
- C. All hoist sockets shall be constructed of type 316 stainless steel. The hoist sleeves shall be floor socket type mounted to structures as shown or specified on the plans.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Assemble and install hoist in accordance with manufacturers installation instructions.
- B. Sockets shall be mounted with four (4) 3/4" diameter by 3 1/2" or larger stainless steel wedge anchors.

+ + END OF SECTION + +

SECTION 11350 – AIR IONIZATION ODOR CONTROL SYSTEM

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish, deliver, and install new and complete air ionization odor control system intended for use on this project for the Roslyn Village Pump Station.

System shall include furnishing the necessary equipment and controls to provide an operating air ionization odor control system complete with: supply air ionization makeup air unit (IM) including fan, fan controls, intake screen, washable inlet filter, cold plasma generator(s), safety switches and all other equipment and accessories as specified to provide a complete and functioning system.

It is the intent of these specifications that a single manufacturer-supplier, regularly engaged in the design, manufacture, assembly and production of air ionization odor control systems of the type specified, shall have complete responsibility for the final design, furnishing, coordination, assembly, and installation supervision of all components in air ionization odor control system.

The system shall be designed and fabricated in compliance with National Fire Protection Agency Code 820.

1.02 SUBMITTALS

- A. Submit complete air odor control system drawings that show mounting details, equipment outline dimensions, motor electrical data, fan data, operating weights of all equipment and sufficient information to allow the Engineer/Owner to check clearances, connections, and conformance with the specifications. Submit Installation and Operation and Maintenance Manuals.
- B. Provide documentation to demonstrate that the manufacturer has been regularly engaged in fabricating cold plasma ion generation air odor control systems for at least 5 years.
- C. Provide reference list of at least 3 separate installations of similar function to that of this specification. Installations provided must include as part of the scope of supply air handling equipment in addition to the ionization generators to demonstrate system responsibility. Provide the following information for each installation:
1. Location
 2. Application
 3. Size and number of units
 4. Start-up date
 5. Airflow
 6. Facility contact name and phone number
- D. Provide manufacturer's catalog data, operating literature, specifications, and performance data for all components.
- E. Provide instrumentation, control, logic and power wiring diagrams in sufficient detail to allow installation of the instrumentation, controls, and electrical components.
- F. Provide materials of construction for all components.

1.03 QUALITY ASSURANCE

- A. To ensure a satisfactory and integrated system, all products furnished under this section

SECTION 11350 – AIR IONIZATION ODOR CONTROL SYSTEM

shall be furnished by a single manufacturer who has been regularly engaged in the design, fabrication and testing of cold plasma ion generation air odor control systems of the size, materials and scope specified herein.

- B. The odor reduction ionization system manufacturer shall have been in operation for at least 5 years in the United States and has an established, in-house engineering department with at least one Professional Engineer in the mechanical discipline.
- C. Major components, to include fans, damper, volume control ducting and control panels, shall be manufactured in the United States, without exception.
- D. The Owner and Engineer reserve the right to be present at the fabricator's facility for visual inspection of equipment to be supplied.
- E. The system shall be designed, furnished, and installed to achieve the conditions of service specified herein.

1.04 SYSTEM PROCESS DESCRIPTION

- A. A stainless steel inlet screen, washable inlet filter, fan, and ion generator are housed inside the respective supply Ionizing Makeup Air Unit (IM). Ambient outside air (OA) is drawn into an IM by the fan through the screen and filter and past the ion generator. The ion generator transforms the oxygen present in the ambient air into oxygen ions to form an atmosphere rich with superoxide ion clusters. These oxygen clusters are sent through a duct system into the area where they interact with the odorous pollutants on a molecular level to eliminate odors. The process shall not consume any chemicals or water in its operation or require the disposal of spent media.
- B. The entire system shall be housed in a Stainless Steel NEMA 4X enclosure.

1.05 WARRANTY

- A. Supplier shall provide a one (1) year warranty for the IM equipment, ion generators and electrical panels. Supplier shall repair or replace, at its discretion, any piece of equipment that has failed or is not working according to the manufacturers' performance criteria except for the ionization tubes, which are a required maintenance item. The warranty shall not cover removal or installation labor, failures due to electrical service abnormality, or damages outside normal wear and tear.

PART 2 – PRODUCT

2.01 MANUFACTURER

- A. The manufacturer and provider of the air ionization odor control systems for this project shall be Kusters Water Division (Terminodour™ Mini) 864-576-0660. All other bidders must be pre-qualified at least fourteen (14) days in advance of bid date.
- B. All components used in this process shall be supplied as specified in this part of the specifications. These components shall be incorporated in the automatic operation of the air ionization odor control system controls as supplied by the air ionization odor control system manufacturer.
- C. The major equipment supplied by the air ionization odor control system manufacturer shall be as listed in the paragraphs shown below.

2.02 AIR IONIZATION MAKEUP AIR UNIT (IM)

A. Scope of Work

1. The air ionization odor control system supplier shall furnish an air ionization makeup air unit (IM) to supply highly-ionized air into the Wet Well side of the Roslyn Village Pump Station. The IM shall be comprised of a weatherproof cabinet with access door, intake air filter, fan, ion generator, safety switch, to provide a complete and functioning unit.
2. The IM will be mounted outdoors in an unclassified area.

B. IM Construction

1. Weatherproof cabinet will be capable of operating with direct exposure to the elements with no degradation in performance including ambient air temperatures up to 140 degrees F.

C. Intake Screen & Inlet Filter

1. Stainless steel fine mesh screen followed by stainless steel inlet filter.
2. Stainless steel inlet filter to be washable.

D. Fan

1. Fan housing and wheel to be polypropylene construction. Fan to be double inlet single outlet configuration.
2. One (1) direct drive supply fan with four speed selector controller.
3. The fan shall be selected to deliver 540 CFM at 1.0" TSP.
4. Fan motor is to be fractional horsepower, 115 V., 1 Ph., 60 Hz. with ball bearings and thermal protection.

E. Ion Generators

1. One (1) CSO Group Model T6F -series units shall be provided
2. Ionizer housing: Resin filled ABS.
3. Ionization Tubes: Glass with stainless steel mesh cover, 6 Model CSO IRF520 21"- length tubes per unit.
4. System shall provide 4,000 positive and negative ions per cubic centimeter in the areas served under odor-free conditions.
5. Electrical
 - a. Field electrical connection: Removable power fitting, connected to Module ion generator power junction box via flexible cable.

SECTION 11350 – AIR IONIZATION ODOR CONTROL SYSTEM

- b. Low voltage monitoring: shall be carried out in the control panel with an undercurrent monitor on the supply feed.
 - c. Internal fuse: Slow blow 0.63 amp.
 - d. 230 VAC/60 Hertz, single phase.
- F. Safety Switches
 - 1. Ion generator access door shall have a proximity switch to interrupt power to ionizer-when access door is open.
- G. System Legs
 - 1. 304 Stainless steel legs shall be provided.
- H. Discharge Damper
 - 1. 8" diameter Ruskin 304 stainless steel discharge damper shall be provided. Damper shall be complete with a NEMA 4 actuator that is designed for power open and spring closed on the loss of power. Damper to be installed by contractor and wired to the ionization system.
- I. Volume Control Duct Work Assembly
 - 1. Stainless steel ducting and volume control dampers are to be provided.
 - 2. 8" diameter and 4" diameter manual control dampers are to be used to set proper air flow into treated space.
 - 3. Dampers and duct to be assembled per the drawings as shown.
- J. Spare Parts
 - 1. The following spare parts shall be provided by the IM supplier:
 - a. (6) CSO IRF520 ionizer tubes
 - b. (20) ion generator fuses 0.63 amp
 - c. (2) Inlet filters
 - d. Ionizer Tube Tester

2.03 DUCTWORK

- A. Ductwork to be stainless steel. All duct work and supports to be per specification 15890.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install equipment in accordance with manufacturer's instructions and per the Drawings.
- B. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting installation.
- C. Examine piping, ducts, and electrical systems to verify actual locations of connections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

SECTION 11350 – AIR IONIZATION ODOR CONTROL SYSTEM

- E. Install ductwork per specifications in this Section.

3.02 OPERATION AND MAINTENANCE MANUAL

- A. One (1) paper copy and one electronic copy of the Operation & Maintenance Manuals shall be furnished during start-up.
 - 1. These manuals shall include maintenance instructions for all equipment provided.
 - 2. Operation & Maintenance Manual shall include a Functional Design Specification (description of control logic) and Operational Description (description of process).

3.03 FIELD SERVICES, START-UP AND TRAINING

- A. Qualified representative from the manufacturer shall be available to inspect the installation of the air odor control system to ensure installation in accordance with manufacturer's recommendation.

END OF SECTION

SECTION 11350 – AIR IONIZATION ODOR CONTROL SYSTEM

+ + NO TEXT ON THIS PAGE + +

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Provide transportable precast concrete building components for one building location.
- B. Design, engineer, construct, deliver, unload and assemble precast concrete building in accordance with the layout and parameters provided. The work shall be inclusive of all precast concrete building materials, systems, components, accessories and any other items as required to provide complete and code compliant structures and first class installations. The Work of the precast concrete building shall also include, but not be limited to the following:
 - 1. All professional engineering calculations, design and design documents for the precast concrete building and their related components and accessories.
 - 2. Fabrication in compliance with all third-party certifications and special inspection agency requirements as may be required for NYS special inspections and approvals.
 - 3. All materials, equipment and labor required for the construction of the precast concrete building and its related components and accessories (on and off site).
 - 4. Delivery of the precast concrete buildings and its related components and accessories to the Project Site.
 - 5. Unloading of the precast concrete building and the related components and accessories.
 - 6. Assembly of the precast concrete building and the related components and accessories (on site).
 - 7. Coordination of and with all non precast concrete building construction and installations on site that impact and/or are impacted by the precast concrete building. These items include and are inclusive of the following:
 - a. Site preparations for the precast concrete building.
 - 1) Reinforced concrete foundations and slabs for precast concrete building.
 - 2) All associated construction, site excavations, regrading and restorations associated with above.
 - b. AHJ approvals and permitting.

1.02 RELATED SECTIONS

- A. Section 09900 – Painting
- B. Division 16 - Electrical (boxes)

1.03 REFERENCES

- A. ASTM A1064 - Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- B. ASTM A615 - Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- C. ACI-318-02, "Building Code Requirements for Reinforced Concrete".
- D. Concrete Reinforcing Institute, "Manual of Standard Practice".
- E. ANSI/ASCE-7-2 "Building Code Requirements for Minimum Design Loads in Buildings and Other Structures".
- F. ACI-318-02, "Building Code Requirements for Reinforced Concrete".
- G. Concrete Reinforcing Institute, "Manual of Standard Practice".

1.04 REGULATORY REQUIREMENTS

- A. Conform to all applicable building codes and reference standards including but not necessarily limited to:
 - 1. NYS Building Codes.
 - 2. NYS Building Codes Reference Standards.
 - 3. Any other codes, rules, regulations, etc. that shall govern in addition to the specific codes referenced for any part of the Work to be undertaken. This is inclusive but is not limited to any work or activities performed outside of the work area and NYS.

1.05 MATERIALS AND CONSTRUCTION STANDARDS

- A. All work and materials shall comply with the latest industry and building construction codes and regulations and material standards.

1.06 MANUFACTURER AND FACILITY DESIGN REQUIREMENTS

- A. Manufacturer shall be producer member of the National Precast Concrete Association (NPCA) and participate in its Plant Certification Program.
- B. Building materials, designs and plans shall be provided by a single source provider, with at least five years of demonstrated experience in precast concrete building design, construction and installations.
- C. The precast concrete building's construction shall meet or exceed the product specifications listed herewith. Said product specification defines the requirements and specifications for the precast concrete buildings that are to be constructed. The precast concrete building wall panels and framed roof shall be constructed off site (on the premises of a fabricator registered and approved to perform such work without NYS special inspection) and shall be installed on site to meet local codes and approvals for permanent structures. Note: for prevailing wage projects that all on site labor shall be paid at NYS prevailing wage rates.
- D. The precast concrete building shall be provided to meet all of the requirements listed in this specification section, where no specific requirement is listed, the precast concrete building shall be furnished with the latest standard products of the Manufacturer. All requested or standard products shall be installed in a professional manner and in accordance with industry standards and best practices.
- E. The materials and equipment shall be supplied or manufactured by manufacturers capable of producing said items compatible with the requirements of the precast concrete building.
- F. Building sidings, treatments, finishes and roofing shall be as specified. Substitutions of materials will not be considered as architecturally equivalent.

1.07 DESIGN AND ENGINEERING REQUIREMENTS

- A. The building shall be designed by professionals experienced in the design and engineering of precast concrete buildings.
 - 1. Building plans shall be signed and sealed by a professional engineer or architect licensed in the State of New York. This professional will be considered as the Design Professional of Record for the precast concrete building.
 - 2. Signed and sealed building plans shall be provided for submission to the local building authority for design approval. Submission of plans for building location and setbacks from property line and other structures, foundation design, anchoring of building to foundation, means of providing access to the Building and utility connection(s) for the building will be made by Others (Owner's Design Professional).

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3. The Design Professional of Record shall also provide a separate certification stating that the precast concrete building has been designed to be NYS code compliant including but not limited to the Building's materials, systems, components, accessories and other items.
 4. Signed and sealed building plans shall be submitted to the Owner's Design Professional for submission to Owner for AHJ code review, inspection(s) and approval of the precast concrete building.
- B. The precast concrete building shall be engineered to meet the specified regulatory requirements defined in Paragraph 1.04, the engineering shall be inclusive of but not limited to the following:
1. The precast concrete building shall be designed and engineered to accommodate the specific site conditions including but not limited to wind and snow loading, fire rating, energy performance and seismic requirements.
 2. The precast concrete building shall be designed and engineered to meet the specific requirements associated with the specific occupancy.
 3. The precast concrete building shall be designed and engineered to comply with the requirements of a stand alone permanent building.

1.08 SUBSTITUTIONS/OR EQUALS

- A. Substitutions/or Equals for the precast concrete building, including but not limited to building materials, systems, components, accessories and any other items listed in this specification shall be submitted in conformance with the Contract and as otherwise modified by the following:
1. A proposed Substitution/or Equal submission package shall be submitted to the Owner no later than (10) ten business days prior to the bid date. Otherwise, any Substitution/or Equal other than the items specified will not be considered.
 2. Submittal to Owner shall include:
 - a. Identification of project – project name;
 - b. Name of submitting bidder;
 - c. Telephone and email address of submitting bidder;
 - d. Manufacturer's name of proposed or equal/substitution;
 - e. Proposed substitution item;
 - f. Product data sheet for proposed substitution item;
 - g. Product data sheet for specified item to be substituted;
 - h. Reason for substitution;
 - i. Line by line comparison of proposed substitution compared to specified item;
 - j. Listing of both short term and long term benefits to Owner for acceptance of substitution;
 - k. Listing of any known negatives of substitution compared to specified item;
 - l. List a minimum of 5 projects where the proposed substitution has been utilized for a similar use/occupancy.
 3. Failure to follow any of the procedures outlined in the Contract or above may subject the entire submission for rejection.
 4. Partial and/or incomplete submissions may not be reviewed.
 5. Substitution/ or Equals if found acceptable will be approved via addenda, which will be issued to all bidder's.
 6. In order to include an approved Substitution/or Equal in the bid, the bidder must acknowledge on the bidders bid form that the bidder intends to provide the approved Substitution/or Equal. Failure of the bidder to express their intent to use the approved Substitution/or Equal as part of the bid will exclude the bidder from being able to utilize the Substitution/or Equal.
 7. If a bidder uses a Substitution/or Equal, the bidder will take responsibility to pay for the re-engineering and coordination of all other items that are to be provided that have been defined in the Contract Documents that is being performed by Others to prepare for or

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connect to the precast concrete building as part of the installation, if revisions are required, including but not limited to all footings, foundations, slabs, sitework, walkways, ramps, stairs, railings, anchors and utility connections.

1.09 SUBMITTALS

- A. Building engineering calculations shall be provided for the precast concrete building and sloped framed roof that have been designed and sealed by a State licensed Professional Engineer in which the building shall be installed.
- B. Fabrication drawings including location of all built-in elements (electrical boxes, etc) that are to be used for in-field installations.
- C. Product data for roofing system, siding and other accessories.
- D. Submit all information under the provisions outlined in Division 01 submittal section.
- E. Submit Installer qualifications, including but not limited to the following: (See Paragraph 3.03 Installer for additional requirements)
 - 1. Installer
 - a. Name of Foreman/Supervisor
 - b. Resume of Installer's Foreman/Supervisor, including years of experience, work experience, and a list of five similar jobs
 - c. Copy of electrical license(s) for electrician(s) to be used, if any.
 - d. Copy of plumbing license(s) for plumber(s) to be used, if any.
- F. Submit Fabrication and Third Party Certification Agency (Special Inspection Agency) qualifications and information, including but not limited to the following:
 - 1. Fabricator submittals
 - a. Qualifications and Certifications.
 - 1) NYS experience and documentation of experience.
 - b. The fabricator must provide evidence of compliance with the following:
 - 1) Participation in a third-party inspection program by an approved special inspection agency (SIA). The inspection program shall include review of the fabricators written procedural and quality control manual and periodic auditing of fabrication practices, including verification of procedures related to structural aspects of the work (materials and welding).
 - c. The fabricator shall submit the fabricators QC Manual.
 - 2. Special Inspection Agency (SIA) submittals
 - a. Qualifications and Certifications.
 - 1) NYS experience and documentation of experience.
 - (a) Submit documentation that demonstrates compliance with NYS Code section 1703, including but not limited to the following:
 - (b) Certification that the SIA is independent from the fabricator and/or manufacturer.
 - (c) Documentation that the SI is objective and competent.
 - (d) Disclosure or any possible conflicts of interest so that objectivity can be confirmed.
 - (e) Testing equipment owned and maintained along with their calibration schedule.
 - (f) Resumes and qualifications of the personnel responsible for conducting, supervising and evaluating tests and/or inspections.
- G. Shop Drawings:
 - 1. Concept Layout Approval Drawings

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- a. Concept Layout Approval Drawings are to be submitted to Owner's Construction Representative within 1 month after contract award.
 - 1) Furnish for Owner's review, precast concrete building layouts for Owner to accept, comment upon or reject concept. Information shall be used to coordinate and confirm the preparatory Work to be performed on the site.
 - 2) Submission shall demonstrate compliance with Owner specified design requirements and coordination of Work items identified to be performed by Others.
 - 3) At a minimum the submission shall include:
 - (a) Site concept plan. A scaled site concept plan shall show at a minimum the following:
 - (1) North arrow.
 - (2) Location of Building.
 - (3) Location of precast concrete building dimensioned to edges of precast concrete building pad, which shall be constructed in-situ by others. Any projections from the building should be noted. Indicate height and dimension of any projections in order to coordinate with Owner's access around and into the building.
 - (4) Delineation of areas needed for staging, rigging and installation.
 - (5) Delineation of changes that will be needed to the site for staging, rigging and installation.
 - (b) Floor plans. Scaled floor plans must show at a minimum the following:
 - (1) Interior dimension of precast concrete building.
 - (2) Exterior dimension of precast concrete building.
 - (3) Location and swing of doors.
 - (4) Locations of access or service doors.
 - (5) Locations of clear floor space, if needed, to accommodate any precast concrete building elements or to service any precast concrete building elements. (For both interior and exterior elements).
 - (6) Location of built-in components (electrical boxes, etc.)
 - (7) Location of sleeves (piping, conduit, etc.)
 - (8) Building tie-down anchor locations.
 - (c) Reflected ceiling plans. Scaled reflected ceiling plans shall show at a minimum the following:
 - (1) Location of hatch.
 - (2) Location of any built-in components (electrical boxes, etc.)
 - (3) Location of any ceiling mounted equipment, elements and devices.
 - (d) Elevations. Scaled exterior elevations (of each building side) shall show at a minimum the following:
 - (1) Location of doors.
 - (2) Locations of any access or service doors.
 - (3) Locations of clear floor space, if needed, to accommodate any precast concrete building elements or to service any precast concrete building elements. (For both interior and exterior elements).
 - (4) Locations of any built-in equipment, elements and devices.
 - (5) Locations of any building penetrations.
 - (6) Outlet and switch locations.
 - (7) Exterior lighting locations.
 - (e) Building section. Scaled section shall show at a minimum the following:
 - (1) Identify clear floor height within building.
 - (2) Identify overall building height.
 - (f) Details. Details shall show at a minimum the following:
 - (1) Connection details of panels.
 - (2) Roof framing and roofing details.

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- (3) Gable end siding details.
 - (4) Soffit detailing.
 - 4) If commented upon or rejected by Owner, revised concept layout approval Drawings shall be re-submitted to Owner's Construction Representative within 2 weeks after receipt of comments or rejection.
- 2. Code Compliant Engineering Drawings
 - a. Code Compliant Engineering Drawings shall be submitted to Owner's Construction Representative within 2 weeks after concept layout approval.
 - 1) Furnish for Owner's review of precast concrete building layouts for Owner to accept, comment upon or reject. Information shall be used to further coordinate the preparatory Work to be performed on the site, and for submission to the local building authority for design approval.
 - 2) The full set of code compliant engineered drawings shall be prepared under the direction of a Professional Engineer or Registered Architect licensed by the State of New York and such documents shall be signed and sealed by aforementioned professional, who will be the Design Professional of Record for the precast concrete buildings.
 - 3) Submission shall comply with the approved concept layout documents, regulatory requirements and Owner's design requirements and shall clearly demonstrate compliance with all of the aforementioned as well as the coordination of work items identified to be performed by Others as listed within this specification.
 - 4) At a minimum the submission shall include:
 - (a) Design criteria and code summary
 - (b) Provide information demonstrating or certifying building has been engineered to accommodate the specific site conditions including but not limited to wind and snow loading, fire rating, energy performance and seismic requirements.
 - (c) Site concept plan. A scaled site concept plan shall show at a minimum the same information as the previous submission.
 - (d) Floor plans. Scaled floor plans shall show at a minimum the same information as the previous submission.
 - (e) Reflected ceiling plans. Scaled reflected ceiling plans shall show at a minimum the same information as the previous submission.
 - (f) Elevations. Scaled exterior elevations (of each building side) shall show at a minimum the same information as the previous submission.
 - (g) Building section. Scaled section shall show at a minimum the same information as the previous submission.
 - (h) Details. Details shall show at a minimum the same information as the previous submission.
 - (i) Additional drawings as deemed necessary to define all work required for the construction of and complete installation of the precast concrete buildings. Drawings shall include and represent in adequate detail and specification all construction materials, systems, components, accessories and any other items as required to be part of and will be built into the precast concrete buildings to provide complete and code compliant structures and a first class installation. Drawings as appropriate shall show coordination and compliance with Owner's specified requirements.
 - 5) The design professional shall also provide a separate certification stating that the precast concrete building has been designed to be NYS code compliant including but not limited to the Building's materials, systems, components, accessories and other items.
 - 6) If commented upon or rejected by Owner, revised code compliant engineering Drawings are to be re-submitted to Owner's Construction Representative within 2 weeks after receipt of comments or rejection.

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- H. Product Data: Provide product data on all materials, components and accessories for all items listed in Section 2. Where appropriate provide color charts where color options are available for selection.
- I. Product Samples: Submit one full sized sample (max 12"x12") of all finished interior and exterior materials.
- J. At completion of fabrication, the approved fabricator shall submit a certificate of compliance to the Owner stating that the work was performed in accordance with the approved construction documents.

1.10 WARRANTY

- A. The precast concrete building panels and all its associated materials and components shall be warranted against defects in materials and workmanship for a period of not less than one year from date of final acceptance with the exception of elements related to the building's structural integrity, which shall be warranted against defects in workmanship and material for a period of 15 years from the date of shipment.
- B. The installing contractor shall warrant all installations against defects in workmanship for a period of not less than one year from date of final acceptance.

1.11 PROJECT CLOSEOUT DOCUMENTATION

- A. In addition to the items requested in Division 01. Provide a complete set of as built drawings, using the final code compliant engineering Drawings as approved by New York State as a background and highlight the following items:
 - 1. Locations and description of concealed items, if not shown on final engineering drawings.
 - 2. Any modifications to approved drawings.
 - 3. Field changes or modifications to the work as required to suit field conditions, as required to coordinate installations by others or for changes to the work as requested by Owner.
 - 4. The Design Professional of Record shall provide written approval for all changes.
- B. Provide precast concrete building Manufacturer warranty covering all building materials and components for items included in this specification section as defined in 1.10 Warranty.
 - 1. Warranty shall be accompanied by a copy of Manufacturer's required periodic maintenance requirements; and
 - 2. Manufacturer's contact information along with the procedures of how to process a claim.
- C. Provide precast concrete building Installer warranty covering all installed materials and components for items included in this specification section as defined in 1.10 Warranty.
- D. Provide specification sheets and manuals for all components, equipment and accessories installed in the building.
- E. Provide all keys in the quantity listed. Furnish eight (8) keys for each different key access.

PART 2 – PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. Design Requirements: Provide a building designed in accordance with ACI-318 and local prevailing building codes for reinforced concrete, and manufactured under Prestressed Concrete Institute (PCI) standards and Quality Control Manual MNL-116.

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- B. Model 1230 Dimensions: (Dimensions required may be different than listed. Refer to bid drawings for actual dimensional requirements)
 - 1. Exterior: 30'-0" x 12'-4" x 12'-9" high
 - 2. Interior: 28'-6" x 10'-10" x 12' ceiling
- C. Design Loads and Energy Code Performance Requirements: Precast building shall be designed to meet 2020 New York State Building Code Loading and Energy Code requirements. (See design criteria stipulated on Contract Drawings).
 - 1. If any discrepancies exist between this specification section, structural drawings, code drawings or the current NYS Building Code, the more restrictive and/or greater requirement shall be followed.
- E. Precast roof/ceiling panel shall be insulated, shall have a consistent thickness and have flat top. The precast roof/ceiling panels shall align with the outside of the wall panel on each side and have a turndown design which extends ½-inch below the top edge of the wall panels.
- F. Pre-assembled roof system shall include a standing seam metal roofing system with all underlayments, flashings and incidental construction elements. The roofing system shall be applied over a wood framed structure with exterior sheathing secured to the precast roof panels.
- G. Roof/ceiling and walls panels shall each be produced as single component monolithic panels. Wall panels shall set on top of cast in place foundation. Roof/ceiling panels shall set on top of wall panels. Pre-assembled roof structure shall be set on top of roof/ceiling panels.
- H. Roof and exterior wall panels shall be able to withstand the design loads to be imposed upon them. Panels shall be insulated by means of "sandwiching" a thermomass insulation between two concrete panels, which shall be adequate to meet the energy code.
- I. Openings shall be sized based on shop drawings found in conformance with the Contract and in conformance with Manufacturer's structural requirements.

2.02 MANUFACTURERS

- A. Manufacturer with the experience listed in Paragraph 1.06 and that can provide the precast concrete buildings that will meet all of the requirements set forth throughout this specification section and can demonstrate they can comply with all other requirements throughout this specification and all other contract requirements.
 - 1. EASI-SET™ as manufactured by M&W Precast, LLC, 210 Durham Road, Ottsville, PA (610) 847-1423. (Representative: J. David Worthington) or an approved substitution.

2.03 MATERIALS - WALL AND ROOF/CEILING PANELS

- A. Concrete: Steel-reinforced, 5000 psi minimum 28-day compressive strength, air-entrained (ASTM-C260)
- B. Reinforcing Steel: ASTM A615, grade 60 unless otherwise indicated.
- C. Post-tensioning Strand: 41K Polystrand CP50, .50, 270ksi, 7-wire strand, enclosed within a greased plastic sheath, (ASTM A416). Roof and floor each to be post-tensioned by a single, continuous tendon. Said tendon shall form a substantially rectangular configuration having gently curving corners wherein the positioning of the cable member results in a pattern of one or more loops and a bisecting of the loop(s). The cable member starts from one corner of the concrete building panel, forms a gentle perimeter loop(s) returning to a point where the cable member entered the concrete building panel. The tendon then turns 90 degrees and follows the cable member(s) to a point midway along the "Y" axis of the concrete building panel and

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then turns 90 degrees along the "X" axis of the concrete building panel. This bisects the concrete building panel and crosses the opposite parallel portion of the cable member and exits from an adjacent side of the concrete building panel.

- D. Caulking: All joints shall be caulked on both the exterior and interior surfaces of the joint. SIKAFLEX-1A elastic sealant for exterior joints. SIKAFLEX-15LM elastic sealant for interior joints.
- E. Panel Connections: All panels shall be securely fastened together with 3/8-inch thick steel brackets. Steel is to be of structural quality, hot-rolled carbon complying with ASTM A283, Grade C and powder coated after fabrication. All fasteners shall be 1/2-inch diameter bolts complying with ASTM A307 for low-carbon steel bolts. Cast-in anchors used for panel connections to be Meadow-Burke #FX-19, or equal. All inserts for corner connections must be fastened directly to form before casting panels. No-floating-in of connection inserts shall be allowed.
- F. Roof Panel Connections: Bolt pockets.
- G. Adhesive Anchors: Hilti HIT RE-500 Adhesive Anchor with HAS Rod.
- H. Finishes:
 - 1. Interior of Building: Smooth steel trowel finish on all interior panel surfaces. The walls and ceilings of building shall be coated with Sherwin Williams Tred Plex to per customer's selection from manufacturer's standard color chart.
 - 2. Exterior of Building: Brick running bond (form liner) on all exterior panel surfaces. Finish shall be imprinted in top face of panel while in form using an impression form liner as manufactured by Architectural Polymers, Inc. Finished brick size shall be 2-3/8" x 7-5/8". Joints between each brick shall be 3/8" wide and 3/8" deep. Back of joint shall be concave to simulate a hand tooled joint. Each brick face shall be coated with H&C concrete stain by Sherwin Williams. Joints shall be kept free of stain and shall be natural grey.
- I. Insulation: Thermomass Building System, as supplied by Thermomass, PO Box 950, Boone, Iowa 50010 (800 232 1748) consisting of both:
 - 1. Insulation: Minimum 3-inch thick extruded polystyrene board insulation for walls and roof panels complying with ASTM C578, Type IV; with regularly spaced holes identifying connector placement locations.
 - 2. Structurally non-composite wythe connectors: Non-conductive, non-corrosive, fiber-composite connectors, having a tensile strength of 120,000 psi, minimum glass content of 76 percent by weight, and a coefficient of thermal expansion of 5x10-6in/in/°F, nominal.

2.04 ROOF

- A. Wooden truss gable roof of 2x construction. Roof shall be sheathed with minimum 3/4" plywood, roofing underlayment and a standing seam aluminum roofing system. Roof shall be assembled as a modular unit and attached to concrete building roof on site. Gable ends shall be covered with cementitious siding on 5/8" sheathing with proper air/vapor barrier. Soffit shall be an aluminum vented soffit supported by wood framing. Siding, soffit, fascia, gutters and leaders may be field applied.

2.05 ACCESSORIES/COMPONENTS

- A. Doors and Frames: Doors shall be 18 gauge, frames shall be 16 gauge. Metal components shall be zinc-coated (galvannealed) by hot-dip process in accordance with ASTM A653/A653M. Provide at least A60/ZF180 (galvannealed) or G60/Z180 (galvanized). All doors and frames to have reinforcement for all hardware locations. Insulation values shall meet or exceed code. Vision panels, where called for, shall be glazed with tempered glass minimum 1/4" (or as

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required by jurisdiction). Doors and frames shall be finished with a rust inhibiting primer and factory applied finish (color to be selected by Owner). Manufacturers: Ceco Door, Curries, Krieger or an approved substitution. All hardware shall be heavy duty.

- B. Door Hardware: All doors shall be provided with hardware per hardware schedule on drawings. Manufacturers: IVES, Pemko, Stanley, Norton, Schlage, Von Duprin or an approved substitution.
- C. Fiber-Cement Siding: Board and batten style. Siding constructed of cement and cellulose fiber which is formed under high pressure, complying with ASTM C1186, Type A, Grade II. Panels shall have machined edges, smooth texture 5/16" nominal thickness, nailable. Boards shall be minimum 48 x 96 and shall have a factory applied finish (color to be selected by Owner). Trim boards and battens shall be same material, texture, finish as siding. Where necessary to conceal fasteners, siding shall be filled and field painted in accordance with siding manufacturers installation requirements. Manufacturers: Allura, James Hardie Building Products Inc., Nichiha USA Inc. or an approved substitution.
- D. Standing Seam Roofing: Standing seam roofing shall be 24 gauge and shall have a PVDF (Polyvinylidene Fluoride) coating. Roofing shall have a minimum of 1" standing seams. Roofing shall be provided as a complete roofing system as approved by a single manufacturer and shall include all flashings, underlayments and accessories as necessary. Roofing shall be provided with a suitable underlayment, synthetic non-asphaltic, self sealing. Underlayment shall comply with ICC-ES ACI88 for non-self adhesive sheet, and ASTM D1970/D1970M for self sealability. Vapor permeance must comply with code. Snow guards shall be designed and installed at locations suitable to prevent snow and ice from falling in large sheets. Minimum 1 continuous guard is required on each sloped surface. Gutters, leaders and flashings shall be same material and finish as roofing. (Gauge of elements are to be sized to suit each purpose). Roofing and roofing details shall comply with SMACNA requirements. Colors to be selected by Owner. Roofing system and finish shall have a minimum 30 year full system warranty. Manufacturers: Atas International, Garland, Petersen Aluminum Corporation or approved substitution.

PART 3 – EXECUTION

3.01 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle materials to and on site under provisions of the Contract, and best practices.
- B. Contractor shall be responsible for the delivery, storage and handling of all items including but not limited to the precast concrete buildings and any other materials associated with the precast concrete buildings to be installed.
- C. Obtain and pay for all permits required for the delivery of the precast concrete buildings and any other materials associated with the work to be performed.
- D. Schedule, coordinate and pay for the handling (loading and unloading) of the precast concrete building panels and other materials. Any permits required for this work shall also be secured.
- E. Take all necessary precautions to properly protect all materials, systems, components, accessories, and any other items in order to prevent damage during shipping, unloading and installation and until such a point that the Owner has accepted the Work. Should a building panel or any part of the permanent installation be damaged during shipping, unloading or installation to such an extent that the Owner's Construction Representative believes that an in-situ repair would not provide the same level of quality as was intended, provide a replacement at no additional cost to the Owner.

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- F. Immediately notify the Owner's Construction Representative of any damages. Do not install any damaged products.

3.02 COORDINATION

- A. Coordinate work under the provisions of the Contract.
- B. Coordinate the work with all other work that is part of the project, work that shall be undertaken, at the time the work is being performed as well as with all work that may be performed by others associated with the project, including but not limited to the specific items as listed in Section 1.01, B item 7.
- C. Specific coordination is required but is not limited to the following items:
 - 1. During the design phase:
 - a. Coordinate all activities and scheduling with Owner's Construction Representative.
 - b. Verify precast concrete buildings size, anchor point locations and that Manufacturer's preferred method of attachment is coordinated with the Owner's Design Professional's foundation/slab design. Confirm design provided and detailing is of the proper dimension, has the proper configuration to meet the manufacturer's product and warranty requirements and allows for the proper installation of the precast concrete building.
 - c. Verify rigging and installation requirements for the precast concrete buildings is coordinated with the Owner's Design Professional's site configuration and the design and detailing of site features. Confirm design has proper clearances and allows for the proper installation of the precast concrete buildings.
 - d. Verify precast concrete buildings floor height, exterior envelope, doors, etc. is coordinated with any project equipment, ramps, platforms and walkway designs. Confirm design provided and detailing is of the proper dimension and configuration to meet the manufacturer's product and warranty requirements, has proper clearances and allows for the proper installation of the precast concrete buildings.
 - 2. Prior to Shipping:
 - a. Attend a pre-arrival meeting at the site a minimum of two weeks prior to delivery to coordinate with Owner's Construction Representative to discuss staging and rigging areas, delivery and installation schedule and any modifications to the site that will be performed to accommodate the delivery, unloading and installation. All site modifications and their subsequent restorations to prior condition will be required to be performed by the Installer as part of the work of this specification and no additional costs are to be incurred by the Owner.
 - 3. During the construction phase:
 - a. Coordinate all activities and scheduling with Owner's Construction Representative.
 - b. Coordinate precast concrete buildings installation with installation of in-situ construction which shall be performed by others outside of the work of this specification.
 - c. Coordinate installation with any other trades that are needed.

3.03 EXAMINATION

- A. Verify existing conditions under the provisions of the Contract.
- B. Verify items are installed as needed and in the correct positions. Before proceeding with any work, verify that existing conditions, materials and surfaces and previous installations are ready to receive work. At a minimum:
 - 1. Inspect foundation and slab for buildings to confirm it is suitable for proper installation and meets manufacturer's requirements for a proper installation.

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- a. The building foundation upon which the wall panels rest shall be level within 1/4-inch differential over the entire building area.
 - b. The finish floor slab elevation shall be above the exterior grade. Grade shall have positive slope and drainage away from the building at all points.
 - c. Top of floor slab shall have a 1/2-inch step-down the width of the building panel around the entire perimeter to prevent water migration into the building along the bottom of wall panels.
 2. Verify any ramps, stairs or other site features are compatible with installation
 3. Verify any connections are properly located and will be able to be installed as required to connect building.
- C. Perform any testing required to verify adequacy of previously installed work or their condition(s).
- D. If any unsuitable conditions are found or if any site preparations are inadequate or improper, notify Owner's Construction Representative to have remedied before installation of buildings.
- E. Verify condition(s) have been rectified before proceeding. Commencement of installation means contractor has accepted all conditions as suitable for their work to be installed and therefore will not be compensated for any additional work required to remove and reinstall any of their newly installed work.

3.04 GENERAL INSTALLATION

- A. Follow all Manufacturer's requirements, instructions and procedures for unloading, unpacking, inspection and installation. Follow Manufacturer's recommended sequence of procedures.
- B. Unloading:
1. Inspect condition of preconstructed items prior to unloading to determine if any damage may be present. Check for damage to packaging used to protect these items.
 2. Notify Owner's Construction Representative of any damage found or concerns prior to unloading.
 3. Prepare building items for unloading. Use an appropriately sized equipment, follow Manufacturer's recommendations and proper safety procedures for unloading and placement. Provide crane and use spreader bars.
 - a. Provide a crane and operator and all required manpower and off-loading equipment necessary to unload and position the panels.
 - b. Obtain and pay for all required permits that may be required for unloading and/or installation.
 - c. Provide level unobstructed area large enough for crane and tractor-trailer to park adjacent to pad. Crane shall be able to place outriggers within 3 feet of edge of pad and truck and crane must be able to get side-by-side under their own power.
- C. Unpacking:
1. After panels are unloaded from the truck onto site, remove any packing material and tapes.
- D. Inspection:
1. Inspect panels thoroughly for damage. If damage found, notify Owner's Construction Representative immediately. Document extent of damage and provide options for remediation.
 2. Inspect any fittings to see if any have loosened during shipping, have broken apart and/or require attention and possible adjustment. Inspect the building and all equipment contained within for damage as well. At a minimum:
 - a. Tighten and secure all fittings, fasteners and moving parts.

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- b. Inspect all interior and exterior paint and coatings. Check for abrasions, chips, seals, and other areas that might have been affected during shipment and off-loading.
 - c. Check buildings doors and door handles/closures to make sure they are moving and closing properly.
 - d. Check all locks are keyed properly.
- E. Installation:
- 1. Once unpacking and inspection of complete building and components is completed and if no damage is found, commence further installations and assembly.
 - a. Place precast building components on prepared foundation in accordance with manufacturer's recommendations.
 - b. Place Con-Seal CS367 ½-inch butyl tape seal on the floor slab prior to installation of wall panel onto the cast in place floor or foundation wall.
 - c. Caulk exterior and interior surface of the wall to floor joints
 - 2. Perform field touch-up painting.

3.05 INFORMATION AND INTERPRETATIONS

- A. The items listed in this specification are a list of the major materials, systems, components, accessories, and items for the precast concrete buildings. This specification is not intended to be a complete list of everything that is required to design, engineer, construct, deliver, unload, and assemble the buildings. All incidental items required for a complete installation if required as part of a fully code compliant precast concrete building installation shall be provided as if they are stated herewith and shall be new, first class, code compliant materials that are made for and suitable for the Work to be undertaken.
- B. If any requirements listed within these Contract Documents contradict or are duplications of another requirement, the Owner's Construction Representative should be notified for resolution but it should be interpreted herewith regardless of how the contradiction is resolved by the Owner's Construction Representative that the most restrictive and/or higher costing requirement is intended and therefore no additional costs should be incurred by the Owner above and beyond the price bid, unless said contradiction or duplication was identified and resolved prior to Contract.
- C. If any requirement listed within these Contract Documents contradict, conflict or are at variance with any code requirement, the Owner's Construction Representative should be notified, the code requirement shall govern but it should be interpreted herewith that the code requirement was always intended and therefore no additional costs should be incurred by the Owner above and beyond the price bid, unless said contradiction, conflict or variance was identified and resolved prior to Contract.

END OF SECTION 131220

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope:
 - 1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish, install, calibrate, test, adjust and place into satisfactory operation all primary sensors and field instruments shown and specified herein.
 - 2. Contract Documents illustrate and specify functional and general construction requirements of the sensors and field instruments and do not necessarily show or specify all components, wiring, piping and accessories required to make a completely integrated system. Contractor shall provide all components, piping, wiring, accessories and labor required for a complete, workable, and integrated system.
 - 3. Contractor shall be responsible for installing in-line flow elements (magnetic flow meter flow transmitters, paperless chart recorders pressure level sensors, floats switches and for providing taps in the process piping systems for installation of other flow, pressure, and temperature sensing instrumentation.
- B. Coordination: Coordinate with other suppliers for installation of all items specified herein and required to ensure the complete and proper interfacing of all components and systems.
- C. Related Sections:
 - 1. Section 11316, Variable Speed Sewage Pumps
 - 2. Section 11317, Constant Speed Sewage Pumps
 - 3. Division 16, Electrical

1.02 QUALITY ASSURANCE

- A. Acceptable Manufacturers:
 - 1. Furnish primary sensors and field instruments by the named manufacturers or equal equipment by other manufacturers.
 - 2. The named manufacturers have been specified to establish the standard of quality and performance of the equipment to be supplied.
 - 3. Obtain all sensors and field instruments of a given type from the same manufacturer.

1.03 DELIVERY, STORAGE AND HANDLING

- A. Comply with the requirements of Section 01610 – Transportation and Handling of Materials and Equipment.
- B. Primary sensors and field instruments shall not be delivered to the Site until all product information and system Shop Drawings for the sensors and instruments have been approved by the Engineer.

1.04 SUBMITTALS

- A. Comply with the requirements of Section 01300 – Submittals and Section 13401 – Process Control Systems General Provisions.

1.05 REQUIRED WARRANTIES

- A. All equipment shall be warranted for a minimum period of two (2) years from the date of acceptance of the Work by the Engineer and the Owner.
- B. Any equipment which is found to be defective during the warrantee period shall be repaired or replaced, in a timely manner, at no cost to the Owner.

1.05 MATERIALS OF CONSTRUCTION FOR WETTABLE PARTS

- A. Provide compatible materials of construction for primary sensors and field instrument (wetted) parts that come in contact with the process fluids.

1.06 IDENTIFICATION TAGS

- A. Tagging Requirements:
 - 1. Tag numbers of sensors and field instruments shall be as shown and as specified. For items not shown or specifically tagged, the item tag number shall be established by the

system supplier. All instruments, whether field or panel mounted, shall have an identification tag.

2. Information to be permanently engraved onto the tag shall include the identifying tag number, manufacturer, model number, service, and range.
3. Identifying tag number shall be permanently etched or embossed onto a stainless steel tag which shall be fastened to the device with self-tapping stainless steel screws. Where fastening with screws cannot be accomplished the tags shall be permanently attached to the device by a circlet of stranded stainless steel wire rope and clamp.
4. All sensors and field instruments mounted on or within control panels and enclosures shall have the identification tag installed so that the engravings are easily visible to service personnel. Devices mounted on the face of panels shall have the tags attached to the rear of the devices.

1.07 MANUFACTURER'S SERVICES

- A. The contractor shall provide the services of an authorized field representative of the system manufacturer to start up and calibrate the system in the presence of the Engineer and the regulatory agencies.

PART 2 - PRODUCTS

2.01 GENERAL DESIGN REQUIREMENTS

- A. Power Supplies:
 1. All electrically powered equipment and devices shall be suitable for operation on 115 volt, ± 10 percent, 60 Hz, ± 2 Hz power. If a different voltage or closer regulation is required, a suitable regulator or transformer shall be provided at no additional cost to the Owner.
 2. Appropriate power supplies shall be furnished by Contractor for any field instrument requiring a power source less than 115 volts. Power supplies shall be mounted in control panels or enclosures installed near the instruments or in field panels.
 3. Design all power supplies for a minimum of 130 percent of the maximum simultaneous current draw.
- B. Miscellaneous:
 1. All instrumentation components shall be heavy-duty types, designed for continuous service. The system shall contain products of a single manufacturer, when possible, and consist of equipment models which are currently in production.
 2. All field-mounted instruments and system components shall be designed for installation in humid and corrosive service conditions. All field mounted instrument enclosures, junction boxes and appurtenances shall conform to the NEMA ratings that meet hazardous rating requirements shown on Contract Drawings.
 4. The named manufacturers have been specified to establish the standard of quality and performance of equipment to be supplied.

2.02 MAGNETIC TYPE FLOW METERS

- A. The magnetic flow meters shall be the magnetic-inductive type that produces a magnetic field by positioning the coils inside the flow tube. The flow meter sizes shall be as specified on the contract documents. Flow meters shall be the Toshiba Mount Anywhere Series – Flanged electromagnetic flow meter or ABB WaterMaster, electromagnetic flow meter, or equal.
- B. Continuous zero stability shall be an inherent characteristic of the flow meter system. The system shall cancel out interference voltages, thus eliminating the zero-drift by loading the magnetic coils with a pulsed direct current (DC).
- C. Measurement shall not be affected by alternating current (AC) line interference voltages, stratified flow, changes in liquid electrical conductivity (down to 5 micromhos/cm), or non-homogeneity of the fluids electrical conductivity. Zero point shall be stable even with partially fouled electrodes.
- D. The flow meters must meet the following requirements:
 1. General:

SECTION 13420 – PRIMARY SENSORS AND FIELD INSTRUMENTS

- a. Function: Measure, indicate, and transmit the process flow in a full pipe. Meter must be a full bore meter with the magnetic field traversing the entire cross-section of the flow tube. Insertion magmeters or multiple single point probes inserted into a spool piece are not acceptable.
- b. Type: Magnetic flowmeter, operating based on Faraday's law, using a pulsed DC type coil excitation with high impedance electrodes.
- c. Parts: Flow tube, transmitter, interconnection cables, mounting hardware.
 - 1) Service: pumped raw sewage flow as shown on the Contract Drawings.
 - (a) Performance:
 - (1) Range: 1500 to 1
 - (2) Accuracy: 0.2%
 - (3) Repeatability: 0.05% or 0.0008 ft/s, whichever is greater.
 - (4) Calibration: High accuracy 0.2%
 - (b) Process Connection:
 - (1) Meter Size: as indicated on the Contract Documents
 - (2) Connection Type: ANSI 250 flanges
 - (3) Flange Material: Carbon steel
 - (4) Pressure Rating: Meter system must be fully rated to the same design pressure as the flanges.
 - (c) Flow Tube:
 - (1) Meter Tube Material: 304 stainless steel
 - (2) Liner Material: Hard Rubber, suitable for wastewater sludge containing 1% solids and replaceable without disturbing the field coils.
 - (3) Electrode Type: Conical self-cleaning electrodes.
 - (4) Electrode Material: 316 stainless steel
 - (5) Enclosure Classification: NEMA 4X, Explosion Proof for Class 1, Div. 2, Group D locations.
 - (6) Housing Material: Epoxy Coated Carbon Steel
 - (7) Grounding: Type 2 corrosion-resistant metallic grounding rings are required.
 - (8) Submergence: Continuous to 30 feet and direct burial 3 to 16 feet IP68/NEMA6P.
 - (d) Transmitter:
 - (1) Power: 120VAC 60Hz
 - (2) Display: Three-line 16 character back-lit display indicating instantaneous flow and total flow in GPM.
 - (3) Integral Keypad: Allows for external configuration without removing covers and compromising the integrity of the electrical and environmental classifications.
 - (4) Bi-direction flow: Forward and reverse flow indication and totalization
 - (5) Totalizers: Three 9 digit totalizers for forward, reverse and net
 - (6) Mounting: Integral mounting on the flow meter.
 - (7) Enclosure: NEMA 4X Polypropylene with polycarbonate window
 - (8) Input Impedance: 1015 ohms.
 - (9) Isolation: Galvanic separation to 50V DC between analog, pulse/alarm, earth/ground.
 - (10) Current Output: Two standard 4-20 mA, galvanically isolated. Maximum loop resistance 750 W.
 - (11) Pulse Output: One standard 0-800Hz, <35VDC for forward and one for reverse.
 - (12) Contact Outputs: Two programmable as standard.
 - (13) Empty Pipe Detection: Required.
 - (14) Remote Communications capability: Shall be capable of RS232/485, and HART Protocol, where required.

SECTION 13420 – PRIMARY SENSORS AND FIELD INSTRUMENTS

- (15) Low flow cut off: Adjustable
- (16) Power consumption: < 20VA
- (17) Cable supplied: 30 feet minimum of shielded transmitter cable. Meter shall only require one cable and conduit between sensor and transmitter.
- (18) Maximum Cable length: 330 feet with standard cable, longer separation possible.
- (e) Calibration:
 - (1) Test Mode: Provide the ability to verify the accuracy of the unit and the integrity of the current loop without any external equipment.
 - (2) Self-diagnostics: Internal checks of all outputs and displays.
 - (3) Meter calibration shall be in accordance with OIML R49 Type P, self-calibration requirements.
 - (4) Meter must be able to periodically generate simulated signals that verify that the output is within predefined limits.
 - (5) Coil inductance and resistance along with electrode voltage and impedance must be verifiable through diagnostic functionality
 - (6) Warnings and Alarms: Shall be classified to NAMUR NE 107 standards. Meter must have ability to display severity of warning with "maintenance, check-function, failure and out of spec" warning indications.
 - (7) Alarm priorities shall be classified as: "None; Maintenance; Out-of-spec; Function check; and Error."
 - (8) The quantity of occurrences, total time duration of the alarm occurrences, and time since last occurrence.
 - (9) All replacement transmitters shall be interchangeable without need for programming sensor calibration factors, meter size, site information, and serial numbers
 - (10) In-Situ Calibration Verification: This system shall be used to verify in a quantifiable manner the meter's current conditions versus the meter's condition when originally manufactured. This calibration verification of the meter shall be performed without need for physical access to the meter flow tube. The calibration verification shall meet or exceed the following requirements:
 - (11) The original FINGERPRINT values shall be stored on a computer disk given to the owner.
 - (12) The verification process shall consist of at least 52 meter conditions pertaining to the primary coils, electrodes, interconnecting cable and signal converter.
 - (13) The coil verification shall include faults of continuity, impedance, resistance to ground, inductance, and magnetic field strength.
 - (14) The electrode verification shall include faults of continuity, impedance and insulation.
 - (15) The cable verification shall include faults of coil, electrode, driven shield, and ground connections, cable cuts, cable damage, and water in the cable.
 - (16) Signal converter verification shall include faults of current supply to coils, zero offset, span forward and reverse, electrode offset, current output, frequency output forward and reverse, driven shield to ground, overall shield to ground and signal ground connection to ground.
 - (17) The calibration verification shall include the following: water ingress into the primary elements, faulty electrodes, dirty electrodes, electrode leakage, corroded electrodes, high process noise, liner failure, conductive coatings on the liner, insulating coatings on the liner, and primary element damage.

- (18) All tests shall be performed by means of comparison between the absolute values and change in values from the new conditions.
- (19) Verification standard shall be 1% of wet calibration for meters produced using the calibration verification service, or 2% for standard meters.
- (20) The software shall be Windows based. This software shall be capable of generating a report based upon the result of the forgoing described tests. The software shall be capable of creating and storing an audit trail of the meter's conditions and the meter's history.
- (21) The calibration verification and metering system shall meet or exceed the standards established by the National Testing Laboratories.
- (22) Meters to be designed, manufactured, and calibrated in an ISO9001, UKAS/NAMAS, NIST, or NATA certified facility. Flow facility must be certified by volume or weight certified provers. Facility must have the capability to hold the flow rate at the specified calibration points for a minimum of five minutes to allow stabilization for flow and repeatability point checks.

2.03 PAPERLESS CHART RECORDERS

- A. Furnish and install a paperless chart recorder in each of the four pump stations as shown on the plans and specified herein. The chart recorders shall record and display sanitary flow data from the flow meters. The recorders shall store historical flow data over time and can be configured by the end user to display various summaries of the data in real time.
- B. The flow recorder shall be model SM500F "field mountable paperless recorder" as manufactured by ABB, or approved equal.
- C. The recorder shall have at least 64MB of internal flash memory and be capable of logging data to a removable SD card.
- D. The Contractor shall provide an SD card which is compatible with the recorder with a capacity of at least 1GB, but not greater than 2GB. The SD card shall be of the "high endurance" type as manufactured by Transcend, or approved equal. The card shall be capable of operation in the temperature range -25C to 85C and intended for continuous data writing. Common "consumer grade" SD cards which are not intended for continuous data writing are not acceptable.
- E. The recorder shall have a Color TFT, liquid crystal display with built-in backlight and contrast adjustment.
- F. The recorder shall come standard with one (1) universal input and a manufacturer option for up to three (3) additional inputs. For this project, a total of one (1) input is required.
- G. The recorder universal input(s) shall be capable of receiving either analog or digital input data. The recorder shall be suitable for a number of common varieties of analog signals including:
 - 1. Millivolt Input (0 to 150mV)
 - 2. Milliamp Input (0 to 50 mA)
 - 3. Volt Input (0 to 25V)
 - 4. Resistance Input, Low (0 to 550 Ω)
 - 5. Resistance Input, High (0 to 10k Ω)
- H. The recorder shall come standard with at least one (1) relay output signal
- I. The recorder shall be capable of totalizing flow volumes and maintaining two (2) cumulative total flow values. One of the totals shall be resettable back to zero by the end user however the other total will not reset under normal operation.

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- J. The recorder shall be capable of displaying various graphs such that the Operator can visualize the variation of flow rate over time.
- K. The recorder enclosure shall be NEMA 4X with glass-filled polycarbonate case. The recorder shall be capable of continuous operation in the temperature range -10C to 50C.
- L. The recorder dimensions shall be 5.7" x 5.7" x 3.22" (width x height x depth).
- M. The recorder shall be wall-mounted 5' above the ground or floor, unless otherwise noted on the Drawings. The Contractor shall utilize the mounting hardware kit from the manufacturer unless otherwise approved by the engineer.

2.04 PRESSURE LIQUID LEVEL SENSORS

- A. One (1) Ametek 575P, or approved equal, pressure level transmitter with stainless steel base shall be installed in the wet well at the Knott Drive Pump Station in accordance with the manufacturer's recommendations.
- B. Provide (1) spare pressure level transmitter.
- C. Install with manufacturer recommended mounting hardware and provide stainless steel strain relief for electrical/control cables. Neatly coil and secure at least 3' of excess power/control cable near the strain relief support.

2.05 LIQUID LEVEL FLOAT SWITCHES

- A. Provide 2 non-mercury filled polypropylene level float switches with internal weights mounted in the wet wells at Knott Drive, Viola Drive, and Morgan Park pump stations.
- B. Provide (4) four spare level float switches.
- C. Floats shall have an electrical rating of 7A @ 120V ac.
- D. Provide 40' of cable for connection in a junction box adjacent to the pump station. At the Morgan Park Pump Station the length of the cables shall be longer as required to extend to the junction box mounted on the wall of the pump station as shown on the plans.
- E. Floats shall be ECO-Float Model GS1 as manufactured by Anchor Scientific, Inc. or equal.
- F. The level sensors shall be mounted at a level in the wet wells as shown on the plans to monitor:
 - 1. High - High Water Alarm
 - 2. Low - Low Water Alarm
- G. Install in accordance with manufacturer's recommendations with manufacturer recommended stainless steel mounting hardware and stainless-steel strain relief supports. Neatly coil and secure at least 3' of excess power/control cable near the strain relief support.

2.06 GAUGE PRESSURE TRANSMITTERS

- A. Type
 - 1. Microprocessor based, intelligent type.
 - a. Function/Performance
 - 1) Range: Range of the transmitter shall be the standard range of the manufacturer closest to the pressure range to be metered.
 - 2) Accuracy: 0.075 percent of span.
 - 3) Operating Temperature: -20 to 80 degrees C.
 - 4) Temperature Effect: Combined temperature effects shall be less than 0.2 percent of maximum span per 28 degrees C temperature change.
 - 5) Output: 4-20 mA DC linear with pressure, with HART protocol. Zero adjustable over the range of the instrument provided calibrated span is greater than the minimum calibrated span.
 - 6) Stability: 0.05 percent of upper range limit for 1 year.
 - 7) Display: Digital indicator displaying pressure.
 - 8) Diagnostics:

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- (a) Self-diagnostics with transmitter failure driving output to above or below out of range limits.
 - (b) Simulation capability for inputs and loop outputs.
 - (c) Test terminals available to ease connection for test equipment without opening the loop.
 - (d) Registers to record minimum and maximum pressure and temperatures transmitter has been exposed to shall be available.
 - (e) Run-time clock available to determine usage for warranty purposes. 5-year warranty on this clock reading is included.
 - (f) Over Range Protection: Provide positive over range protection to 150 percent of the maximum pressure of the system being monitored by the instrument.
 - (g) If required to meet the range or suppression/elevation requirements, a differential pressure transmitter shall be provided.
- b. Physical
 - 1) Enclosure: NEMA 4X (IP66), explosion proof, approved for Class I, Division 1, Groups C and D (EEx d IIC T5).
 - 2) Process Wetted Parts: Isolating diaphragm and other wetted metal parts shall be Type 316L stainless steel, unless otherwise indicated in the device schedule. Gaskets and O rings shall be Teflon.
 - 3) Power Supply: 24 VDC loop power.
 - 4) Sensor Fill Fluid: Silicone.
- c. Accessories Required
 - 1) Provide span and zero adjustment at each transmitter and through the handheld programming unit.
 - (a) Configuration of the transmitter may be accomplished using the local display and pushbuttons without the use of an external programming device.
- d. Manufacturers
 - 1) Smar
 - 2) ABB
 - 3) Rosemount
 - 4) Foxboro
 - 5) Siemens Sitrans
 - 6) Or equal.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Contractor shall require the system supplier to furnish the services of qualified factory-trained servicemen to assist in the installation of the instrumentation and control system equipment.
- B. Install each item in accordance with manufacturer's recommendations and in accordance with the Contract Documents. Transmitters and instruments, which require access for periodic calibration or maintenance, shall be mounted so they are accessible while standing on the floor. Care shall be taken in the installation to ensure sufficient space is provided between instruments and other equipment or piping to allow for easy removal and servicing.
- C. All items shall be mounted and anchored using stainless steel hardware, unless otherwise noted.
- D. All field instruments shall be rigidly secured to walls, stands or brackets as required by the manufacturer and as shown.
- E. Conform to all applicable provisions of the NEMA standards, NEC and local, State and Federal codes when installing the equipment and interconnecting wiring.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. This section describes the general requirements for all mechanical items and systems required by the Contract Documents.
- B. Comply with all Contract Requirements, General Conditions, Supplementary Conditions and Division 1 Sections applying to or affecting the Work of Division 15.
- C. Unless specifically dimensioned, the Work shown on the Drawings is in diagrammatic form only to show general arrangement.
- D. Include, in the Work, all accessories and appurtenances, necessary and integral, for the intended operation of any system, component or device, as such systems, components and devices are specified.
- E. Do not install pipe or conduit through ductwork.
- F. If the pipe or duct size shown on the Drawings does not match the connection size of the equipment that it is connected to, provide the necessary transition pieces at the piece of equipment.
- G. Do not use or allow to be used asbestos or asbestos-containing materials on this project. Be rigorous in assuring that all materials, equipment, systems and components thereof do not contain asbestos. Any deviations from this requirement shall be remedied at the Contractor's expense without regard to prior submittal approvals.

1.02 RELATED DOCUMENTS

- A. The General Conditions and General Requirements Division 1 apply to the Work of this Section.

1.03 REFERENCE STANDARDS

- A. Compliance with the following codes and standards shall be required:
 - 1. Codes, Rules and Regulations of the State of New York
 - 2. USAS USA Standards Institute (Formerly ASA)
 - 3. AMCA Air Moving and Conditioning Association
 - 4. ADC Air Diffusion Council
 - 5. NEMA National Electrical Manufacturers Association
 - 6. FM Factory Mutual
 - 7. NFPA National Fire Protection Association
 - 8. ASTM American Society for Testing Materials
 - 9. UL Underwriters Laboratories, Inc.
 - 10. NEC National Electrical Code
 - 11. ASME American Society of Mechanical Engineers
 - 12. ANSI American National Standards Institute
 - 13. OSHA Occupational Safety and Health Act
 - 14. BSA Board of Standards and Appeals
 - 15. MEA Materials and Equipment Acceptance
 - 16. DEC New York State Department of Environmental Conservation - 6 NYCRR Part 613 Handling and Storage of Petroleum
 - 17. ASHRAE American Society of Heating, Refrigeration and Air Conditioning Engineers.
 - 18. AWWA American Water Works Association

SECTION 15010 – GENERAL MECHANICAL REQUIREMENTS

19. MSS	Manufacturer's Standardization Society of the Valve and Fitting Industry
20. ARI	American Refrigeration Institute
21. SMACNA	Sheet Metal and Air Conditioning Contractor's National Association
22. TEMA	Tubular Exchanger Manufacturers Association
23. F.S. or FED	Spec. Federal Specification
24. ASA	Acoustical Society of America
25. NACE	National Association of Corrosion Engineers
26. ASSE	American Society of Sanitary Engineers
27. New York State Building Code	
28. New York State Fire Code	
29. New York State Existing Building Code	
30. New York State Fuel Gas Code	
31. New York State Plumbing Code	
32. New York State Energy Conservation Code	
33. New York State Mechanical Code	
34. New York State Industrial Code Rules	
35. IRI	Industrial Risk Insurers
36. AGA	American Gas Association
37. AABC	American Air Balance Council
38. NEBB	National Environmental Balancing Bureau
39. AWS	American Welding Society

1.04 DEFINITIONS

- A. "Provide" means furnish and install, complete the specified material, equipment or other items and perform all required labor to make a finished installation.
- B. "Furnish and install" has the same meaning as given above for "Provide."

1.05 Refer to General Conditions for other definitions.

1.06 ABBREVIATIONS

- A. Reference by abbreviation may be made in the Specifications and the Drawings in accordance with the following list:
 - 1. HVAC Heating, Ventilating and Air Conditioning
 - 2. CM Construction Manager
 - 3. AC Air Conditioning
 - 4. H & V Heating and Ventilating
 - 5. AWG American Wire Gauge
 - 6. BWG Birmingham Wire Gauge
 - 7. USS United States Standard
 - 8. B & S Brown & Sharpe
 - 9. OS & Y Outside Screw and Yoke
 - 10. IBBM Iron Body Brass Mounted
 - 11. WSP Working Steam Pressure

SECTION 15010 – GENERAL MECHANICAL REQUIREMENTS

12. PSIG	Pounds per Square Inch Gauge
13. PRV	Pressure Reducing Valve
14. GPM	Gallons per Minute
15. MBH	Thousand BTU per hour
16. BTU	British Thermal Units
17. WG	Water Gage
18. LB	Pound (Also shown as: #)
19. ASME	American Society of Mechanical Engineers
20. ASTM	American Society for Testing Materials
21. ABMA	American Boiler Manufacturers Association
22. ASA	American Standards Associates
23. MER	Mechanical Equipment Room

See Drawings for additional abbreviations

1.07 REVIEW OF CONTRACT DOCUMENTS AND SITE

- A. Give written notice with the submission of bid to the Architect/Engineer of any materials or apparatus believed inadequate or unsuitable, in violation of laws, ordinances, rules or regulations of Authorities having jurisdiction, and any necessary items of work omitted. In the absence of such written notice, it is mutually agreed that the Contractor has included the cost of all required items in his proposal for a complete project.
- B. Contractors shall acknowledge that they have examined the Plans, Specifications and Site, and that from his own investigations he has satisfied himself as to the nature and location of the Work; the general and local conditions, particularly those bearing upon transportation, disposal, handling and storage of materials; availability of labor, utilities, roads and uncertainties of weather; the composition and condition of the ground; the characters quality and quantity of subsurface materials to be encountered; the character of equipment and facilities needed preliminary to and during the execution of the Work; all federal, state, county, township and municipal laws, ordinances and regulations particularly those relating to employment of labor, rates of wages, and construction methods; and all other matters which can in any way affect the Work or the cost thereof under this Contract. Any failure by the Contractor to acquaint himself with the available information concerning these conditions will not relieve him from the responsibility for successfully performing the Work.
- C. Owner assumes no responsibility for any understanding or representation made during or prior to the negotiation and execution of this Contract unless such understanding or representations are expressly stated in the Contract and the Contract expressly provides that the responsibility, therefore, is assumed by the Owner.

1.08 MEASUREMENTS

- A. Base all measurements, both horizontal and vertical from established bench marks. Make all Work agree with these established lines and levels. Verify all measurements at site; and check the correctness of same as related to the Work.

1.09 LABOR AND MATERIALS

- A. Provide all materials and apparatus required for the Work of new and first-class quality. Furnish, deliver, arrange, erect, connect and finish all materials and equipment in every detail, so selected and arranged as to fit properly into the building spaces.
- B. Remove all materials delivered, or work erected, which does not comply with Drawings or Specifications, and replace with proper materials, or correct such work as directed, at no additional cost to the Owner.

SECTION 15010 – GENERAL MECHANICAL REQUIREMENTS

1.10 COVERING OF WORK

- A. Do not cover up or hide from view any duct, piping, fitting, or other work of any kind before it has been examined or approved by the Architect/Engineer and/or other authority having jurisdiction over the same. Remove and correct immediately any unacceptable or imperfect work or unauthorized or disapproved materials discovered immediately after being disapproved.

1.11 PROTECTION

- A. Protect the Work and material of all trades from damage and replace all damaged material with new.
- B. Protect work and equipment until the Work is finally inspected, tested, and accepted; protect the Work against theft, injury or damage; and carefully store material and equipment received on site which is not immediately installed; close open ends of work with temporary covers or plugs during construction to prevent entry of foreign material.
- C. Preserve all public and private property, along and adjacent to the Work, and use every precaution necessary to prevent damage or injury thereto. Use suitable precautions to prevent damage to pipes, conduits and other underground structures or utilities, and carefully protect from disturbance or damage all property marks until an authorized agent has witnessed or otherwise referenced their location, and do not remove them until directed.

1.12 CUTTING AND PATCHING

- A. Provide all cutting and rough patching required for the Work. Perform all finish patching.
- B. Furnish and locate all sleeves and inserts required before the floors and walls are built, pay the cost of cutting and patching required for pipes where sleeves and inserts were not installed in time, or where incorrectly located. Provide all drilling required for the installation of hangers.
- C. Punch or drill all holes cut through concrete slabs or arches from the underside. Do not cut structural members without the approval of the Architect/Engineer. Perform all cutting in a manner directed by the Architect/Engineer.
- D. Do not do any cutting that may impair strength of building construction. Do not drill any holes, except for small screws, in beams or other structural members without obtaining prior approval. All Work shall be done in a neat manner by mechanics skilled in their trades and as approved.

1.13 SUBMITTALS

- A. Submit for review, shop drawings for all materials and equipment furnished and installed under this Contract. Submissions shall include but not be limited to:
 - 1. Ductwork layout drawings, air devices and accessories
 - 2. Breeching layout drawings
 - 3. Piping and equipment layout drawings.
 - 4. Piping materials, valves, hangers, supports and accessories
 - 5. Automatic temperature control equipment, diagrams and control sequences
 - 6. Equipment, fixtures, and appurtenances
 - 7. Insulation
 - 8. Rigging Plan - Include the name of the rigging company; a layout drawing that details the crane with its outriggers extended outward. Provide dimensions showing how rigging operations will affect the road and parking lines being used, the type of crane and its specification including crane arm height, lift capacity, crane reach.
 - 9. Piping freeze protection system.
 - 10. Staging, sequencing of work and maintenance of plant operations.
- B. Reports
 - 1. Compliance with listings and approvals for equipment and for fire ratings.
 - 2. Acceptance certificates from inspecting agencies.

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3. Complete printed and illustrated operating instructions in report format.
 4. Manufacturer's performance tests of equipment.
 5. Field pipe and duct testing reports.
 6. Field operating test results for equipment.
 7. Performance report on the balancing of air and water systems.
 8. Performance reports for vibration isolation equipment.
 9. Manufacturer's reports on motorized equipment alignment and installation.
- C. Specific references to any article, device, product or material, fixture or item of equipment by name, make or catalog number shall be interpreted as establishing a basis of cost and a standard of quality. All devices shall be of the make and type listed by Special Agencies, such as the Underwriters' Laboratories, and where required, approved by the Fire Department.

1.14 SPACE ALLOTMENTS AND SUBSTITUTIONS

- A. The space allotments and equipment layouts on the Drawings are based on the manufacturer's model indicated or scheduled as the "Basis of Design". Ensure that any equipment that is submitted other than the "Basis of Design" will fit in the space allotment and will provide the necessary maintenance clearances as recommended by the manufacturer. If maintenance clearances are not met, pay for any changes such that maintenance clearances will be met.
- B. Bear all costs associated with re-layout of the equipment, changes to piping/ductwork, and other changes as required if approved equipment other than the "Basis of Design" equipment is purchased. This shall also include any structural steel modifications and structural steel design changes. Submit, at no cost to the Owner, a steel design stamped by a structural engineer licensed in the state in which the Work is to be performed for structural modifications that must be made resulting from the use of equipment other than the "Basis of Design" or not specified.

1.15 PAINTING

- A. Prime paint all bare supplemental steel, supports and hangers required for the installation of Division 15 Work in accordance with "Painting" Specification Section. Touch up welds of galvanized surfaces with galvanizing primer.

1.16 MATERIAL SAFETY DATA SHEETS

- A. Submit material safety data sheets (MSDS) for all chemicals, hydraulic fluids, seal oils, lubricating oils, glycols and any other hazardous materials used in the performance of the Work, in accordance with the US Department of Labor, Occupational Safety and Health Administration (OSHA) hazard communication and right-to-know requirements stipulated in 29 CFR 1910.1200 (g).

1.17 MOTORS AND STARTERS

- A. Provide new NEMA Standard electric motors, sized and designed to operate at full load and full speed continuously without causing noise, vibration, and temperature rise in excess of their rating. Provide motors with a service factor of at least 1.15.
- B. Equip motors for belt driven equipment with rails with adjusting screws for belt tension adjustment. Weather protect motors exposed to the weather.
- C. Install high efficiency electric motors for air handling units, relief fans, and exhaust fans.
- D. Provide all motors for use with Variable Frequency Drives with "high efficiency inverter duty" insulation class "F" with class "B" temperature rise and that conform to or exceed the International Energy Conservation Code or the Federal EP Act of 1992 requirements for efficiency.
- E. Provide stainless steel nameplates, permanently attached to the motor, and having the following information as a minimum:
 1. Manufacturer
 2. Type
 3. Model

SECTION 15010 – GENERAL MECHANICAL REQUIREMENTS

4. Horsepower
 5. Service Factor
 6. RPM
 7. Voltage/Phase/Frequency
 8. Enclosure Type
 9. Frame Size
 10. Full-Load Current
 11. UL Label (where applicable)
 12. Lead Connection Diagram
 13. Bearing Data
 14. Efficiency at Full Load.
- F. Provide motors whose sound power levels do not exceed that recommended in NEMA MG 1-12.49.
- G. Provide motors with drive shafts long enough to extend completely through belt sheaves when sheaves are properly aligned and balanced.
- H. Protect motor starters on equipment located outdoors in weatherproof NEMA 4X enclosures.
- I. Provide weatherproof NEMA 4X disconnect switches when located outdoors.
- J. Motor Characteristics:
1. 120V/1/60 Hz, 208V/1/60 Hz or 240V/1/60 Hz: Capacitor start, open drip-proof type, ball bearing, rated 40 C. continuous rise.
 2. 208V/3/60 Hz, 240V/3/60 Hz or 460/3/60 Hz: NEMA B, normal starting torque, single speed, squirrel-cage type, open drip-proof, rated 40 C continuous rise, with ball bearings rated for B-10 life of 100,000 hours and fitted with grease fittings and relief ports. Provide motors with aluminum end brackets with steel inserts in bearing cavities.

1.18 ACOUSTICAL PERFORMANCE OF EQUIPMENT AND SYSTEMS

- A. Install the Work in such a manner that noise levels from operation of motor driven equipment, whether airborne or structure-borne, and noise levels created by or within air handling equipment and air distribution and control media, do not to exceed sound pressure levels determined by the noise criteria curves published in the ASHRAE guide.
- B. Acoustical Tests
1. Owner may direct the Contractor to conduct sound tests for those areas he deems too noisy.
 2. If NC level exceeds the requirements of the Contract Documents due to improper installation or operation of mechanical systems, make changes or repairs to bring noise levels to within required levels.
 3. Retest until specified criteria have been met.

1.19 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Instructions and Demonstration for Owner's Personnel
1. Provide operating and maintenance instruction to the Owner when project is completed and all HVAC equipment serving the building is ready to be turned over to the Owner.
 2. Turn over the HVAC equipment to the Owner only after the final testing and proper balancing of HVAC systems.
 3. Instruct the Owner's personnel in the use, operation and maintenance of all equipment of each system.
 4. The above instruction requirements are in addition to that specified for specific equipment or systems. Conform to specified requirements if more stringent or longer instruction is specified for specific equipment or systems.

SECTION 15010 – GENERAL MECHANICAL REQUIREMENTS

1.20 CODES, RULES, PERMITS & FEES

- A. Give all necessary notices, obtain all permits and pay all government sales taxes, fees, and other costs, in connection with the Work. Unless indicated otherwise, fees for all utility connections, extensions, and tap fees for water, storm, sewer, gas, telephone, and electricity will be paid directly to utility companies and/or agencies by the Owner. File all necessary plans, prepare all documents and obtain all necessary approvals of all governmental departments having jurisdiction; obtain all required certificates of inspection for the Work and deliver same to the Owner's Representative before request for acceptance and final payment for the Work.
- B. Conform to the requirements of the NFPA, NEC, FM, UL and any other local or State codes which may govern.

1.21 RECORD DRAWINGS

- A. During the progress of the Work, make a record set of drawings of all changes by which the actual installation differs from the Drawings.
- B. Create all record drawings in AutoCAD version 2017 or later in .dwg format. Upon completion of the Work, submit to the Architect/Engineer for approval three complete sets of hard copies of the record drawings, of the same size as the Drawings for approval. Upon approval by the Architect/Engineer furnish the Owner a CD copy of the record drawings along with one hard copy for his records.

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 CLEANING AND ADJUSTING

- A. Cleaning
 - 1. Blow out, clean and flush each system of piping and equipment, to thoroughly clean the systems.
 - 2. Clean all materials and equipment; leave in condition ready to operate and ready to receive final finishes where required.
 - 3. Clean the operating equipment and systems to be dust free inside and out.
 - 4. Clean concealed and unoccupied areas such as plenums, pipe and duct spaces and equipment rooms to be free of rubbish and dust.
- B. Adjusting
 - 1. Adjust and align equipment interconnected with couplings or belts.
 - 2. Adjust valves of all types and operating equipment of all types to provide proper operation.
 - 3. Clean all strainers after system cleaning and flushing and again before system startup.
- C. Lubrication
 - 1. Lubricate equipment as recommended by the manufacturer, during temporary construction use.
 - 2. Provide complete lubrication just prior to acceptance.
- D. Permanent Equipment Operating During Construction
 - 1. Use only in same service as the permanent applications.
 - 2. Use disposable filters during temporary operation.
 - 3. Replace expendable media, including belts used for temporary operation and similar materials just prior to acceptance of the Work.
 - 4. Repack packing in equipment operated during construction just prior to system acceptance, using materials and methods specified by the equipment manufacturer.
- E. Retouch or repaint equipment furnished with factory finish as required to provide same appearance as new.

SECTION 15010 – GENERAL MECHANICAL REQUIREMENTS

F. Tools

1. Provide one set of specialized or non-standard maintenance tools and devices required for servicing the installed equipment.

3.02 EQUIPMENT BASES, PLATFORMS AND SUPPORTS

- A. Provide supporting platforms, steel supports, anchor bolts, inserts, etc., for all equipment and apparatus provided.
- B. Obtain prior approval for installation method of structural steel required to frame into building structural members for the proper support of equipment, conduit, etc. Welding will be permitted only when approved by the Architect/Engineer.
- C. Submit shop drawings of supports to the Architect/Engineer for approval before fabricating or constructing.
- D. Provide leveling channels, anchor bolts, complete with nuts and washers, for all apparatus and equipment secured to concrete pads and further supply exact information and dimensions for the location of these leveling channels, anchor bolts, inserts, concrete bases and pads.
- E. Where supports are on concrete construction, take care not to weaken concrete or penetrate waterproofing.

3.03 ACCESSIBILITY

- A. Install valves, dampers and other items requiring access conveniently and accessibly located with reference to the finished building.

3.04 USE OF EQUIPMENT

- A. The use of any equipment, or any part thereof, even with the Owner's consent, is not an indication of acceptance of the Work on the part of the Owner, nor shall it be construed to obligate the Owner in any way to accept improper work or defective materials.

3.05 MODIFICATIONS OF EXISTING WORK

- A. Coordinate the Work with all other contractors and provide necessary dimensions for all openings. Provide all cuts and openings which are necessary for the Work for passage of piping and ductwork
- B. Upon completion, remove all temporary piping and equipment, shoring, scaffolds, etc., and leave all areas clean and free from material and debris resulting from the Work performed under this Section. Provide rough patching in areas required.

3.06 EQUIPMENT INSTALLATION

- A. Locate and set equipment anchor bolts, dowels and aligning devices for equipment requiring them.
- B. Level and shim the equipment; coordinate and oversee the grouting work.
- C. Perform field assembly, installation and alignment of equipment under direct supervision provided by the manufacturer or with inspections, adjustments and approval by the manufacturer.
- D. Alignment and Lubrication Certification for Motor Driven Apparatus
 1. After permanent installation has been made and connections have been completed, but before the equipment is continuously operated, have a qualified representative of the equipment manufacturer inspect the installation and report in writing on the manufacturer's letterhead on the following:
 - a. Whether shaft, bearing, seal, coupling, and belt drive alignment and doweling is within the manufacturer's required tolerances so that the equipment will remain aligned in the normal service intended by the Contract Documents and that no strain or distortion will occur in normal service.
 - b. That all parts of the apparatus are properly lubricated for operation.
 - c. That the installation is in accordance with manufacturer's instructions.

SECTION 15010 – GENERAL MECHANICAL REQUIREMENTS

- d. That suitable maintenance and operating instructions have been provided for the Owner's use.
 - e. Make any corrections to items that are required or recommended based on the manufacturer's inspection and have the equipment re-inspected.
- E. Belt Drives
 - 1. V-belt drives - a driving and driven sheave grooved for belts of trapezoidal cross-section. Construct belts of fabric and rubber so designed so as not to touch the bottom of the grooves, the power being transmitted by the contact between the belts and V-shaped groove sides. Design drives for a minimum of 150 percent of motor horsepower. Provide companion type driven sheaves.
 - 2. Select drives to provide for 12-1/2 percent variation in speed, plus or minus, from specified speed. Provide all motors with adjustable sheaves except where indicated otherwise in the Specifications or on the Drawings.
 - 3. Install all fans with adjustable pitch sheaves on their drive motors. Select sheaves to provide air quantities under specified conditions. Put air systems into operation, and determine as a result of the completed air balance the actual size of sheaves required to produce specified air quantities on installed systems. The adjustable pitch sheaves shall then be replaced with the proper size fixed sheaves. Remove adjustable pitch sheaves from premises. Provide fixed motor sheaves manufactured by Wood's.
 - 4. Where indicated on the Drawings or specified, provide spare motor, bearings, and belts.
- F. Machinery Guards
 - 1. Protect motor drives by guards furnished by the equipment manufacturer or in accordance with the Sheet Metal and Air Conditioning Contractors National Association's Low Pressure Duct Manual. Provide guards of all types approved as acceptable under OSHA Standards.
- G. Equipment Start-up
 - 1. Require each equipment manufacturer to provide qualified personnel to inspect and approve equipment and installation and to supervise the start-up of the equipment and to supervise the operating tests of the equipment.
 - 2. For Pre-Manufactured Piping Systems, a manufacturers representative shall be onsite to verify that offloading and storage is being performed properly. The representative shall also perform a training with the contractor on how to properly weld the premanufactured system.
 - 3. The representative shall perform a minimum of 5 site visits throughout the construction of the system.
 - 4. If a minimum number of hours for start-up and instruction are not stated with the equipment specifications, these shall be 2 full 8-hour working days as a minimum.
 - 5. Advise Owner of start-up at least 72 hours in advance.

3.07 CLOSEOUT PROCEDURES

- A. General Operating and Maintenance Instructions: Arrange for each installer of operating equipment and other work that requires regular or continuing maintenance, to meet at the site with the Owner's personnel to provide necessary basic instructions in the proper operation and maintenance of the entire Work. Where installers are not expert in the required procedures, include instruction by the manufacturer's representatives.
- B. Where applicable, provide instruction and training, including application of special coatings systems, at manufacturer's recommendation.
- C. Provide a detailed review of the following items:
 - 1. Maintenance manuals
 - 2. Record documents and catalog cuts for each piece of equipment.
 - 3. Spare parts and materials

SECTION 15010 – GENERAL MECHANICAL REQUIREMENTS

4. Tools
 5. Lubricants
 6. Fuels
 7. Identification systems
 8. Control sequences
 9. Hazards
 10. Cleaning
- D. Warranties, bonds, maintenance agreements, and similar continuing commitments.
- E. Demonstrate the following procedures:
1. Start-up
 2. Shut-down
 3. Emergency operations
 4. Noise and vibration adjustments
 5. Safety procedures
 6. Economy and efficiency adjustments
 7. Effective energy utilization.
- F. Prepare instruction periods to consist of approximately 50% classroom instruction and 50% "hands-on" instruction. Provide minimum instruction periods as follows:

Systems or Equipment	Training Time (Hours)
All other equipment	4 hrs. (each)

Note: Consult individual equipment specification sections for additional training requirements.

- G. Prepare a written agenda for each session and submit for review and approval. Include date, location, purpose, specific scope, proposed attendance and session duration.
- H. Record training sessions in digital format, format as selected by the Owner. Turn over digital files to the Owner after training has been completed.

END OF SECTION

SECTION 15015 – MECHANICAL DEMOLITION

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. This Section describes the draining, disconnecting, dismantling, demolition, removal, relocation, rerouting and reconnection of existing mechanical facilities, in a neat and workmanlike manner, of mechanical systems, materials and accessories as required, as shown on the Drawings and specified herein, to accomplish alteration, restoration and to accommodate the Work.

1.02 RELATED WORK

- A. General Mechanical Requirements - Section

1.03 REFERENCES

- A. NFPA Fire Code
- B. ANSI A10.6 - Safety Requirements for Demolition
- C. National Association of Demolition Contractors (NADC) - Demolition Safety Manual
- D. NFPA 51B - Cutting and Welding Processes
- E. NFPA 70 - National Electrical Code
- F. NFPA 241 - Safeguarding Building Construction and Demolition Operations
- G. OSHA 29 CRF 1910 - Occupational Safety and Health Standards
- H. US EPA - Clean Air Act Amendment of 1990.

1.04 SUBMITTALS

- A. Demolition Schedule
- B. Fire Watch Procedures
- C. Inspection Report of Underground Piping Systems
- D. Welding/Burning Permit - Obtain a welding/burning permit from the local Fire Official prior to the start of any welding or burning in accordance with the local Fire Code or as required by the Owner.

1.05 QUALITY ASSURANCE

- A. Only employ workers skilled in the specific trades involved for cutting, patching and removal.
- B. Job Conditions: Prior to start of the Work, make an inspection accompanied by the Architect/Engineer to determine physical condition of adjacent construction that is to remain.

1.06 SPECIAL PRECAUTIONS

- A. Do not torch cut ductwork.
- B. Torch cutting of other mechanical equipment will be permitted only with the specific written approval of the Architect/Engineer.
- C. Include "Fire Watch" procedures as required by the Fire Code and/or Owner's Fire Insurance Carrier for any cutting work that may produce sparks. Submit fire watch procedures for approval.
- D. Perform draining operations so that damage to existing building components does not occur.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Adequately sized rubbish containers for the proper and safe disposal of all debris.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Construct temporary partitions enclosing respective work prior to any demolition work. Erect temporary fencing and signage around demolished materials.
- B. Protect existing materials and equipment which are not to be demolished.

SECTION 15015 – MECHANICAL DEMOLITION

- C. Prevent movement of structure; provide required bracing and shoring.
- D. Do not begin the work until the time schedules and manner of operations have been approved by the Architect/Engineer and Owner. Include all interruptions of existing services in schedules submitted for approval by the Architect/Engineer and Owner.

3.02 GENERAL

- A. Provide alteration and demolition of mechanical facilities as required by the Drawings and Specifications. The Drawings are diagrammatic and do not show the exact location of all existing mechanical work. Where existing equipment is to remain in service during construction, provide rerouting and reconnection of mechanical services as required to maintain continuous service.
- B. Review all equipment with the Architect/Engineer and Owner prior to disposal. Completely remove existing ductwork, piping, conduit and similar items to be abandoned that are not embedded in walls or floor slabs unless otherwise shown on the Drawings. Cap open ends at all walls and floors.
- C. Remove, store and protect all equipment or materials designated to be turned over to the Owner. Coordinate exact location of storage with the Owner.
- D. Temporarily cap ends of ductwork, piping and sanitary vent piping to avoid entry of dirt, debris, or discharge of foul odors and gases.
- E. Where existing louvers or ductwork penetrations are to remain, blank-off the opening on the inside with galvanized sheet metal on both sides of 2-inch thick, 6 pcf density rigid fiberglass board insulation. Paint side attached to the opening with weather resistant flat black paint.
- F. Do not close or obstruct egress width to exits.
- G. Do not disable or disrupt building fire or life safety systems without five (5) days prior written notice to the Architect/Engineer and Owner.
- H. Conform to procedures applicable when discovering hazardous or contaminated materials.
- I. Conduct demolition to minimize interference with adjacent building structures or Owner's operations.
- J. Cease operations immediately if structure appears to be in danger or hazardous materials are encountered. Notify Architect/Engineer. Do not resume operations until directed.
- K. Demolish in an orderly and careful manner. Do not cut or remove more than is necessary to accommodate the new construction or alteration.
- L. Remove demolished materials from site daily. Do not burn or bury materials on site. Dispose of all material at an approved disposal facility.
- M. Protect finished surfaces at all times and repair or replace, if damaged, to match existing construction to the satisfaction of the Architect/Engineer.

3.03 PIPING REMOVAL

- A. Cut off all welded piping square at the locations indicated on the Drawings. No cutting is required where the demolition ends at a flanged valve or equipment. Close off all openings of any remaining valves, piping or fittings with weld caps or blind flanges to prevent debris from entering the existing system.
- B. Disconnect all threaded piping at the location indicated on the Drawings. Close off all openings of remaining valves, piping, fittings and equipment with pipe plugs or pipe caps as required to prevent debris from entering the existing systems.
- C. Remove all pipe hangers, supports, miscellaneous steel and anchors with the piping.

3.04 PROTECTION FROM FREEZING

- A. It is intended that the building remain protected from damage due to freezing temperatures. To that end, keep in place and in operation existing equipment and systems used for heating until scheduling permits shutdown.

SECTION 15015 – MECHANICAL DEMOLITION

- B. Where the removal of equipment, etc. will leave an area unprotected from freezing, notify the Owner and Architect/Engineer at least 72 hours in advance prior to removal so appropriate steps can be taken by the Owner to protect the area. Provide temporary heating equipment sufficient to prevent freezing.
- C. It is the Contractor's responsibility to ensure that piping systems that are being worked on are completely drained from water prior to the start of demolition. If water is not drained and the water freezes it is the Contractor's responsibility to replace piping and repair all damages caused by water leakage at his own expense.

3.05 DISCONNECTION AND INTERRUPTION OF MECHANICAL SERVICES

- A. When portions of an existing piping system or ductwork system are removed, and this removal causes loss of operation to another piece of equipment due to open or disconnected piping or ductwork, cap piping or ductwork or provide temporary piping or ductwork system to retain operation of the system.

3.06 MECHANICAL EQUIPMENT REMOVAL

- A. Remove all mechanical equipment as shown on the Drawings. Remove all electrical work, including wiring between equipment, and wiring to power source or point of origin.
- B. Where equipment is supported by steel and/or structural supports, remove these supports.

3.07 DUCTWORK REMOVAL

- A. Disconnect all ductwork which must be removed, at the closest joint and support the remaining ductwork.
- B. Prepare all remaining ductwork joints at the point of disconnection to receive new ducts or blank-off panels.
- C. Remove all ductwork supports and miscellaneous steel with ductwork to be demolished.

3.08 INSULATION REMOVAL

- A. Remove insulation, together with all piping, fittings, valves and equipment designated for demolition.

END OF SECTION

SECTION 15051 – BURIED PIPING INSTALLATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to install and test all buried piping, fittings, and specials. The Work includes the following:
 - a. All types and sizes of buried piping, except where buried piping installations are specified under other Sections.
 - b. Unless otherwise shown or specified, this Section includes all buried piping Work required, beginning at the outside face of structures or structure foundations, including piping beneath structures, and extending away from structures.
 - c. Work on or affecting existing buried piping.
 - d. Installation of all jointing and gasket materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie rods, cathodic protection, and other Work required for a complete, buried piping installation.
 - e. Supports, restraints, and thrust blocks.
 - f. Pipe encasements, with the exception of the following, which are specified under Section 15052, Exposed Piping Installation:
 - 1) Piping embedded in concrete within a structure, or
 - 2) Piping embedded in a foundation.
 - (a) Field quality control, including testing.
 - (b) Cleaning and disinfecting.
 - (c) Incorporation of valves, meters, and special items shown or specified into piping systems in accordance with the Contract Documents and as required.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before buried piping Work.
2. Coordinate with appropriate piping Sections of Division 15, Mechanical.
3. Refer to Section 01711, Maintenance of Facility Operations, for constraints before developing laying schedules.

C. Related Sections:

1. Section 02200, Earthwork.
2. Section 03300, Cast-In-Place Concrete.
3. Section 09900, Painting.
4. Section 15061, Ductile Iron Pipe.
5. Section 15066, Copper Pipe.
6. Section 15080, Piping Insulation.
7. Section 15120, Couplings, Adapters, and Specials for Piping.
8. Section 15121, Wall Pipes, Floor Pipes, and Pipe Sleeves.

1.02 REFERENCES

A. Standards referenced in this Section are:

1. ASTM B32, Specification for Solder Metal.
2. ANSI/AWWA C105, Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. ANSI/AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
4. ANSI/AWWA C606, Standard for Grooved and Shouldered End Joints.
5. ANSI/AWWA C605, Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
6. AWWA M41, Ductile-Iron Pipe and Fittings.
7. ASCE 37, Design and Construction of Sanitary and Storm Sewers.
8. NFPA 24

SECTION 15051 – BURIED PIPING INSTALLATION

1.03 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with requirements and recommendations of authorities having jurisdiction over the Work.
 - 2. Obtain required permits for Work in roads, rights-of-way, railroads, and other areas of the Work.

1.04 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Laying schedules for concrete pipe and piping with restrained joints.
 - b. Details of piping, specials, joints, harnessing and thrust blocks, and connections to piping, structures, equipment, and appurtenances.
 - 2. Product Data:
 - a. Manufacturer's literature and specifications, as applicable, for products specified in this Section.
 - 3. Testing Procedures:
 - a. Submit proposed testing procedures, methods, apparatus, and sequencing. Obtain Engineer's approval prior to commencing testing.
- B. Informational Submittals: Submit the following:
 - 1. Certificates:
 - a. Certificate signed by manufacturer of each product certifying that product conforms to applicable referenced standards.
 - 2. Field Quality Control Submittals:
 - a. Results of each specified field quality control test.
- C. Closeout Submittals: Submit the following:
 - 1. Record Documentation:
 - a. Maintain accurate and up-to-date record documents showing modifications made in the field, in accordance with approved submittals, and other Contract modifications relative to buried piping Work. Submittal shall show actual location of all piping Work and appurtenances at same scale as the Drawings.
 - b. Show piping with elevations referenced to Project datum and dimensions from permanent structures. For each horizontal bend in piping, include dimensions to at least three permanent structures, when possible. For straight runs of piping provide offset dimensions as required to document piping location.
 - c. Include profile drawings with buried piping record documents when the Contract Documents include piping profile drawings.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
 - 2. Upon delivery inspect pipe and appurtenances for cracking, gouging, chipping, denting, and other damage and immediately remove from Site and replace with acceptable material.
- B. Storage:
 - 1. Store materials to allow convenient access for inspection and identification. Store material off ground using pallets, platforms, or other supports. Protect packaged materials from corrosion and deterioration.
 - 2. Pipe and fittings specified herein may be stored outdoors without cover.
- C. Handling:
 - 1. Handle pipe, fittings, specials, and accessories carefully in accordance with pipe manufacturer's recommendations. Do not drop or roll material off trucks. Do not drop, roll or skid piping.
 - 2. Avoid unnecessary handling of pipe.

SECTION 15051 – BURIED PIPING INSTALLATION

3. Keep pipe interiors free from dirt and foreign matter.
4. Protect interior linings and exterior coatings of pipe and fittings from damage. Replace pipe and fittings with damaged lining regardless of cause of damage.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Piping materials are specified in the Schedules and/or shown on the Plans. Piping materials shall conform to Specifications for each type of pipe and piping appurtenances in applicable Sections of Division 15, Mechanical.
- B. General:
 1. Pipe Markings:
 - a. Factory-mark each length of pipe and each fitting with designation conforming to those on approved laying schedules.
 - b. Manufacturer shall cast or paint on each length of pipe and each fitting pipe material, diameter, and pressure or thickness class.
- C. Polyethylene Encasement:
 1. Polyethylene may be supplied in tubes or sheets.
 2. Polyethylene encasement materials shall be in accordance with ANSI/AWWA C105.

2.02 BURIED PIPING IDENTIFICATION

- A. Polyethylene Underground Warning Tape for Metallic Pipelines:
 1. Tracer tape shall be of inert, acid- and alkali-resistant, polyethylene, four mils thick, six inches wide, suitable for direct burial. Tape shall be capable of stretching to twice its original length.
 2. Message shall read, "CAUTION [insert customized name of pipe service, i.e., "POTABLE WATER", "SANITARY SEWER", "CHLORINE GAS", or other service as appropriate, as indicated in the Buried Pipe Schedule at the end of this Section] PIPE BURIED BELOW", with bold letters approximately two inches high. Messages shall be printed at maximum intervals of two feet. Tape shall be custom colored the same as pipeline colors specified for associated pipe service in Section 09910, Painting.
 3. Manufacturer: Provide products of one of the following:
 - a. Brady Corporation
 - b. Seton Identification Products
 - c. Marking Services, Inc.
 - d. Or equal.
- B. Detectable Underground Warning Tape for Non-Metallic Pipelines:
 1. Tape shall be of inert, acid- and alkali-resistant, polyethylene, five mils thick, six inches wide, with aluminum backing, and have 15,000 psi tensile strength and 140 percent elongation capability. Tape shall be suitable for direct burial.
 2. Message shall read, "CAUTION [insert customized name of pipe service, i.e., "POTABLE WATER", "SANITARY SEWER", "CHLORINE GAS", or other appropriate service, as indicated in the Buried Pipe Schedule at the end of this Section] PIPE BURIED BELOW" with bold letters approximately two inches high. Messages shall be printed at maximum intervals of two feet. Tape shall be custom colored the same as the pipeline colors as specified for the associated pipe service in Section 09900, Painting.
 3. Manufacturer: Provide products of one of the following:
 - a. Brady Corporation
 - b. Seton Identification Products
 - c. Marking Services, Inc.
 - d. Or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General:

SECTION 15051 – BURIED PIPING INSTALLATION

1. Install piping as shown, specified, and as recommended by pipe and fittings manufacturer.
 2. In event of conflict between manufacturer's recommendations and the Contract Documents, request interpretation from Engineer before proceeding.
 3. Engineer will observe excavations and bedding prior to laying pipe by Contractor. Notify Engineer in advance of excavating, bedding, pipe laying, and backfilling operations.
 4. Minimum cover over buried piping shall be four feet, unless otherwise shown or approved by Engineer.
 5. Earthwork is specified in Section 02200, Earthwork.
 6. Excavation in excess of that required or shown, and that is not authorized by Engineer shall be filled at Contractor's expense with granular material furnished, placed, and compacted in accordance with Section 02200, Earthwork.
 7. Comply with NFPA 24 for "Outside Protection", where applicable to water piping systems used for fire protection.
- B. Manufacturer's Installation Specialist:
1. Provide services of competent installation specialist of pipe manufacturer when pipe installation commences for:
 - a. Concrete pipe.
 2. Retain installation specialist at the Site for minimum of two days (eight hours per day at the Site) or until competency of pipe installation crew has been satisfactorily demonstrated.
- C. Separation of Sewers and Potable Water Piping:
1. Horizontal Separation:
 - a. Where possible, existing and proposed potable water mains and service lines, and sanitary, combined, and storm sewers shall be separated horizontally by clear distance of at least ten feet.
 - b. If local conditions preclude the specified clear horizontal separation, installation will be allowed if potable water main is in separate trench or on undistributed earth shelf on one side of sewer and with bottom of potable water main at least 18 inches above top of sewer.
 - c. Exception: Where it is not possible to provide minimum horizontal separation described above, construct potable water main of cement-lined ductile iron pipe with restrained push-on joint or restrained mechanical joint pipe complying with public water supply design standards of authority having jurisdiction. Hydrostatically test water main and sewer as specified in this Section prior to backfilling. Hydrostatic test pressure at crossing shall be at least 150 psi
 2. Vertical Separation:
 - a. Provide minimum vertical distance of 18 inches between outside of potable water main and outside of sewer when sewer crosses over potable water main.
 - b. Center a section of potable water main pipe at least 17.5 feet long over sewer so that sewer joints are equidistant from potable water main joints.
 - c. Provide adequate structural support where potable water main crosses under sewer. At minimum, provide compacted select backfill for ten feet on each side of crossing.
 - d. Exceptions:
 - 1) Where it is not possible to provide minimum vertical separation described above, construct potable water main of cement-lined ductile iron pipe with restrained push-on joint or restrained mechanical joint pipe. Hydrostatically test water main and sewer as specified in this Section, prior to backfilling. Hydrostatic test pressure at crossing shall be at least 150 psi.
 - 2) Encase either potable water main or sewer in watertight carrier pipe extending ten feet on each side of crossing, measured perpendicular to potable water main.

SECTION 15051 – BURIED PIPING INSTALLATION

D. Plugs:

1. Temporarily plug installed pipe at end of each day of work or other interruption of pipe installation to prevent entry of animals, liquids, and persons into pipe, and entrance or insertion of deleterious materials into pipe.
2. Install standard plugs in bells at dead ends, tees, and crosses. Cap spigot and plain ends.
3. Fully secure and block plugs, caps, and bulkheads installed for testing to withstand specified test pressure.
4. Where plugging is required for phasing of the Work or subsequent connection of piping, install watertight, permanent type plugs, caps, or bulkhead acceptable to Engineer.

E. Bedding Pipe: Bed pipe as specified and in accordance with details on the Drawings.

1. Trench excavation and backfill, and bedding materials shall conform to Section 02200, Earthwork, as applicable.
2. Where pipe is installed in rock excavation, provide minimum of three inches of granular bedding material underneath pipe smaller than four-inch nominal diameter, and minimum of six inches of granular bedding material underneath pipes four-inch nominal diameter and larger.
3. Excavate trenches below bottom of pipe by amount shown and indicated in the Contract Documents. Remove loose and unsuitable material from bottom of trench.
4. Carefully and thoroughly compact pipe bedding with hand held pneumatic compactors.
5. Do not lay pipe until Engineer approves bedding condition.
6. Do not bring pipe into position until preceding length of pipe has been bedded and secured in its final position.

F. Laying Pipe:

1. Conform to manufacturer's instructions and requirements of standards and manuals listed below, as applicable:
 - a. Ductile Iron Pipe: ANSI/AWWA C600, ANSI/AWWA C105, AWWA M41.
 - b. Sanitary and Storm Sewers: ASCE 37.
2. Install pipe accurately to line and grade shown and indicated in the Contract Documents, unless otherwise approved by Engineer. Remove and reinstall pipes that are not installed correctly.
3. Slope piping uniformly between elevations shown.
4. Keep groundwater level in trench at least 24 inches below bottom of pipe before laying pipe. Do not lay pipe in water. Maintain dry trench conditions until jointing and backfilling are complete. Keep clean and protect interiors of pipe, fittings, valves, and appurtenances.
5. Start laying pipe at lowest point and proceed towards higher elevations, unless otherwise approved by Engineer.
6. Place bell and spigot-type pipe so that bells face the direction of laying, unless otherwise approved by Engineer.
7. Excavate around joints in bedding and lay pipe so that pipe barrel bears uniformly on trench bottom.
8. Deflections at joints shall not exceed 75 percent of amount allowed by pipe manufacturer, unless otherwise approved by Engineer.
9. Carefully examine pipe, fittings, valves, and specials for cracks, damage, and other defects while suspended above trench before installation. Immediately remove defective materials from the Site and replace with acceptable products.
10. Inspect interior of all pipe, fittings, valves, and specials and completely remove all dirt, gravel, sand, debris, and other foreign material from pipe interior and joint recesses before pipe and appurtenances are moved into excavation. Bell and spigot-type mating surfaces shall be thoroughly wire brushed, and wiped clean and dry immediately before pipe is laid.
11. Field cut pipe, where required, with machine specially designed for cutting the type of pipe being installed. Make cuts carefully, without damage to pipe, coating or lining, and with smooth end at right angles to axis of pipe. Cut ends on push-on joint type pipe shall be tapered and sharp edges filed off smooth. Do not flame-cut pipe.

SECTION 15051 – BURIED PIPING INSTALLATION

12. Do not place blocking under pipe, unless specifically approved by Engineer for special conditions.
 13. Touch up protective coatings in manner satisfactory to Engineer prior to backfilling.
 14. Notify Engineer in advance of backfilling operations.
 15. On steep slopes, take measures acceptable to Engineer to prevent movement of pipe during installation.
 16. Thrust Restraint: Where required, provide thrust restraint conforming to Article 3.3 of this Section.
 17. Exercise care to avoid flotation when installing pipe in cast-in-place concrete, and in locations with high groundwater.
- G. Polyethylene Encasement:
1. Provide polyethylene encasement for ductile iron piping to prevent contact between pipe and surrounding bedding material and backfill.
 2. Polyethylene encasement installation shall be in accordance with ANSI/AWWA C105.
- H. Jointing Pipe:
1. Ductile Iron Mechanical Joint Pipe:
 - a. Immediately before making joint, wipe clean the socket, plain end, and adjacent areas. Taper cut ends and file off sharp edges to provide smooth surface.
 - b. Lubricate plain ends and gasket with soapy water or manufacturer's recommended pipe lubricant, in accordance with ANSI/AWWA C111, just prior to slipping gasket onto plain end of the joint assembly.
 - c. Place gland on plain end with lip extension toward the plain end, followed by gasket with narrow edge of gasket toward plain end.
 - d. Insert plain end of pipe into socket and press gasket firmly and evenly into gasket recess. Keep joint straight during assembly.
 - e. Push gland toward socket and center gland around pipe with gland lip against gasket.
 - f. Insert bolts and hand-tighten nuts.
 - g. If deflection is required, make deflection after joint assembly and prior to tightening bolts. Alternately tighten bolts approximately 180 degrees apart to seat gasket evenly. Bolt torque shall be as follows:

PIPE DIAMETER (INCHES)	BOLT DIAMETER (INCHES)	RANGE OF TORQUE (FT-LBS)
3	5/8	45 TO 60
4 TO 24	3/4	75 TO 90
30 TO 36	1	100 TO 120

- A. Bolts and nuts, except those of stainless steel, shall be coated with two coats, minimum dry film thickness of eight mils each, of high build solids epoxy or bituminous coating manufactured by Thnec, or equal.
- B. Restrained mechanical joints shall be in accordance with Section 15061, Ductile Iron Pipe.
1. Ductile Iron Push-On Joint Pipe:
 - a. Prior to assembling joints, thoroughly clean with wire brush the last eight inches of exterior surface of spigot and interior surface of bell, except where joints are lined or coated with a protective lining or coating.
 - b. Wipe clean rubber gaskets and flex gaskets until resilient. Conform to manufacturer's instructions for procedures to ensure gasket resiliency when assembling joints in cold weather.
 - c. Insert gasket into joint recess and smooth out entire circumference of gasket to remove bulges and to prevent interference with proper entry of spigot of entering pipe.

SECTION 15051 – BURIED PIPING INSTALLATION

- d. Immediately prior to joint assembly, apply thin film of pipe manufacturer's recommended lubricant to surface of gasket that will come in contact with entering spigot end of pipe, or apply a thin film of lubricant to outside of spigot of entering pipe.
 - e. For assembly, center spigot in pipe bell and push pipe forward until spigot just makes contact with rubber gasket. After gasket is compressed and before pipe is pushed or pulled in the rest of the way, carefully check gasket for proper position around the full circumference of joint. Final assembly shall be made by forcing spigot end of entering pipe past gasket until spigot makes contact with base of the bell. When more than a reasonable amount of force is required to assemble the joint, remove spigot end of pipe to verify proper positioning of gasket. Do not use gaskets that have been scored or otherwise damaged.
 - f. Maintain an adequate supply of gaskets and joint lubricant at the Site when pipe jointing operations are in progress.
 - 2. Ductile Iron Proprietary Joints:
 - a. Install pipe that utilizes proprietary joints for restraint specified in Section 15061, Ductile Iron Pipe, or other such joints, in accordance with manufacturer's instructions.
 - 3. Copper Tubing Joints:
 - a. Soldered Joints:
 - 1) Assemble copper tubing with soldered joints. Solder shall be 95-5 tin-antimony solder conforming to ASTM B32.
 - 2) Ream or file pipe to remove burrs.
 - 3) Clean and polish contact surfaces of joints.
 - 4) Apply flux to both male and female ends.
 - 5) Insert end of tube into full depth of fitting socket.
 - 6) Heat joint evenly.
 - 7) Form continuous solder bead around entire circumference of joint starting at the bottom.
 - 4. Mechanical Coupling Joints:
 - a. Mechanical couplings include: sleeve-type flexible couplings, split flexible couplings, ANSI/AWWA C606 grooved or shouldered end couplings, plasticized PVC couplings, and other mechanical couplings specified in Section 15120, Couplers, Adapters, and Specials for Piping.
 - b. Prior to installing and assembling mechanical couplings, thoroughly clean joint ends with wire brush to remove foreign matter.
 - c. For mechanical couplings that incorporate gaskets, after cleaning apply lubricant to rubber gasket or inside of coupling housing and to joint ends. After lubrication, install gasket around joint end of previously installed piece and mate joint end of subsequent piece to installed piece. Position gasket and place coupling housing around gasket and over grooved or shouldered joint ends. Insert bolts and install nuts tightly by hand. Tighten bolts uniformly to produce an equal pressure on all parts of housing. When housing clamps meet metal to metal, joint is complete and further tightening is not required.
- C. Backfilling:
 - 1. Conform to applicable requirements of Section 02200, Earthwork.
 - 2. Place backfill as Work progresses. Backfill by hand and use power tampers until pipe is covered by at least one foot of backfill.
- D. Connections to Valves and Hydrants:
 - 1. Install valves and hydrants as shown and indicated in the Contract Documents.
 - 2. Provide suitable adapters when valves or hydrants and piping have different joint types.
 - 3. Provide thrust restraint at all hydrants and at valves located at pipeline terminations.
- E. Transitions from One Type of Pipe to Another:
 - 1. Provide necessary adapters, specials, and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

SECTION 15051 – BURIED PIPING INSTALLATION

F. Closures:

1. Provide closure pieces shown or required to complete the Work.

3.02 TRACER TAPE INSTALLATION

A. Polyethylene Underground Warning Tape for Metallic Pipelines:

1. Provide polyethylene tracer tape for buried metallic piping, which includes pipe that is steel, ductile iron, cast iron, concrete, copper, and corrugated metal.
2. Provide tracer tape 12 to 18 inches below finished grade, above and parallel to buried pipe.
3. For pipelines buried eight feet or greater below finished grade, provide second line of magnetic tracer tape 2.5 feet above crown of buried pipe, aligned along pipe centerline.
4. Tape shall be spread flat with message side up before backfilling.

3.03 THRUST RESTRAINT

- A. Provide thrust restraint on pressure piping systems where shown or indicated in the Contract Documents.
- B. Thrust restraint may be accomplished by using restrained pipe joints, concrete thrust blocks, or harnessing buried pipe. Thrust restraints shall be designed for axial thrust exerted by test pressure specified in the Buried Piping Schedule at the end of this Section.
- C. Place concrete thrust blocks against undisturbed soil. Where undisturbed soil does not exist, or for projects where the Site consists of backfill material, thrust restraint shall be provided by restrained pipe joints.
- D. Restrained Pipe Joints:
1. Pipe joints shall be restrained by means suitable for the type of pipe being installed.
 - a. Ductile Iron, Push-on Joints and Mechanical Joints: Restrain with proprietary restrained joint system as specified in Section 15061, Ductile Iron Pipe; lugs and tie rods; or other joint restraint systems approved by Engineer.
 - b. Prestressed Concrete Cylinder Pipe Joints: Restrain utilizing clamp type restrained joint, snap ring-type restrained joint, or by welding. Restrain, at a minimum, pipe segments to all wall fittings, and both joints of all bends and other transition pieces. Concrete pipe requiring restraint shall have sufficient longitudinal steel reinforcement provided to handle thrust forces at maximum design stress of 12,500 psi. Thrust forces in longitudinales must be transmitted directly to steel joint bands using welded connections sufficient to carry stresses involved. No allowance for the concrete to handle tensile forces is allowed. Thrust restraint shall be in accordance with ANSI/AWWA Manual M9.
 - c. Joints for Concrete Pipe Other than Prestressed Concrete Cylinder Pipe: Restrain joints utilizing clamp type restrained joint or snap ring-type restrained joint.
- E. Concrete Thrust Blocks:
1. Provide concrete thrust blocks on pressure piping at changes in alignment of 15 degrees or more, at tees, plugs and caps, and where shown or indicated in the Contract Documents. Construct thrust blocks of Class B concrete, conforming to Section 03300, Cast-In-Place Concrete.
 2. Install thrust blocks against undisturbed soil. Place concrete so that pipe and fitting joints are accessible for repair.
 3. Concrete thrust block size shall be as shown on the Drawings or as approved by Engineer.
- F. Harnessed lengths of buried pipe shall be determined by the pipe manufacturer in accordance with the formula for determination of buried pipe harnessed lengths located at the end of this Section.

3.04 WORK AFFECTING EXISTING PIPING

- A. Location of Existing Underground Facilities:

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1. Locations of existing Underground Facilities shown on the Drawings should be considered approximate.
 2. Determine the true location of existing Underground Facilities to which connections are to be made, crossed, and that could be disturbed, and determine location of Underground Facilities that could be disturbed during excavation and backfilling operations, or that may be affected by the Work.
- B. Work on Existing Pipelines or Underground Facilities:
1. Cut or tap piping or Underground Facilities as shown or required with machines specifically designed for cutting or tapping pipelines or Underground Facilities, as applicable.
 2. Install temporary plugs to prevent entry of mud, dirt, water, and debris into pipe.
 3. Provide necessary adapters, sleeves, fittings, pipe, and appurtenances required to complete the Work.

3.05 FIELD QUALITY CONTROL

- A. General:
1. Test all piping, except as exempted in the Buried Piping Schedule in this Section.
 2. When authorities having jurisdiction are to witness tests, notify Engineer and authorities having jurisdiction in writing at least 48 hours in advance of testing.
 3. Conduct all tests in presence of Engineer.
 4. Remove or protect pipeline-mounted devices that could be damaged by testing.
 5. Provide all apparatus and services required for testing, including:
 - a. Test pumps, compressors, hoses, calibrated gages, meters, test containers, valves, fittings, and temporary pumping systems required to maintain Owner's operations.
 - b. Temporary bulkheads, bracing, blocking, and thrust restraints.
 6. Provide air if an air test is required, power if pumping is required, and gases if gases are required.
 7. Unless otherwise specified, Owner will provide fluid required for hydrostatic testing. Contractor shall provide means to convey fluid for hydrostatic testing into piping being tested. Contractor shall provide fluid for other types of testing required.
 8. Repair observed leaks and repair pipe that fails to meet acceptance criteria. Retest after repair.
 9. Unless otherwise specified, testing shall include existing piping systems that connect with new piping system. Test existing pipe to nearest valve. Piping not installed by Contractor and that fails the test shall be repaired upon authorization of Owner. Unless otherwise included in the Work, repair of existing piping or Underground Facilities will be paid as extra Work.
- B. Test Schedule:
1. Refer to the Buried Piping Schedule in this Section for type of test required and required test pressure.
 2. Unless otherwise specified, required test pressures are at lowest elevation of pipeline segment being tested.
 3. For piping not listed in Buried Piping Schedule in this Section:
 - a. Hydrostatically test pipe that will convey liquid at a pressure greater than five psig. Provide process air pipe test for pipe that will convey air or gas under pressure or vacuum, except chlorine gas, which requires separate test.
 - b. Use exfiltration testing, low-pressure air testing, or vacuum testing for other piping.
 - c. Disinfect for bacteriological testing piping that conveys potable water.
 4. Test Pressure:
 - a. Use test pressures listed in Buried Piping Schedule in this Section.
 - b. If test pressure is not listed in Buried Piping Schedule, or if test is required for piping not listed in the Buried Piping Schedule, test pressure will be determined by Engineer based on maximum anticipated sustained operating pressure and methods described in applicable ANSI/AWWA manual or standard that applies to the piping system.

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C. Hydrostatic Testing:

1. Preparation for Testing:
 - a. Follow procedures described in ANSI/AWWA Manual M9. Wetting period is not required for pipe that is not cement mortar-lined.
 - b. Prior to testing, ensure that adequate thrust protection is in place and joints are properly installed.
2. Test Procedure:
 - a. Fill pipeline slowly to minimize air entrapment and surge pressures. Fill rate shall not exceed one foot of pipe length per second in pipe being tested.
 - b. Expel air from pipe as required. Obtain approval of Engineer prior to tapping pipe for expelling air.
 - c. Examine exposed joints and valves, and make repairs to eliminate visible leakage.
 - d. After specified wetting period, add fluid as required to pressurize line to required test pressure. Maintain test pressure for a stabilization period of ten minutes before beginning test.
 - e. Timed test period shall not begin until after pipe has been filled, exposed to required wetting period, air has been expelled, and pressure stabilized.
 - f. Timed Test Period: After stabilization period, maintain test pressure for at least two hours. During timed testing period, add fluid as required to maintain pressure within five psig of required test pressure.
 - g. Pump from test container to maintain test pressure. Measure volume of fluid pumped from test container and record on test report. Record pressure at test pump at 15 minute intervals for duration of test.
3. Allowable Leakage Rates: Leakage is defined as the quantity of fluid supplied to pipe segment being tested to maintain pressure within five psi of test pressure during timed test period. Allowable leakage rates for piping are:
 - a. No Leakage: Pipe with flanged, welded, fused, threaded, soldered, or brazed joints.
 - b. Rates based on formula or table in ANSI/AWWA Manual M41:
 - 1) Metal pipe joined with rubber gaskets as sealing members, including the following joint types:
 - (a) Bell and spigot and push-on joints.
 - (b) Mechanical joints.
 - (c) Bolted sleeve type couplings.
 - (d) Grooved and shouldered couplings.
 - e) Rates based on make-up allowance in ANSI/AWWA Manual M9:
 - (1) Prestressed concrete cylinder pipe and other types of concrete pipe joined with O-ring rubber gasket sealing members.

D. Sanitary Sewer Testing:

1. Contractor may test sanitary sewer and storm drain piping using the method specified in one of the following: Paragraph 2 or 3. Notify Engineer in writing in advance of the first test of method to be used for testing, and use the same test method for testing all sanitary sewer and storm drain piping in the Contract, unless otherwise accepted by Engineer.
2. Exfiltration Testing:
 - a. Plug and bulkhead ends and lateral connections of pipe segment to be tested and admit fluid until the pipe is full. Admit fluid slowly to minimize air entrapment. Groundwater level shall be below the pipe during exfiltration test.
 - b. Before measuring leakage, allow fluid to wet pipe interior for the following period:
 - 1) Concrete Pipe: 48 hours.
 - 2) Cement Mortar-lined Pipe: 24 hours.
 - 3) Other Pipe: Wetting period not required.
 - 4) Provide minimum hydrostatic head during test of two feet above crown of upstream end of pipe segment tested.
 - 5) Add fluid from test container or from metered supply as required to maintain test water level within three inches of test head throughout the test.

SECTION 15051 – BURIED PIPING INSTALLATION

- 6) Test duration shall be at least two hours.
- 7) Allowable Leakage Rates:
 - (a) Leakage is defined as the quantity of fluid that must be supplied to pipe segment tested to maintain hydrostatic head within three inches of test head during the test after pipe has been filled and exposed to required wetting period, plus quantity required to refill to original head at end of test.
 - (b) Leakage shall not exceed the following rates:
 - (1) Gravity Sewer: 0.079 gallons per hour per 100 feet of pipe per inch in diameter in pipe.
 - (2) Storm Drains: 0.79 gallons per hour per 100 feet of pipe per inch diameter of pipe.
3. Low Pressure Air:
 - a. Plug and bulkhead ends and lateral connections of pipe segment to be tested.
 - b. Required test pressure shall be increased by an amount equal to the elevation of groundwater above invert of lowest point of pipe segment being tested.
 - c. Test in accordance with requirements of authority having jurisdiction.
 - d. If there are no Laws and Regulations covering the test, use test procedures described in the following standards:
 - 1) Concrete Pipe: ASTM C924.
- E. Bacteriological Testing:
 1. Bacteriological testing for potable water lines, finished water lines, and other piping in accordance with the Buried Piping Schedule, is specified in Article 3.6 of this Section.

3.06 CLEANING AND DISINFECTION

- A. Cleaning, General: Clean pipe systems as follows:
 1. Thoroughly clean all piping, including flushing with water, dry air, or inert gas as required, in manner approved by Engineer, prior to placing in service.
 2. Piping 24-inch diameter and larger shall be inspected from inside and debris, dirt and foreign matter removed.
 3. For piping that requires disinfection and has not been kept clean during storage or installation, swab each section individually before installation with five percent sodium hypochlorite solution.
- B. Disinfection:
 1. Disinfect all potable and finished water piping.
 2. Suggested procedure for accomplishing complete and satisfactory disinfection is specified below. Other procedures may be considered for acceptance by Engineer.
 - a. Prior to disinfection, clean piping as specified and flush thoroughly.
 - b. Conform to procedures described in ANSI/AWWA C651. Use continuous feed method of disinfecting, unless alternative method is acceptable to Engineer.
 3. Water for initial flushing, testing, and disinfection will be furnished by Owner. Contractor shall provide all temporary piping, hose, valves, appurtenances, and services required. Cost of water required for redisinfection will be paid by Contractor to Owner at water utility's standard rates.
 4. Chlorine shall be provided by Contractor.
 5. Bacteriologic tests will be performed by Owner. Certified test laboratory report will be provided to Contractor, if requested.
 6. Chlorine concentration in water entering the piping shall be between 50 and 100 ppm, such that minimum residual concentration of 25 mg/L remains after 24-hour retention period. Disinfect piping and all related components. Repeat as necessary to provide complete disinfection.
 7. After required retention period, flush chlorinated water to closed drain line, unless otherwise acceptable to Engineer. Properly dispose of chlorinated water in accordance with Laws and Regulations. Do not discharge chlorinated water to storm sewers, ditches, or overland.

SECTION 15051 – BURIED PIPING INSTALLATION

3.07 FORMULA FOR DETERMINATION OF BURIED PIPE HARNESSSED LENGTHS

A. Lengths shall be based on the following formula:

$$L = \frac{T}{f \cdot \sum W}$$

$$T = 1.25 \cdot P \cdot A \cdot \sin \frac{\Delta}{2}$$

B. where: T = Thrust (lbs.)

C. P = Test pressure (psi)

D. A = Pipe area (sq. in.)

E. Δ = Angle of bend.

F. f = Friction factor between soil and pipe = 0.3*.

G. SW = Wp + Ws + Ww.

H. Wp = Weight of pipe (lbs. per linear foot).

I. Ws = Weight of soil (lbs. per linear foot)**.

J. Ww = Weight of fluid (lbs. per linear foot).

K. For ductile iron and steel pipe, the friction factor f = 0.1.

L. Based on depth of cover on pipe, and outside diameter of pipe. Soil weight equals 100 lbs./ft³.

3.08 SCHEDULES

A. Buried Piping Schedule:

Service	Diameter (inch)	Material	Interior Lining	Exterior Coating	Pressure Class/ Thickness	Joint	Test (psig)	Remarks
WW	4 to 10	DI	CL	AC/PEW	350/Class 53	RMJ	HYD (150)	Force main
WW	4 to 10	DI	CL	AC/PEW	350/Class 53	MJ	HYD (150)	Pump discharge to valve chamber
WW	8 to 12	DI	CL	AC/PEW	350/Class 53	POJ	EX	Gravity Sewer from existing manhole to new wet well
DR	6	HDPE	-	-	-	BS	EX	Roof drainage to drywells

3.09 THE FOLLOWING ABBREVIATIONS ARE USED IN THE BURIED PIPING SCHEDULE:

A. Service Abbreviations:

SERVICE:	ABBREV.:	SERVICE:	ABBREV.:
DRAIN	DR	FIRE WATER	FW
WASTEWATER	WW	CITY WATER	CW
FIRE PROTECTION WATER	FPW	EXISTING DRAIN	D

SECTION 15051 – BURIED PIPING INSTALLATION

B. Material Abbreviations:

MATERIAL:	ABBREV.		MATERIAL:	ABBREV.
DUCTILE IRON	DI		PRE-STRESSED CONCRETE CYLINDER PIPE	PCCP
CARBON STEEL	CS		POLYVINYL CHLORIDE	PVC
STAINLESS STEEL	SS		CHLORINATED POLYVINYL CHLORIDE	CPVC
COPPER	C		CLEAR POLYVINYL CHLORIDE	CLPVC
FIBERGLASS REINFORCED PLASTIC	FRP		CLEAR, FLEXIBLE POLYVINYL CHLORIDE TUBING	CFPVCT
REINFORCED CONCRETE PIPE	RCP		GALVANIZED	GALV
HIGH DENSITY POLYETHYLENE	HDPE			

C. Lining/Coating Abbreviations:

LINING:	ABBREV.		COATING:	ABBREV.
CEMENT MORTAR LINED	CL		ASPHALTIC COATED	AC
GALVANIZED	GALV		POLYETHYLENE WRAPPED	PEW
PAINTED	P			

D. Joint Abbreviations:

JOINT TYPE:	ABBREV.		JOINT TYPE:	ABBREV.
BELL AND SPIGOT	BS		SOLVENT WELD	SW
RESTRAINED BELL AND SPIGOT	RBS		PLASTICIZED PVC COUPLING	PPVC
PUSH-ON JOINT	POJ		GROOVED OR SHOULDERED END COUPLING	GSEC
RESTRAINED PUSH-ON JOINT	RPOJ		FLANGED	FLG
MECHANICAL JOINT	MJ		THREADED	THD
RESTRAINED MECH. JOINT	RMJ		HOSE BARB	HBARB
SOLDERED	SD			

E. Test Abbreviations:

TEST:	ABBREV.		TEST:	ABBREV.
HYDROSTATIC TEST (TEST PRESSURE IN PSIG)	HYD ()		DISINFECTION AND BACTERIOLOGICAL TESTING	DBT
EXFILTRATION	EX		NO TEST REQUIRED	NR

SECTION 15051 – BURIED PIPING INSTALLATION

TESTABLE JOINT GASKET TEST (TEST PRESSURE IN JT () PSIG)		
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END OF SECTION

SECTION 15052 – EXPOSED PIPING INSTALLATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope:

1. Provide all labor, materials, equipment and incidentals as shown, specified, and required to install and test all exposed piping, fittings, and specials. The Work includes the following:
 - a. All types and sizes of exposed piping, except where exposed piping installations are specified under other Sections or other contracts.
 - b. Unless otherwise shown or specified, this Section includes all piping beginning at the outside face of structures or structure foundations and extending into the structure. Piping embedded in concrete within a structure or foundation shall be considered as exposed and is included herein. Piping that is permanently or intermittently submerged, or installed in sub-aqueous environments, is considered as exposed and is included in this Section.
 - c. Work on or affecting existing exposed piping.
 - d. Installation of all jointing and gasket materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie rods, and all Work required for a complete exposed piping installation.
 - e. Supports, restraints, and other anchors.
 - f. Field quality control, including testing.
 - g. Cleaning and disinfecting.
 - h. Incorporation of valves, meters, and special items shown or specified into the piping systems per the Contract Documents and as required

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before exposed piping Work.
2. Coordinate with appropriate piping Sections of Division 15, Mechanical.

C. Related Sections:

1. Section 09900, Painting.
2. Section 10400, Identification Devices.
3. Section 15055, Pipe Hangers and Supports.
4. Section 15061, Ductile Iron Pipe.
5. Section 15066, Copper Pipe.
6. Section 15067, Thermoplastic Pipe.
7. Section 15120, Couplings, Adapters, and Specials for Process Piping.
8. Section 15121, Wall Pipes, Floor Pipes and Pipe Sleeves.

1.02 REFERENCES

A. Standards referenced in this Section are:

1. ASME Boiler and Pressure Vessel Code.
2. ASME B31.3, Process Piping.
3. American Society for Non-Destructive Testing (ASNT), ASNT-TC-1A, Recommended Practice, Personnel Qualification, and Certification in Non-destructive Testing.
4. ASTM A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
5. ASTM B32, Specification for Solder Metal.
6. AWS D1.1/D1.1M, Structural Welding Code-Steel.
7. ANSI/AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
8. ANSI/AWWA C206, Field Welding of Steel Water Pipe.
9. ANSI/AWWA C600, Installation of Ductile Iron Water Mains and Their Appurtenances.
10. ANSI/AWWA C605, Standard for Underground Installation of PVC and PVCO Pressure Pipe and Fittings.
11. ANSI/AWWA C606, Grooved and Shouldered Joints.

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12. ANSI/AWWA C651, Disinfecting Water Mains.
13. AWWA M11, Steel Pipe - A Guide for Design and Installation.
14. AWWA M23, PVC Piping - Design and Installation.
15. AWWA M41, Ductile-Iron Pipe and Fittings.

1.03 QUALITY ASSURANCE

- A. Regulatory Requirements:
 1. Comply with requirements and recommendations of authorities having jurisdiction over the Work.
- B. The Work shall conform to vibratory, seismic, and wind requirements in accordance with Section 15050, Vibration, Seismic and Wind Controls.

1.04 SUBMITTALS

- A. Action Submittals: Submit the following:
 1. Shop Drawings:
 - a. Detailed drawings in plan and, as applicable, section.
 - b. Details of piping, valves, supports, accessories, specials, joints, harnessing, and main anchor supports, and connections to existing piping, structures, equipment, and appurtenances.
 - c. Laying schedules for concrete pipe and piping with restrained joints.
 2. Testing Plans, Procedures, and Testing Limitations
 - a. Submit description of proposed testing methods, procedures, and apparatus, and obtain Engineer's approval prior to testing.
- B. Informational Submittals: Submit the following:
 1. Certificates:
 - a. Submit a certificate signed by manufacturer of each product certifying product conforms to applicable referenced standards.
 - b. Welder's Certificate to comply with Paragraph 3.1.E.7.c.
 2. Source Quality Control Submittals:
 - a. Submit copies of testing report for each test.
 3. Site Quality Control Reports:
 - a. Submit copies of testing report for each test.
- C. Closeout Submittals: Submit the following:
 1. Record Documentation:
 - a. Maintain accurate and up-to-date record documents showing field and Shop Drawing modifications. Record documents for exposed piping Work shall show actual location of all piping and appurtenances on a copy of the Drawings, unless otherwise approved by Engineer.
 - b. Record documents shall show piping with elevations referenced to the project datum and dimensions from permanent structures. For straight runs of pipe provide offset dimensions as required to document pipe location.
 - c. Include section drawings with exposed piping record documents when the Contract Documents include section Drawings.
 - d. Conform to Section 01720, Record Documents.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Delivery:
 1. Deliver products to Site to ensure uninterrupted progress of the Work.
 2. Upon delivery, inspect pipe and appurtenances for cracked, gouged, chipped, dented, and other damage and immediately remove damaged products from Site.
- B. Storage:
 1. Store products for convenient access for inspection and identification. Store products off the ground using pallets, platforms, or other supports. Protect packaged products from corrosion and deterioration.

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2. Pipe and fittings other than thermoplastic materials may be stored outdoors without cover. Thermoplastic pipe and fittings stored outdoors shall be covered.
- C. Handling:
 1. Handle pipe, fittings, specials, and accessories carefully with approved handling devices. Do not drop or roll material of delivery vehicles. Do not otherwise drop, roll, or skid piping.
 2. Avoid unnecessary handling of pipe.
 3. Keep pipe interiors free of dirt and foreign matter.
 4. Protect interior linings and exterior coatings of pipe and fittings from damage. Replace pipe and fittings with damaged lining regardless of cause of damage. Repair damaged coatings.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Piping materials are specified in the Exposed Piping Schedule at the end of this Section. Piping materials shall conform to Specification for each type of pipe and piping appurtenances in applicable sections of Division 15, Mechanical.
- B. Markings and Identification:
 1. Pipe Markings:
 - a. Clearly mark each piece of pipe or fitting with a designation conforming to that shown on the approved Shop Drawings.
 - b. Manufacturer shall cast or paint on each length of pipe and each fitting the pipe material, diameter, and pressure or thickness class.
 2. Pipe Identification Markers and Arrows: Refer to Section 10400, Identification Devices.
- C. Appurtenances: Provide products that comply with:
 1. Section 15055, Pipe Hangers and Supports.
 2. Section 15120, Couplings, Adapters and Specials for Process Piping.
 3. Section 15121, Wall Pipes, Floor Pipes and Pipe Sleeves.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine conditions under which the Work is to be installed and notify Engineer in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General:
 1. Install piping as shown, specified and as recommended by the pipe and fittings manufacturer.
 2. If there is a conflict between manufacturer's recommendations and the Contract Documents, request in writing instructions from Engineer before proceeding.
 3. Provide pipe manufacturer's installation specialist at Site as specified on this Section.
- B. Temporary Blind Flanges, Plugs, Caps, and Bulkheads:
 1. Temporarily plug installed pipe at the end of each day of work or other interruption of pipe installation to prevent entry of animals, liquids, and persons into pipe, and entrance or insertion of deleterious materials into pipe.
 2. Install standard plugs in all bells at dead ends, tees, and crosses. Cap all spigot and plain ends.
 3. Fully secure and block blind flanges, plugs, caps, and bulkheads installed for testing, designed to withstand specified test pressure.
 4. Where plugging is required for phasing of Work or subsequent connection of piping, install watertight, permanent type blind flanges, plugs, caps, or bulkhead acceptable to Engineer.
- C. Piping Installation:
 1. Conform to manufacturer's instructions and requirements of standards and manuals listed in this Section, as applicable:

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- a. Ductile Iron Pipe: ANSI/AWWA C600, AWWA M41.
 - b. Steel Pipe: ASME B31.3, ANSI/AWWA C206, AWWA M11.
 - c. Thermoplastic Pipe: AWWA M23
 2. Install straight runs true to line and elevation.
 3. Install vertical pipe truly plumb in all directions.
 4. Install piping parallel or perpendicular to walls of structures. Piping at angles and 45 degree runs across corners of structures will not be accepted unless specifically shown on the Contract Documents or approved by the Engineer.
 5. Install small diameter piping generally as shown when specific locations and elevations are not indicated. Locate such piping as required to avoid ducts, equipment, beams, and other obstructions.
 6. Install piping to leave all corridors, walkways, work areas, and similar spaces unobstructed. Unless otherwise approved by Engineer provide a minimum headroom clearance under piping and pipe supports of 7.5 feet. Clearances beneath piping shall be measured from the outermost edge of piping, flanges or other type of joint that extends beyond the nominal outside diameter of piping.
 7. Protect and keep clean interiors, fittings, and valves of pipe that will convey potable water, chemicals, and other pipe designated by Engineer.
 8. Cutting: Cut pipe from measurements verified at Site. Field cut pipe, where required, with a machine specially designed for cutting type of pipe being installed. Make cuts carefully without damage to pipe, coating, or lining, and with a smooth end at right angles to axis of pipe. Cut ends of push-on joint type pipe shall be tapered and sharp edges filed off smooth. Do not flame-cut pipe.
 9. Deflections at joints shall not exceed 75 percent of amount allowed by pipe manufacturer, unless otherwise approved by the Engineer.
 10. Additional General Requirements for Thermoplastic Piping:
 - a. Utilize wide band supports as recommended by pipe manufacturer and approved by Engineer to minimize localized stresses.
 - b. Provide piping passing through walls with a sleeve of wearing material to prevent abrasion damage to piping.
 - c. Provide anchored supports at elbows, valves, bends in piping, and at connections to equipment and tanks.
 - d. Spacing of supports shall be in accordance with the manufacturer's published recommendations at maximum design operating temperature of pipe.
 - e. Provide U-clamps with wide band circumferential contact.
 - f. Provide guides on long runs of piping to maintain alignment and reduce chance of elastic failure of pipe. Space guides as recommended by pipe manufacturer.
 - g. Provide anchored supports to restrain joints that allow expansion. Minimize use of bellows style joints. Where required and approved by the Engineer provide bellows style joints with low axial force to take up pipe expansion. Flexible connectors may be used to absorb thermal movement when approved in writing by Engineer.
- D. Jointing Pipe:
1. General:
 - a. Make joints in accordance with pipe manufacturer's recommendations and Contract Documents.
 - b. Cut piping accurately and squarely and install without forcing or springing.
 - c. Ream out pipes and tubing to full inside diameter after cutting. Remove all sharp edges on end cuts.
 - d. Remove all cuttings and foreign matter from inside of pipe and tubing before installation. Thoroughly clean all pipe, fittings, valves, specials, and accessories before installing.
 2. Ductile Iron Mechanical Joint Pipe:
 - a. Wipe clean the socket, plain end and adjacent areas immediately before making joint. Make certain that cut ends are tapered and sharp edges are filed off smooth.

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- b. Lubricate plain end and gasket with soapy water or pipe manufacturer's recommended pipe lubricant, per ANSI/AWWA C111, just prior to slipping gasket onto plain end of joint assembly.
- c. Place gland on plain end with lip extension toward plain end, followed by gasket with narrow edge of gasket toward the plain end.
- d. Insert pipe into socket and press gasket firmly and evenly into gasket recess. Keep joint straight during assembly.
- e. Push gland toward socket and center it around pipe with the gland lip against the gasket.
- f. Insert bolts and hand tighten nuts.
- g. Deflect joint only after assembled when approved by Engineer.
- h. Make deflection after joint assembly, if approved by Engineer, but prior to tightening bolts. Alternately tighten bolts 180 degrees apart to seat the gasket evenly. Bolt torque shall be:

PIPE DIAMETER (INCHES)	BOLT DIAMETER (INCHES)	RANGE OF TORQUE (FT-LBS)
3	5/8	45 TO 60
4 TO 24	3/4	75 TO 90
30 TO 36	1	100 TO 120
42 TO 48	1.25	120 TO 150

A. Ductile Iron Push-On Joint Pipe:

1. Prior to assembling joints, thoroughly clean with a wire brush the last eight inches of exterior surface of spigot and interior surface of bell, except where joints are lined or coated with a protective lining or coating.
2. Wipe clean rubber gaskets and flex gaskets until resilient. Conform to manufacturer's instructions for procedures to ensure gasket resiliency when assembling joints in cold temperatures.
3. Insert gasket into joint recess and smooth out entire circumference of gasket to remove bulges and to prevent interference with proper entry of spigot of entering pipe.
4. Immediately prior to joint assembly, apply a thin film of pipe manufacturer's recommended lubricant to surface of gasket that will come in contact with entering spigot end of pipe, or apply a thin film of lubricant to outside of spigot of entering pipe.
5. For assembly, center spigot in pipe bell and push pipe forward until spigot just makes contact with the rubber gasket. After gasket is compressed and before pipe is pushed or pulled in the rest of the way, carefully check gasket for proper position around the full circumference of joint. Final assembly shall be made by forcing spigot end of entering pipe past gasket until spigot makes contact with the base of the bell. When more than a reasonable amount of force is required to assemble the joint, remove spigot end of pipe to verify proper positioning of gasket. Do not use gaskets that have been scored or otherwise damaged.
6. Maintain an adequate supply of gaskets and joint lubricant at Site when pipe jointing is in progress.
7. Ductile Iron Proprietary Joints:
 - a. Pipe that utilizes proprietary joints for restraint specified in Section 15061, Ductile Iron Pipe, or other such joints, shall be installed in accordance with manufacturer's instructions.
8. Ductile Iron and Steel Flanged Joints:
 - a. Assemble flanged joints using ring-type gaskets, with thickness as recommended by pipe manufacturer but not less than 1/8-inch thick, for raised-face flanges. Use full-face gaskets for flat-face flanges, unless otherwise approved by Engineer or recommended by pipe manufacturer. Gaskets shall be suitable for the service intended in accordance with the manufacturer's ratings and instructions. Gaskets shall be properly centered.

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- b. Tighten bolts in a sequence that provides equal distribution of bolt loads.
 - c. Length of bolts shall be uniform. Bolts shall not project beyond the nut more than 1/4-inch or fall short of the nut when fully taken up. Machine-cut ends of bolts to be neatly rounded. Do not use washers.
 - d. Prior to assembly of flanged joints, lubricate bolt threads and gasket faces.
 - e. Alternately tighten bolts 180 degrees apart to compress the gasket evenly.
 - f. After assembly, coat all bolts and nuts, except stainless steel bolts and nuts, with same coating specified in Section 09910, Painting, for material of pipe and fittings being joined.
9. Field Welded Steel Pipe Joints:
- a. Joints in steel pipe shall be butt welded or lap welded, except that flexible couplings, mechanical couplings, or flanged connections shall be provided at connections to valves, meters, and similar equipment, and where shown or specified.
 - b. Welding procedures and welder qualifications shall conform to ASME Boiler and Pressure Vessel Code Section IX or to American Welding Society Structural Welding Code D1.1/D1.1M, Section 5, whichever is required. Welding of steel water pipe shall conform to the requirements of AWWA C206.
 - c. For all piping, submit current certificates that all welders and welding operators have been qualified in accordance with ASME Boiler and Pressure Vessel Code Section IX or American Welding Society Structural Welding Code D1.1/D1.1M, Section 5, whichever is required.
 - d. Conform to field welding procedures recommended by pipe manufacturer and as specified herein.
 - e. Clean ends to be welded up to at least 1/2-inch beyond the estimated toe of weld by sandblasting or other means to remove surface contamination such as paint, oil, grease, scale, oxide, rust, and other contamination.
 - f. Verify that ends to be welded are adequately prepared in shop for welding.
 - g. Provide full penetration welds, free of cracks, overlap and cold laps.
 - h. Preheat and interpass temperatures shall be not less than 60 degrees F and not more than 350 degrees F, respectively.
 - i. Limit on Undercut: 1/32-inch or ten percent of base metal thickness, whichever is less.
 - j. For pipe wall thickness up to 11-gauge (0.125-inch) use GTAW (Gas Tungsten Arc Welding).
 - k. For pipe wall thickness greater than 11-gauge, use GTAW root pass followed by GMAW (Gas Metal Arc Welding) or SMAW (Shielded Metal Arc Welding) Cap.
 - l. Where required for pipes 36-inch diameter and larger, and heavier-wall pipes, provide joints double beveled and welded from both inside and outside with the flux core process.
 - m. Provide internal inert gas purge to exclude atmosphere.
 - n. Filler Wire: ELC grade, of matching composition or of higher molybdenum content.
 - o. Weld Thickness: Equal to or greater than parent metal. Strength of welded joints shall be equal to or greater than strength of pipes being joined.
 - p. All welds shall be smooth with an internal crown of 1/16-inch or less, and external crown of 3/32-inch or less.
 - q. For grinding operations, use iron-free grinding wheels.
 - r. After welding, joint and the surrounding damaged or uncoated area shall be coated with same coating and thickness as shop applied coating.
 - s. Tack Welds: Make tack welds when required to aid in joining, with same grade of filler metal as for finished welds. For finish welding, either completely remove tack welds or grind starting and finishing ends of tack welds for incorporation into finished welds.
 - t. Clean and de-scale all welds per ASTM A380.
10. Steel Pipe Threaded Joints:

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- a. For threaded joints, use standard, right hand tapered full depth threads on steel piping and apply a manufacturer's recommended joint compound to male threads only, before installation.
 - b. Remove cuttings and foreign matter from inside of pipe.
 - c. Thoroughly clean all pipe, fittings, valves, specials, and accessories before installing.
11. Thermoplastic Pipe Joints:
 - a. Solvent Cement Welded Joints:
 - 1) Bevel pipe ends and remove all burrs before making joint. Clean pipe and fittings thoroughly. Do not make solvent cement joints if temperature is below 40 degrees F. Do not make solvent cement welded joints in wet conditions.
 - 2) Use solvent cement supplied or recommended by pipe manufacturer.
 - 3) Apply joint primer and solvent cement and assemble joints in accordance with recommendations and instructions of manufacturer of joint materials and pipe manufacturer.
 - 4) Implement appropriate safety precautions when using joint primers and solvent cements. Allow air to circulate freely through pipelines to allow solvent vapors to escape. Slowly admit fluid when flushing or filling pipelines to prevent compression of gases within pipes.
12. Copper Tubing Joints:
 - a. Soldered Joints:
 - 1) Assemble copper tubing with soldered joints. Solder shall be 95-5 tin-antimony solder conforming to ASTM B32.
 - 2) Ream or file pipe to remove burrs.
 - 3) Clean and polish contact surfaces of joints.
 - 4) Apply flux to both male and female ends.
 - 5) Insert end of tube into full depth of fitting socket.
 - 6) Heat joint evenly.
 - 7) Form continuous solder bead around entire circumference of joint starting at the bottom.
13. Mechanical Coupling Joints:
 - a. Mechanical couplings include: sleeve-type flexible couplings, split flexible couplings, ANSI/AWWA C606 grooved or shouldered end couplings, plasticized PVC couplings, and other mechanical couplings used.
 - b. Prior to installing and assembling mechanical couplings, thoroughly clean joint ends with a wire brush to remove foreign matter.
 - c. For mechanical couplings that incorporate gaskets, after cleaning apply lubricant to rubber gasket or inside of coupling housing and to joint ends. After lubrication, install gasket around joint end of previously installed piece and mate joint end of subsequent piece to installed piece. Position gasket and place coupling housing around gasket and over grooved or shouldered joint ends. Insert bolts and install nuts tightly by hand. Tighten bolts uniformly to produce an equal pressure on all parts of housing. When housing clamps meet metal to metal, joint is complete and further tightening is not required.
 - d. For plasticized PVC couplings, loosen the stainless steel clamping bands and remove the clamps from the coupling. Slide the coupling over the plain ends of the pipes to be joined without using lubricants. Place clamps over each end of coupling at grooved section and tighten with a torque wrench to torque recommended by manufacturer.
- B. Installing Valves and Accessories:
 1. Provide supports for large valves, flow meters, and other heavy items as shown or required to prevent strain on adjoining piping.
 2. Position flow measuring devices in pipe lines so that they have the amount of straight upstream and downstream runs recommended by the flow measuring device manufacturer, unless specific location dimensions are shown.

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3. Position swing check valves and butterfly valves so that they do not conflict with upstream and downstream elements of the piping system.
- C. Unions:
 1. Install dielectric unions as specified in Section 15120, Couplings, Adapters and Specials for Process Piping, where dissimilar metals are connected, except for bronze or brass valves in ferrous piping.
 2. Provide a union downstream of each valve with screwed connections.
 3. Provide screwed or flanged unions at each piece of equipment, where shown, and where necessary to install or dismantle piping.
- D. Transitions from One Type of Pipe to Another:
 1. Provide all necessary adapters, specials, and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.
- E. Closures:
 1. Provide closure pieces, such as blind flanges and caps, shown or required to complete the Work.

3.03 THRUST RESTRAINT

- A. Provide thrust restraint on all pressure piping systems and where otherwise shown or specified.
- B. Thrust restraints shall be designed for axial thrust exerted by test pressure specified in the Exposed Piping Schedule at end of this Section.
- C. Restrained Pipe Joints:
 1. Pipe joints shall be restrained by means suitable for the type of pipe being installed.
 - a. Ductile Iron, Push-on Joints and Mechanical Joints: Restrain with a proprietary restrained joint system as specified in Section 15061. Ductile iron pipe, lugs, and tie rods, or other joint restraint systems approved by Engineer. Restrain ductile iron pipe connected by flexible couplings or flanged coupling adapters by harnessing across the coupling or adapter using tie rods or extended bolts connecting between flanges.
 - b. Steel Pipe Joints: Provide butt-welded joints, lap welded joints, flanged joints, or mechanical coupling connections as shown and specified in Exposed Piping Schedule. Provide tie rods connected to lugs welded to the steel pipe for restraint at mechanical couplings.
 - c. Thermoplastic Joints: Where non-restrained joints are utilized, provide tie rods across the joint or other suitable joint restraint system, subject to approval of Engineer.

3.04 WORK AFFECTING EXISTING PIPING

- A. Location of Existing Piping:
 1. Locations of existing piping shown on Drawings is approximate.
 2. Determine the true location of existing piping to which connections are to be made, crossed, and that could be disturbed, and determine location of other facilities that could be affected by the Work.
- B. Taking Existing Pipelines Out of Service:
 1. Conform to Section 01711, Maintenance of Facility Operations.
- C. Work on Existing Pipelines:
 1. Cut or tap pipes as shown or required with machines and tools specifically designed for cutting or tapping pipelines.
 2. Install temporary plugs to prevent entry of mud, dirt, water, and debris into pipe.
 3. Provide necessary adapters, sleeves, fittings, pipe, and appurtenances required to complete the Work.
 4. Conform to applicable requirements of Section 01711, Maintenance of Facility Operations and Section 01031, Additions, Modifications and Alterations to Existing Buildings.

3.05 PAINTING

- A. Field painting shall conform to Section 09900, Painting.

3.06 FIELD QUALITY CONTROL

- A. Manufacturer's Installation Specialist:
 - 1. Provide services of a competent installation specialist of the pipe manufacturer when pipe installation commences for:
 - a. Thermoplastic pipe.
 - 2. Retain installation specialist at Site for a minimum of two days (eight hours per day at the Site) or until competency of the pipe installation crew has been satisfactorily demonstrated to Engineer.
- B. Testing, General:
 - 1. Test all piping, except as exempted in the Exposed Piping Schedule.
 - 2. Notification:
 - a. Notify Engineer at least 48 hours prior to testing.
 - b. When authorities having jurisdiction are to witness tests, notify Engineer and authorities having jurisdiction in writing at least 48 hours in advance of testing.
 - 3. Conduct all tests in presence of Engineer.
 - 4. Remove or protect pipeline-mounted devices that could be damaged by testing.
 - 5. Provide all apparatus and services required for testing, including:
 - a. Test pumps, compressors, hoses, calibrated gages, meters, test containers, valves, fittings, and temporary pumping systems required to maintain Owner's operations.
 - b. Temporary bulkheads, bracing, blocking, and thrust restraints.
 - 6. Provide air if an air test is required, power if pumping is required, and gases if gases are required.
 - 7. Unless otherwise specified, Owner will provide fluid required for hydrostatic testing. CONTRACTOR shall provide means to convey fluid for hydrostatic testing into the pipe being tested. CONTRACTOR shall provide fluid for other types of testing required.
 - 8. Repair observed leaks and repair pipe that fails to meet acceptance criteria. Retest after repair.
 - 9. Unless otherwise specified, testing shall include existing piping systems that connect with new piping system. Test existing pipe to nearest valve. Piping not installed by CONTRACTOR and that fails the test shall be repaired upon authorization of Engineer or Owner. Repair of existing piping will be paid as extra work unless otherwise specified.
- C. Test Schedule:
 - 1. Refer to the Exposed Piping Schedule for type of test required and required test pressure.
 - 2. Unless otherwise specified, the required test pressures are at lowest elevation of pipeline segment being tested.
 - 3. For piping not listed in Exposed Piping Schedule:
 - a. Hydrostatically test pipe that will convey liquid at a pressure greater than five psig. Provide process air pipe test for pipe that will convey air or gas under pressure or vacuum, except chlorine gas, which requires a separate test.
 - b. Disinfect for bacteriological testing piping that conveys potable water.
 - 4. Test Pressure:
 - a. Use test pressures listed in Exposed Piping Schedule.
 - b. If test pressure is not listed in Exposed Piping Schedule, or if a test is required for piping not listed in the Exposed Piping Schedule, test pressure will be determined by the Engineer based on the maximum anticipated sustained operating pressure and the methods described in the applicable ANSI/AWWA manual or standard that applies to the piping system.
- D. Hydrostatic Testing:
 - 1. Preparation for Testing:
 - a. For thermoplastic pipe, follow procedures described in Section 7 of ANSI/AWWA Standard C605.
 - b. For steel pipe, follow procedures described in AWWA Manual M11. Wetting period is not required for pipe that is not cement-lined.

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- c. For other piping follow procedures described in AWWA Manual M9. A wetting period is not required for pipe that is not cement mortar-lined.
 - d. Prior to testing, ensure that adequate thrust protection is in place and all joints are properly installed.
- 2. Test Procedure:
 - a. Fill pipeline slowly to minimize air entrapment and surge pressures. Fill rate shall not exceed one foot of pipe length per second in the pipe being tested.
 - b. Expel air from pipe as required. Obtain approval of Engineer prior to tapping pipe for expelling air.
 - c. Examine joints and valves, and make repairs to eliminate visible leakage.
 - d. After specified wetting period, add fluid as required to pressurize line to required test pressure. Maintain test pressure for a stabilization period of ten minutes before beginning test.
 - e. Timed test period shall not begin until after the pipe has been filled, exposed to the required wetting period, air has been expelled, and pressure stabilized.
 - f. Timed Test Period: After the stabilization period, maintain test pressure for at least two hours. During timed testing period, add fluid as required to maintain pressure within five psig of required test pressure.
 - g. Pump from a test container to maintain test pressure. Measure volume of fluid pumped from test container and record on test report. Record pressure at test pump at fifteen minute intervals for duration of test.
- 3. Allowable Leakage Rates: Leakage is defined as the quantity of fluid supplied to pipe segment being tested to maintain pressure within five psi of the test pressure during timed test period. Allowable leakage rates for piping are:
 - a. No Leakage: Pipe with flanged, welded, fused, threaded, soldered, or brazed joints.
 - b. Rates based on formula or table in AWWA Manual M41:
 - 1) Metal pipe joined with rubber gaskets as sealing members, including the following joint types:
 - (a) Bell and spigot and push-on joints.
 - (b) Mechanical joints.
 - (c) Bolted sleeve type couplings.
 - (d) Grooved and shouldered couplings.
 - c. Rates based on formula or table in ANSI/AWWA C605:
 - 1) Plastic pipe joined with O-ring gasket sealing members.
- E. Bacteriological Testing:
 - 1. Bacteriological testing for potable water lines, finished water lines, and other piping per Exposed Piping Schedule, is specified in Article 3.6 of this Section.

3.07 CLEANING AND DISINFECTION

- A. Cleaning, General: Clean pipe systems as follows:
 - 1. Thoroughly clean all piping, including flushing with water, dry air, or inert gas as required, in a manner approved by Engineer, prior to placing in service. Flush chlorine solution and sodium hypochlorite piping with water.
 - 2. Piping 24-inch diameter and larger shall be inspected from inside and debris, dirt and foreign matter removed.
 - 3. For piping that requires disinfection and has not been kept clean during storage or installation, swab each section individually before installation with a five percent hypochlorite solution.
- B. Disinfection:
 - 1. Disinfect all potable and finished water piping.
 - 2. A suggested procedure for accomplishing complete and satisfactory disinfection is specified below. Other procedures may be considered for acceptance by Engineer.
 - a. Prior to disinfection, clean piping as specified and flush thoroughly.

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- b. Conform to procedures described in ANSI/AWWA C651. Continuous feed method of disinfecting shall be used, unless alternative method is acceptable to Engineer.
3. Water for initial flushing, testing, and disinfection will be furnished by Owner. CONTRACTOR shall provide all temporary piping, hose, valves, appurtenances, and services required. Cost of water required for re-disinfection will be paid by CONTRACTOR to Owner at the water utility's standard rates.
4. Chlorine shall be provided by CONTRACTOR.
5. Bacteriologic tests will be performed by Owner. A certified test laboratory report will be provided to CONTRACTOR, if requested.
6. Chlorine concentration in the water entering the piping shall be between 50 and 100 ppm, such that a minimum residual concentration of 25 mg/l remains after a 24-hour retention period. Disinfect the piping and all related components. Repeat as necessary to provide complete disinfection.
7. After required retention period, the chlorinated water shall be flushed to a closed drain line, unless otherwise directed by Engineer. Properly dispose of chlorinated water in accordance with applicable regulations. Do not discharge chlorinated water to storm sewers, ditches, or overland.

3.08 SCHEDULE

A. Exposed Piping Schedule:

Service	Dia. (inch)	Mat'l.	Interior Lining	Exterior Coating	Pressure Class/ Thickness	Joint	Test (psig)	Remarks
WW	2 to 10	DI	CL	P	350/ Class 53	Flg	HYD (150)	All WW piping
CW	1	C	-	-	Type K	Sd	HYD (150)	Water service

B. Schedule Notes:

C. Heat tracing and insulation of piping to limits as defined on the contract drawings.

3.09 THE FOLLOWING ABBREVIATIONS ARE USED IN THE EXPOSED PIPING SCHEDULE:

A. Service Abbreviations:

SERVICE:	ABBREV.:	SERVICE:	ABBREV.:
WASTEWATER	WW	SPRAY WATER	SPW
DRAIN	DR	SAMPLE LINE	SML
SURGE RELIEF WASTEWATER	SRW		

A. Material Abbreviations:

MATERIAL	ABBREV.	MATERIAL	ABBREV.
DUCTILE IRON	DI	PRE-STRESSED CONCRETE CYLINDER PIPE	PCCP
CARBON STEEL	CS	POLYVINYL CHLORIDE	PVC
STAINLESS STEEL	SS	CHLORINATED POLYVINYL CHLORIDE	CPVC
COPPER	C	CLEAR POLYVINYL CHLORIDE	CLPVC
FIBERGLASS REINFORCED PLASTIC	FRP	CLEAR, FLEXIBLE POLYVINYL CHLORIDE TUBING	CFPVCT

SECTION 15052 – EXPOSED PIPING INSTALLATION

REINFORCED CONCRETE PIPE	RCP		GALVANIZED	GALV
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A. Lining/Coating Abbreviations:

LINING	ABBREV.		COATING	ABBREV.
CEMENT MORTAR LINED	CL		ASPHALTIC COATED	AC
GALVANIZED	GALV		POLYETHYLENE WRAPPED	PEW
PAINTED	P			

A. Joint Abbreviations:

JOINT TYPE	ABBREV.		JOINT TYPE	ABBREV.
BELL AND SPIGOT	BS		SOLVENT WELD	SW
RESTRAINED BELL AND SPIGOT	RBS		PLASTICIZED PVC COUPLING	PPVC
PUSH-ON JOINT	POJ		GROOVED OR SHOULDERED END COUPLING	GSEC
RESTRAINED PUSH-ON JOINT	RPOJ		FLANGED	FLG
MECHANICAL JOINT	MJ		THREADED	THD
RESTRAINED MECH. JOINT	RMJ		HOSE BARB	HBARB
SOLDERED	SD		COMPRESSION FITTINGS	CF

A. Test Abbreviations:

TEST	ABBREV.		TEST	ABBREV.
HYDROSTATIC TEST (TEST PRESSURE IN PSIG)	HYD ()		DISINFECTION AND BACTERIOLOGICAL TESTING	DBT
EXFILTRATION	EX		NO TEST REQUIRED	NR
TESTABLE JOINT GASKET TEST (TEST PRESSURE IN PSIG)	JT ()			

END OF SECTION

PART 1 - GENERAL

1.01 - SECTION INCLUDES

- A. Support of exposed piping. Pipe hangers shall be meant to include pipe support systems.
- B. The Drawings show the layout, sizes, elevations, and general arrangement of piping, valves, primary instrumentation elements, and process equipment. Pipe support systems shall be selected, configured, and installed in order to comply with the requirements contained herein. Install pipe support systems consisting of hangers, supports, clamps, U-bolts, brackets, bracings, attachments, and structural shapes to adequately support piping from building components, tank walls, decking, walkways, slabs, or fabricated structural assemblies specifically designed for this purpose.

1.02 - REFERENCES / QUALITY ASSURANCE

- A. Comply with the following in designing and installing pipe support systems:
 - 1. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 - 2. MSS SP69 - Pipe Hangers and Supports - Selection and Application
 - 3. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practice
- B. Terminology used in this Section is defined in MSS SP-90.
- C. Where product specifications are provided they are intended to provide a standard of quality.
- D. All interior and exterior pipe support systems shall be type 316 stainless steel.
- E. Below grade pipe support systems shall be as specified for underground pipe.

1.03 - SUBMITTALS

- A. Comply with the requirements in Section 01300.
- B. Submit the following:
 - 1. Product data and installation instructions.
 - 2. Pipe hanger and support catalog cuts showing manufacturer's figure number, size, materials of construction, and features for each type of support.
 - 3. Provide catalog cuts for all types of 316 stainless steel pipe supports.
 - 4. Provide details of each size knee brace and indicate materials of construction and the proposed locations.

PART 2 - PRODUCTS

2.01 - PIPE HANGERS AND SUPPORTS

- A. Combination clevis hanger, pipe insulation shield and vapor barrier jacketed high density insulating saddle with companion high density filler piece.
 - 1. Insulating saddles and filler pieces shall be of the same thickness and materials as the adjoining pipe insulation. Saddles shall cover the lower 180 degrees of the pipe or tubing, and companion filler pieces shall cover the upper 180 degrees of the pipe or tubing. Physical sizes, gages, etc. of the components of insulated hangers shall be in accordance with the following schedule:

SECTION 15060 – PIPE HANGERS

PIPE OR TUBING SIZE (Inches)	SHIELD LENGTH (Inches)	SHIELD GAGE	SADDLE LENGTH (Inches)	VAPOR BARRIER JACKET LENGTH (Inches)
Up to 2-1/2	4	16	6	10
3 to 6	4	14	6	10
8 to 14	10	12	12	16
16 and up	10	10	12	16

C. Pipe Insulation Shields: Fabricated of steel, with a minimum arc of 180 degrees, unless otherwise indicated. Shields for use with hangers and supports, with the exception of combination clevis type hangers, shall be in accordance with the following schedule:

D.

PIPE OR TUBING SIZE (Inches)	SHIELD LENGTH (Inches)	SHIELD GAGE
Up to 2-1/2	8	18
3 to 8	10	16
10 to 14	12	12
16 and up	18	10

C. Pipe Covering Protection Saddles: 3/16 inch thick steel, of sufficient depth for the insulation thickness specified, notched so that saddle contact with the pipe is approximately 50 percent of the total axial cross section. Saddles for pipe 12 inches in size and larger shall have a center support.

D. Pipe Hangers: Height adjustable standard duty clevis type, with cross bolt and nut.

1. Pipe spreaders or spacers shall be used on cross bolts of clevis hangers, when supporting piping 10 inches in size and larger.
2. Swivel ring type hangers will be allowed for sprinkler piping up to a maximum of 2 inches in size.

E. Adjustable Floor Rests and Base Flanges: Stainless Steel.

F. Hanger Rods: Stainless steel, fully threaded or threaded at each end, with two nuts at each end for positioning rod and hanger, and locking each in place.

G. Riser Clamps: Malleable iron or steel.

H. Rollers: Cast Iron.

2.02 - ANCHORS AND ATTACHMENTS

A. Sleeve Anchors (Group II, Type 3, Class 3): Molly's Div./USM Corp. Parasleeve Series, Ramset's Dynabolt Series, or Red Head/Phillips AN, HN, or FS Series.

B. Wedge Anchors (Zinc Plated, Group II, Type 4, Class 1): Hilti's Kwik Bolt Series, Molly's Div./USM Corp. Parabolt PB Series, Ramset's Trubolt T Series, or Red Head/Phillips WS Series.

SECTION 15060 – PIPE HANGERS

- C. Self-Drilling Anchors (Group III, Type 1): Ramset's RD Series, or Red Head/Phillips S Series.
- D. Non-Drilling Anchors (Group VIII, Type 1): Ramset's Dynaset DS Series, Hilti's HDI Series, or Red Head/Phillips J Series.
- E. Stud Anchors (Group VIII, Type 2): Red Head/Phillips JS Series.
- F. Beam Clamps: Forged steel beam clamp, with weldless eye nut (right hand thread), steel tie rod, nuts, and washers, Grinnell's Fig No. 292 (size for load, beam flange width, and rod size required).
- G. Metal Deck Ceiling Bolts: B-Line Systems' Fig. B3019.
- H. Continuous Slotted Type Concrete Insert, Galvanized:
 - 1. Load Rating 800 lbs/ft: Kindorf's D-986.
 - 2. Load Rating 1500 lbs/ft: Kindorf's D-980.
 - 3. Load Rating 3000 lbs/ft: Hohmann & Barnard's Inc. Type CS-H.
 - 4. Load Rating 4500 lbs/ft: Hohmann & Barnard's Inc. Type CS-HD.
- I. Threaded Type Concrete Insert: Galvanized ferrous castings, internally threaded to receive 3/4 inch diameter machine bolts.
- J. Wedge Type Concrete Insert: Galvanized box-type ferrous castings, designed to accept 3/4 inch diameter bolts having special wedge shaped heads.

2.03 - SEISMIC RESTRAINT SYSTEM FOR PIPING

- A. General:
 - 1. Coordinate all structural attachments with the Engineer.
 - 2. Design analysis shall include calculated dead loads, static seismic loads, and capacity of materials utilized for the connection of the equipment or system to the structure.
 - 3. Analysis shall detail anchoring methods, bolt diameter and embedment depth.
 - 4. Design seismic restraint devices to accept without failure the forces calculated per the applicable building code and as specified.
 - 5. Friction from gravity loads shall not be considered resistance to seismic forces.
 - 7. Construct seismic supports so that support engagement is maintained.
 - 8. Stamp seismic supports with manufacturer's name and part number for identification.
 - 9. Design seismic supports specifically for mitigation of seismic force loads.
 - 10. Design the stiffness of seismic restraints for mechanical equipment so that the load path for the restraint performs its intended function.
 - 11. Where possible, utilize components designed with tamper resistant break-off bolt heads or break-off nuts to assure visual verification of proper installation.
 - 12. Attachment components shall be UL Listed catalog components with published loads designed specifically for seismic application.
- B. Type: Pre-engineered seismic restraint system designed to support and restrain piping to meet applicable lateral force requirements.
- C. Manufacturers:
 - 1. B-Line.

SECTION 15060 – PIPE HANGERS

2. Mason Industries.
3. TOLCO Inc.
- D. Strut/Channel Bracing: 12 gauge solid steel with no holes, 1-5/8 inches wide x 1-5/8 inches deep of single lengths or stitch-welded back-to-back configurations.
- E. Pipe Bracing: Schedule 40 stainless steel pipe.
- F. Cable Bracing: Pre-stretched galvanized aircraft cable 7 x 19 strand core.
- G. Rigid Seismic Braces for Single Hung Pipe Systems: A12 strut channel or schedule 40 steel pipe. Maximum Brace Length: 13 feet-1 inches.
- H. Rigid Seismic Braces for Trapeze Supported Pipe Systems: A12 strut channel or schedule 40 steel pipe. Maximum Brace Length: 13 feet-1 inches.
- I. Cable Seismic Braces for Single Hung Pipe Systems: Pre-stretched aircraft cable 7 x 19 core.
- J. Cable Seismic Braces for Trapeze Supported Pipe Systems: Pre-stretched aircraft cable 7 x 19 core.
- K. Structural Attachments for Rigid and Cable Seismic Braces for Single Hung and Trapeze Supported Pipe Systems:
 1. Structural attachments shall be positive.
 2. Do not make structural attachments to the bottom of a bar joist.
 3. Supplemental steel shall be installed for all pre-cast decks less than 4 inches thick
 4. Do not use concrete inserts or continuous concrete insert strut to attach brace.
 5. Wedge type anchors are permitted. The size and embedment depth shall be determined by the supplier of the seismic restraint system and as approved.
- L. Vertical Brace Component (up-thrust protection)
 1. Reinforce Vertical Hanger Rod when lengths exceed the following:
 - a. 3/8 inch dia rod: 19 inches.
 - b. 1/2 inch dia rod: 25 inches.
 - c. 5/8 inch dia rod: 31 inches.
 - d. 7/8 inch dia rod: 43 inches.
 - e. 1 inch dia rod: 50 inches.
 - f. 1-1/4 inch dia rod: 62 inches.

2.04 - FASTENERS

- A. Bolts, Nuts, Washers, Lags, and Screws: Stainless steel; size and type to suit application; galvanized for treated wood. Except where shown otherwise on the Drawings, furnish type, size and grade required for proper installation of the Work.

PART 3 - EXECUTION

3.01 - PREPARATORY WORK

- A. Place inserts into construction form work expeditiously, so as not to delay the Work.

3.02 - INSTALLATION

- A. Do not hang or support one pipe from another or from ductwork. Do not bend threaded rod.

SECTION 15060 – PIPE HANGERS

- B. Support all insulated horizontal piping conveying fluids below ambient temperature, by means of hangers or supports with insulation shields installed outside of the insulation.
- C. Space hangers or supports for horizontal piping on maximum center distances as listed in the following hanger schedules, except as otherwise specified, or noted on the Drawings.
1. For Steel, and Threaded Brass Pipe:

PIPE SIZE (Inches)	MAXIMUM SPACING (Feet)
1 and under	8
1-1/4 and 1-1/2	9
2	10
2-1/2 and up	12

2. For Grooved End Steel Pipe:

PIPE SIZE (Inches)	MAXIMUM SPACING (Feet)
1-1/2 and under	7
2 through 4	10
5 and over	12

No pipe length shall be left unsupported between any two coupling joints.

3. For Copper Pipe and Copper Tubing:

PIPE OR TUBING SIZE (Inches)	MAXIMUM SPACING (Feet)
1-1/2 and under	6
2 and over	10

4. For Plastic Tubing:

PIPE OR TUBING SIZE (Inches)	MAXIMUM SPACING (Feet)
Under 2 inch	3

SECTION 15060 – PIPE HANGERS

PIPE OR TUBING SIZE (Inches)	MAXIMUM SPACING (Feet)
2 inch and over	4

5. Cast Iron Soil Pipe:
 - a. General:
 - 1) Where piping is suspended on centers in excess of 18 inches by means of non-rigid hangers, provide sway bracing to prevent horizontal pipe movement.
 - 2) Brace piping 5 inches and larger to prevent horizontal movement and/or joint separation. Provide braces, blocks, rodding or other suitable method at each branch opening, or change of direction
 - b. For Bell & Spigot Cast Iron Soil Pipe: Space hangers or support pipe at each joint or on maximum centers of 5 feet. Place hangers or supports as close as possible to joints and when hangers or supports do not come within 1 foot of a branch line fitting, install an additional hanger or support at the fitting.
 - c. For Hubless Cast Iron Soil Pipe: Space hangers or support pipe at each joint or on maximum centers of 5 feet. Place hanger or supports as close as possible to joints and when hangers or supports do not come within 1 foot of a branch line fitting, install an additional hanger or support at the fitting.
 6. For Directional Changes: Install a hanger or support close to the point of change of direction of all pipe runs in either a horizontal or vertical plane.
 7. For Concentrated Loads: Install additional hangers or supports, spaced as required and directed, at locations where concentrated loads such as in-line pumps, valves, fittings or accessories occur, to support the concentrated loads.
 8. For Branch Piping Runs and Runouts Over 5 feet In Length: Install a minimum of one hanger, and additional hangers if required by the hanger spacing schedules.
 9. Parallel Piping Runs: Where several pipe lines run parallel in the same plane and in close proximity to each other, trapeze hangers may be submitted for approval. Base hanger spacing for trapeze type hangers on the smallest size of pipe being supported. Design the entire hanger assembly based on a safety factor of five, for the ultimate strength of the material being used.
 10. Support floor drain traps from the overhead construction, with hangers of type and design as required and approved. Overhead supports are not required for floor drain traps installed directly below earth supported concrete floors.
- D. Size hanger rods in accordance with the following:

SECTION 15060 – PIPE HANGERS

PIPE OR TUBING SIZE (Inches)	SINGLE ROD HANGER SIZE (Inches)		DOUBLE ROD HANGER SIZE (Inches)	
	PIPE	TUBING	PIPE	TUBING
1/2 to 2	3/8	1/4	3/8	1/4
2-1/2 and 3	1/2	3/8	3/8	1/4
4 and 5	5/8	1/2	1/2	3/8
6	3/4	1/2	5/8	1/2
8, 10 and 12	7/8	5/8	3/4	5/8

1. Size hanger rods, for piping over 12 inches in size and multiple line supports, based on a safety factor of five for the ultimate strength of the materials being used.
 2. Secure hanger rods as follows: Install one nut under clevis, angle or steel member; one nut on top of clevis, angle or steel member; one nut inside insert or on top of upper hanger attachment and one nut and washer against insert or on lower side of upper hanger attachment. A total of four nuts are required for each rod, two at upper hanger attachment and two at hanger.
- E. Vertical Piping:
1. Support vertical risers of piping systems, by means of heavy duty hangers installed close to base of pipe risers, and by riser clamps with extension arms at intermediate floors, with the distance between clamps not to exceed 25 feet, unless otherwise specified. Support pipe risers in vertical shafts equivalent to the aforementioned. Install riser clamps above floor slabs, with the extension arms resting on floor slabs. Provide adequate clearances for risers that are subject to appreciable expansion and contraction, caused by operating temperature ranges.
 2. Support extension arms of riser clamps, secured to risers to be insulated for cold service, 4 inches above floor slabs, to allow room for insulating and vapor sealing around riser clamps.
 3. Install intermediate supports between riser clamps on maximum 6 foot centers, for copper tubing risers 1-1/4 inches in size and smaller, installed in finished rooms or spaces other than mechanical equipment machine or steam service rooms, or penthouse mechanical equipment rooms.
 4. Support cast iron risers, by means of heavy duty hangers installed close to the base of the pipe risers, and 1/4 inch thick malleable iron or steel riser clamps with extension arms at each floor level, with the distance between clamps not to exceed 25 feet. Support cast iron risers in vertical shafts equivalent to the aforementioned.
 5. Support hubless cast iron risers, by means of heavy duty hangers installed close to the base of the pipe risers, and by malleable iron or steel riser clamps with the extension arms at each floor level, with the distance between clamps or intermediate supports not to exceed 12 feet. Support risers in vertical shafts equivalent to the aforementioned.
- F. Underground Cast Iron Pipe Supports: Firmly bed pipe laid underground, on solid ground along bottom of pipe. Install masonry piers for pipe laid in disturbed or excavated soil or where suitable bearing cannot be obtained. Support pipe, laid proximate to building walls in disturbed or excavated

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soil, or where suitable bearing cannot be obtained, by means of wall brackets or hold-fasts secured to walls in an approved manner.

3.03 - UPPER HANGER ATTACHMENTS

A. General:

1. Secure upper hanger attachments to overhead structural steel, steel bar joists, or other suitable structural members.
2. Do not attach hangers to steel decks that are not to receive concrete fill.
3. Do not attach hangers to precast concrete plank decks less than 2-3/4 inches thick.
4. Do not use flat bars or bent rods as upper hanger attachments.

B. Attachment to Steel Frame Construction: Provide intermediate structural steel members where required by pipe support spacing. Select steel members for use as intermediate supports based on a minimum safety factor of five.

1. Do not use drive-on beam clamps.
2. Do not support piping over 4 inches in size from steel bar joists. Secure upper hanger attachments to steel bar joists at panel points of joists.
3. Do not drill holes in main structural steel members.
4. Beam clamps, with tie rods as specified, may be used as upper hanger attachments for the support of piping, subject to clamp manufacturer's recommended limits.

C. Attachment to Cast-In-Place Concrete: Secure to overhead construction by means of cast-in-place concrete inserts.

D. Attachment to Existing Cast-In-Place Concrete:

1. For piping up to a maximum of 4 inches in size, secure hangers to overhead construction with self-drilling type expansion shields and machine bolts.
2. Secure hangers to wall or floor construction with single unit expansion shields or self-drilling type expansion shields and machine bolts.

3.04 - ANCHORS, RESTRAINTS, RIGID SUPPORTS, STAYS AND SWAY BRACES

A. Install pipe anchors, restraints and sway braces, at locations noted on the Drawings. Design anchors so as to permit piping to expand and contract freely in opposite directions, away from anchor points. Install anchors independent of all hangers and supports, and in a manner that will not affect the structural integrity of the building.

B. Cast Iron Soil Piping Systems:

1. Where piping is suspended on centers in excess of 18 inches by means of non-rigid hangers, provide sway braces, of design, number and location in accordance with the Cast Iron Soil Pipe Institute's Cast Iron Soil Pipe and Fittings Handbook to prevent horizontal pipe movement.
2. Additionally, brace piping 5 inches and larger to prevent horizontal movement and/or joint separation. Provide braces, blocks, rodding or other suitable method at each branch opening, or change of direction in accordance with the Cast Iron Soil Pipe Institute's Cast Iron Soil Pipe and Fittings Handbook to prevent horizontal pipe movement.

3.05 - COMBINATION CLEVIS HANGER, PIPE INSULATION SHIELD AND VAPOR BARRIER JACKETED HIGH DENSITY INSULATING SADDLES

- A. Install a combination clevis hanger, pipe insulation shield and vapor barrier jacketed high density insulating saddles, at all points of support for piping or tubing to be insulated for cold service. Furnish companion high density vapor barrier jacketed saddle pieces, of the same material, thickness and length, for installation over the top 180 degree surface of pipe or tubing, at each point of support where an insulated clevis hanger is utilized.

3.06 - PIPE INSULATION SHIELDS

- A. Unless otherwise specified, install a pipe insulation shield, at all points of support. Center shields on all hangers and supports outside of high density insulation insert, and install in such a manner so as not to cut, or puncture jacket.

3.07 - PIPE COVERING PROTECTION SADDLES

- A. Install pipe covering protection saddles at all points of support, for steel piping 6 inches in size and larger, insulated with hot service insulation. Weld saddles to piping to insure movement with pipe.

3.08 - SEISMIC RESTRAINT SYSTEMS

- A. General:
 - 1. Install seismic restraints in accordance with seismic restraint manufacturer's printed installation instructions and guidelines unless otherwise specified.
 - 2. Do not use powder-actuated fasteners for seismic restraint anchorage in tension applications.
 - 3. Laterally support vertical risers with riser clamps at each floor unless otherwise specified.
 - 4. When systems cross building seismic separation points, pass between buildings, or are supported from different portions of the building, install to allow differential support displacements without damaging the pipe, equipment or support connections. Install pipe loops, anchors, offsets, and guides as required to provide specified capability of motion and limit movement of adjacent piping.
 - 5. Do not brace seismic bracing to different parts of the building that may respond differently during seismic activity.
 - 6. Provide adequately sized openings in walls, floors and ceilings for anticipated seismic movement. Provide fire stopping in fire-rated walls.
 - 7. Seismic restraint installations shall not cause any modifications in the positioning of equipment or piping resulting in stresses or misalignment.
 - 8. No rigid connections between equipment, piping, duct, or conduit shall be made to the building structure that degrades the noise and vibration-isolation system specified.
 - 9. Bracing attached to structural members may present additional stresses. Submit loads to the Engineer.
 - 10. Provide vertical stiffening components to support rods when necessary to accept compressive loads. Welding of components to vertical support rods is not acceptable.
 - 11. Clevis supported pipe must have cross-bolt support at each seismic bracing location.
 - 12. Notify Engineer of discrepancies between the specifications and field conditions prior to installation.
- B. Seismic Restraints for Piping:

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1. Trapeze assemblies supporting pipes shall be braced considering the total weight of the pipes on the trapeze.
2. Provide transverse bracing at 40 feet maximum spacing for welded steel pipe, brazed copper pipe or grooved piping with UL 213 listed connections.
 - a. Traverse bracing for threaded steel or copper pipe or non-listed UL grooved connections shall not exceed 20 feet maximum.
3. Provide longitudinal bracing at 80 feet maximum spacing for welded steel pipe, brazed copper pipe or grooved piping with UL 213 listed connections.
 - a. Traverse bracing for threaded steel or copper pipe or non-listed UL grooved connections shall not exceed 40 feet maximum.
4. Transverse piping restraints for one pipe section may also act as a longitudinal restraint for a pipe section of the same size connected perpendicular to it if the restraint is installed within 24-inches of the elbow centerline or tee or combined stresses are within allowable limits at longer distances.
5. Branch line piping shall not be used to brace main piping.
 - a. No larger diameter pipe shall be braced by a smaller diameter pipe.
6. Attach all longitudinal seismic braces directly to piping.
 - a. Encapsulate clamp and brace with insulation equal to that on the pipe.
7. Use hold down clamps to attach pipe to trapeze hangers before installing seismic restraints.
8. Brace vibration isolated piping with cables to allow flexibility.

END OF SECTION

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Scope:
 - 1. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish ductile iron pipe and fittings.
 - 2. Extent of piping is shown on the Drawings. Piping schedules in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation, specify pipe service, diameter, material, lining, coating, pressure rating, joint type, and testing required.
- B. Coordination: Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before ductile iron pipe Work.
- C. Related Sections:
 - 1. Section 02200 - Earthwork.
 - 2. Section 09900 - Painting.
 - 3. Section 15051 - Buried Piping Installation.
 - 4. Section 15052 - Exposed Piping Installation.
 - 5. Section 15120 - Couplers, Adapters, and Specials for Piping.

1.02 REFERENCES

- A. Standards referenced in this Section include:
 - 1. ANSI B18.2.1 - Square and Hex Bolts and Screws Inch Series.
 - 2. ANSI B18.2.2 - Square and Hex Nuts. (Inch Series).
 - 3. ASTM A193 - Alloy Steel and Stainless Steel Bolting Materials for High-Temperature Service.
 - 4. ASTM A194 - Specification for Carbon Steel and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both.
 - 5. ASTM A307 - Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
 - 6. ASTM A563 - Specification for Carbon and Alloy Steel Nuts.
 - 7. ASTM B117 - Practice for Operating Salt Spray (Fog) Apparatus.
 - 8. ASTM C283 - Test Methods for Resistance of Porcelain Enameled Utensils to Boiling Acid.
 - 9. ASTM D714 - Test Method for Evaluating Degree of Blistering of Paints.
 - 10. ASTM D792 - Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
 - 11. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications.
 - 12. ASTM D5162 - Discontinuity (Holiday) Testing of Non-Conductive Protective Coating on Metallic Substrates.
 - 13. ASTM E96 - Test Methods for Water Vapor Transmission of Materials.
 - 14. ASTM G14 - Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test).
 - 15. ASTM G95 - Test Methods for Cathodic Disbondment Test of Pipeline Coatings (Attached Cell Method).
 - 16. ANSI/AWWA C104 - Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water.
 - 17. ANSI/AWWA C110 - Ductile Iron and Gray Iron Fittings for Water.
 - 18. ANSI/AWWA C111 - Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
 - 19. ANSI/AWWA C115 - Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges.
 - 20. ANSI/AWWA C116 - Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile Iron and Gray Iron Fittings for Water Service.
 - 21. ANSI/AWWA C151 - Ductile Iron Pipe, Centrifugally Cast, for Water.
 - 22. ANSI/AWWA C153 - Ductile Iron Compact Fittings, 3 inch through 24 inch and 54 inch through 64 inch for Water Service.
 - 23. ANSI/AWWA C606 - Grooved and Shouldered Type Joints.

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24. MSS-SP 60 - Connecting Flange Joint Between Tapping Sleeves and Tapping Valves.
25. NACE RP0188 - Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
26. NAPF 500-03 - Surface Preparation Standard for Ductile Iron Pipe and Fittings Receiving Special External Coatings and/or Special Internal Linings.
27. NSF/ANSI 61 - Drinking Water System Components - Health Effects.
28. SSPC PA 2 - Measurement of Dry Coating Thickness with Magnetic Gages.
29. SSPC Painting Manual, Volume 1, Para. XIV.

1.03 QUALITY ASSURANCE

- A. Qualifications:
 1. Manufacturer:
 - a. Manufacturer shall have a minimum of five years successful experience producing ductile iron pipe and fittings and shall be able to show evidence of at least five installations in satisfactory operation in the United States that are similar applications to the specified service.
 - b. Lining and coating products shall be manufactured by a firm with a minimum of five years successful experience in protecting pipelines exposed to the specified service conditions , and shall be able to show evidence of at least five installations in satisfactory operation in the United States that are similar applications to the specified service.
 - c. When not applied by the manufacturer, lining and coating Subcontractor shall have a minimum of five years successful experience in the application of the specified linings and coatings for similar applications for the specified service, and shall be able to show evidence of at least five installations in satisfactory operation in the United States.
- B. Supply and Compatibility:
 1. Unless otherwise approved, obtain all pipe, fittings, and appurtenances included in this Section from a single ductile iron pipe manufacturer.
 2. Ductile iron pipe manufacturer shall review and approve or prepare all Shop Drawings and other submittals for pipe, fittings, and appurtenances furnished under this Section.
 3. Pipe, fittings, and appurtenances shall be suitable for the specified service and shall be integrated into overall piping system by ductile iron pipe manufacturer.
 4. Ductile iron pipe manufacturer shall be responsible for all products and all factory-applied linings and coatings, whether installed at pipe manufacturer's facility or at manufacturer's Supplier's facility.
- C. Regulatory Requirements:
 1. Pipe and fittings, including linings and coatings, that will convey potable water or water that will be treated to become potable, shall be certified by an accredited organization in accordance with NSF/ANSI 61 as being suitable for contact with potable water, and shall comply with requirements of authorities having jurisdiction at Site.

1.04 SUBMITTALS

- A. Action Submittals: Submit the following with Shop Drawings required under Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation:
 1. Shop Drawings:
 - a. Detailed drawings and data for pipe, fittings, gaskets, appurtenances, linings, and coatings.
 2. Product Data:
 - a. Surface preparation and application reports and procedures as required for lining and coating of pipe and fittings. Ductile iron pipe and fitting manufacturer and manufacturer and applicator of lining and coating, as specified, shall mutually determine recommended surface preparation and application methods, and provide written verification of mutually selected method in the submittals.

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3. Samples:
 - a. Submit Sample of pipe and fitting with each type of lining, for use at the Site to verify continuity, surface gloss, and color, as applicable, via visual inspection.
4. Test Procedures: For linings and coatings in pipe and fittings.
- B. Informational Submittals: Submit the following:
 1. Certificates:
 - a. Submit certificate signed by manufacturer of each product that product conforms to applicable referenced standards and the Contract Documents.
 - b. Submit certificate signed by applicator of the linings and coatings stating that product to be applied conforms to applicable referenced standards and that the applicator shall conform to the Contract Documents.
 2. Source Quality Control Submittals:
 - a. Submit results of specified shop tests for pipe, fittings, linings, and coatings.
 - b. Lining and coating test coupons.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. General:
 1. Piping systems shall be suitable for their intended use.
 2. Joints shall be as specified in Section 15051, Buried Piping Installation and Section 15052, Exposed Piping Installation. If not specified, provide flanged joints for exposed piping and push-on or mechanical joints for buried piping. Provide couplings on pipe with plain or grooved ends where shown or where approved by Engineer.
- B. Ductile Iron Pipe, Joints, and Fittings:
 1. Flanged Pipe: Fabricate in accordance with ANSI/AWWA C115.
 - a. Pressure Rating: As specified in piping schedule in Section 15052, Exposed Pipe Installation. If not otherwise specified, use Special Thickness Class 53.
 2. Non-Flanged Pipe: Conform to ANSI/AWWA C151 for material, pressure, dimensions, tolerances, tests, markings, and other requirements.
 - a. Pressure Class: As specified in piping schedules in Section 15051, Buried Piping Installation and Section 15052, Exposed Piping Installation.
 - b. Special Thickness Class: As specified in piping schedules in Section 15051, Buried Piping Installation and Section 15052, Exposed Piping Installation.
 3. Pipe Joints:
 - a. Flanged Joints: Conform to ANSI/AWWA C110 and ANSI/AWWA C111 capable of meeting the pressure rating or special thickness class, and test pressure specified in piping schedule in Section 15052, Exposed Pipe Installation.
 - 1) Gaskets: Unless otherwise specified, gaskets shall be at least 1/8-inch thick, ring or full-face as required for the pipe, of synthetic rubber compound containing not less than 50 percent by volume nitrile or neoprene, and shall be free from factice, reclaimed rubber, and other deleterious substances. Gaskets shall be suitable for the service conditions specified, specifically designed for use with ductile iron pipe and fittings.
 - 2) Bolts: Comply with ANSI B18.2.1.
 - (a) Exposed: ASTM A307, Grade B.
 - (b) Buried, Submerged, in Wet Well or in-ground vaults: ASTM A193, Grade B8M, Class 2, Heavy hex, Type 316 stainless steel.
 - 3) Nuts: Comply with ANSI B18.2.2.
 - (a) Exposed: ASTM A563, Grade A, Heavy hex.

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- (b) Buried or Submerged, in Wet Well or in-ground vaults: ASTM A194, Grade B8M, Heavy hex, Type 316 stainless steel.
- b. Mechanical Joints: Comply with ANSI/AWWA C111 and ANSI/AWWA C151, capable of meeting pressure rating or special thickness class, and test pressure specified in piping schedules in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
 - 1) Glands: Ductile iron.
 - 2) Gaskets: Plain tip.
 - 3) Bolts and Nuts: High strength, low alloy steel.
 - 4) Manufacturers: Provide products of one of the following:
 - (a) Clow Water Systems Company
 - (b) Atlantic States Cast Iron Pipe Company
 - (c) McWane Cast Iron Pipe Company
 - (d) Griffin Pipe Products Co.
 - (e) U.S. Pipe and Foundry Co.
 - (f) Or equal.
- c. Push-On Joints: Comply with ANSI/AWWA C111 and ANSI/AWWA C151, capable of meeting pressure class or special thickness class, and test pressure specified in piping schedules in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
 - 1) Gaskets: Vulcanized SBR, unless otherwise specified.
 - 2) Stripes: Each plain end shall be painted with a circular stripe to provide a guide for visual check that joint is properly assembled.
 - 3) Products and Manufacturers: Provide one of the following:
 - (a) Tyton or Fastite Joint by Clow Water Systems, Atlantic States Cast Iron Pipe Company, Canada Pipe Company, Ltd., McWane Cast Iron Pipe Company, Pacific States Cast Iron Pipe Company, and Griffin Pipe Products Company.
 - (b) Fastite Joint by American Cast Iron Pipe Company.
 - (c) Tyton Joint by U.S. Pipe and Foundry Company.
 - (d) Or equal.
- d. Grooved End Joints: Comply with ANSI/AWWA C606.
 - 1) Gaskets: Flush seal type designed for ductile iron that complies with or exceeds requirements of ASTM D2000
 - 2) Bolts and nuts: As specified for flanged joints.
 - 3) Unless otherwise specified, grooved end couplings shall be rigid joint for exposed service and flexible joint for buried service.
 - 4) Products and Manufacturers: Provide one of the following:
 - (a) Victaulic, Style 31.
 - (b) Tyler Pipe, Gustin Bacon Division, Series 500.
 - (c) Or equal.
- e. Restrained Joints: Restrained push-on joints shall be capable of being deflected after full assembly. Field cuts of restrained pipe are not allowed without approval of Engineer.
 - 1) Products and Manufacturers: Provide restrained joints for mechanical joint piping by one of the following:
 - (a) Megalug, Series 1100, by EBBA Iron Sales, Inc.
 - (b) Uni-Flange, Series 1400, by Ford Meter Box Co.
 - (c) One-Lok, Series SLD, by SIGMA Corporation.
 - (d) Stargrip, Series 3000, by Star Pipe Products.
 - (e) Or equal.
 - 2) Products and Manufacturers: Provide restrained joints for push-on joint piping by one of the following:
 - (a) Super-Lock Joint Pipe, by Clow Water Systems, a division of McWane, Inc.

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- (b) TR Flex Joint, by U.S. Pipe and Foundry Company.
 - (c) Snap-Lok, by Griffin Pipe Products Company.
 - (d) Megalug, Series 1700, by EBBA Iron Sales, Inc.
 - (e) Uni-Flange, Series 1450, by Ford Meter Box Co.
 - (f) One-Lok, Series SSLDH, by SIGMA Corporation.
 - (g) Stargrip, Series 3100P, by Star Pipe Products.
 - (h) Or equal.
- 4. Flanged and Push-On Joint Fittings: Comply with ANSI/AWWA C110 and ANSI/AWWA C111.
 - a. Material: Ductile iron.
 - b. Pressure rating, gaskets, bolts, and nuts shall be as specified for flanged joints. Pressure rating of fittings shall meet, but not exceed, specified pressure rating or special thickness class of the connected pipe.
- 5. Mechanical Joint Fittings: Comply with ANSI/AWWA C153, ANSI/AWWA C110 and ANSI/AWWA C111.
 - a. Material: Ductile iron.
 - b. Glands: Ductile iron.
 - c. Pressure rating, gaskets, bolts, and nuts shall be as specified for mechanical joints. Pressure rating of fittings shall meet, but not exceed, specified pressure rating or special thickness class of connected pipe.
- C. Lining, General:
 - 1. Surface Preparation:
 - a. Initial Surface Inspection: Surface to be lined shall be inspected by pipe and fitting manufacturer and applicator, if applicator is other than pipe and fitting manufacturer. Inspecting parties shall inspect surface to be coated and mutually determine recommended surface preparation method.
 - b. Surface Preparation: Prepare surface in accordance with recommended method.
 - c. Finished Surface Inspection: Lining applicator shall inspect finished surface prior to application to determine acceptability. If surface is unacceptable, repeat surface preparation as necessary.
- D. Cement-mortar Lining:
 - 1. Where specified in piping schedules included with Section 15051, Buried Piping Installation and Section 15052, Exposed Piping Installation, pipe and fittings shall be lined with bituminous seal coated cement-mortar lining in accordance with ANSI/AWWA C104.
- E. Couplings:
 - 1. Refer to Section 15120, Couplings, Adapters, and Specials for Process Piping.
- F. Specials:
 - 1. Transition Pieces:
 - a. Provide suitable transition pieces (adapters) for connecting to existing piping.
 - b. Unless otherwise shown or indicated, expose existing piping to determine material, dimensions, and other data required for transition pieces.
 - 2. Taps:
 - a. Provide taps where shown or required for small-diameter piping or instrumentation connections.
 - b. Provide corporation stops where shown or required.
 - c. Where pipe wall thickness or tap diameter will not allow engagement of 5 full threads, provide tapping saddle with outlet joints conforming to requirements of Paragraph 2.1.B.3.a of this Section for four-inch through 12-inch diameter pipe, and Paragraph 2.1.B.3.b. for 14-inch through 54-inch diameter pipe.
 - d. For flanged connections on tapping saddle outlet branch, counterbore flange in accordance with MSS SP-60 dimensions. Inside diameter of outlet shall be 1/4-inch greater than nominal diameter.

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3. Tangential Outlets:
 - a. Provide tangential outlet fittings where shown or indicated.
 - b. Weld-on fittings are acceptable.
 - c. Flanged and grooved end joints are not allowed.
- G. Polyethylene Casing Jacket:
 1. The outer protective jacket shall consist of black PE, UV inhibited, factory applied with the following specifications:
 - a. Seamless casing shall be extruded from polyethylene resin with cell class requirements 334360C as defined in ASTM D3350-12;
 - b. Polyethylene compound shall be of color and UV stabilizer Code C (black) as specified in ASTM D3350, with a target range of 2 to 2.5% well dispersed carbon black (max. 2.8%);
 - c. Jacket thickness: 4.44 mm (175 mils).
 2. Insulation:
 - a. Material: Rigid polyurethane foam, factory applied.
 - b. Thickness: 50.8 mm (2 in).
 - c. Density: ASTM D1622, 35 to 48 kg/m³ (2.2 to 3.0 lbs/ft³).
 - d. Closed cell content: ASTM D6226, 90%, minimum.
 - e. Water absorption: ASTM D2842, 4.0% by volume.
 - f. Thermal conductivity: ASTM C518, 0.020 to 0.025 W/m°C (0.14 to 0.17 Btu in/ft² hr F).
 - g. Temperature range: Cryogenic to 93.3 C (200 F).
 - h. Insulated pipe joints with no mechanical restraints shall be completed with a 228.6 mm (9 in) wide PE cover sheet, stainless steel bands and PE cover sheet
 - i. Insulation kits for fittings: Rigid polyisocyanurate or polyurethane foam half shells complete with a heavy polymer protective coating on the outside surfaces. All insulation kits shall be supplied complete with silicone caulking, stainless steel bands and gear clamps. If the insulation shells are form hugging to the fitting, 152.4 mm (6 in) wide PE cover sheets with stainless steel bands and gear clamps shall be supplied for each end of the kit.

2.02 MARKING FOR IDENTIFICATION

- A. In addition to identification markings specified in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation, also stamp, mark, and identify push-on joint and mechanical joint pipe with:
 1. Name or trademark of manufacturer.
 2. Weight, class or nominal thickness, and casting period.
 3. Country where cast.
 4. Year the pipe was produced.
 5. Letters "DI" or "Ductile" shall be cast or metal stamped
- B. In addition to identification markings specified in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation, also stamp, mark, and identify flanged pipe with:
 1. Flange manufacturer's mark, size, and letters "DI" cast or stamped on the flanges.
 2. Fabricator's mark if other than flange manufacturer.
 3. Length and weight.
- C. In addition to identification markings specified in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation, also stamp, mark, and identify fittings with:
 1. Manufacturer's identification.
 2. Pressure rating.
 3. Nominal diameters of openings.
 4. Country where cast.
 5. Number of degrees or fraction of the circle on bends.
 6. Letters "DI" or "Ductile" cast on them.

2.03 EXTERIOR SURFACE PREPARATION AND COATINGS

- A. General Coating Requirements:
 - 1. Coating types are specified in piping schedules in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
 - 2. Exposed Pipe and Fittings:
 - 3. Surface Preparation:
 - a. Initial Surface Inspection: Pipe and fitting manufacturer and coating applicator shall inspect surface to be coated and mutually determine recommended NAPF 500-03 surface preparation method.
 - b. Surface Preparation: Prepare surface in accordance with recommended NAPF 500-03 method.
 - c. Finished Surface Inspection: Prepared surfaces shall be inspected by coating applicator prior to application to determine acceptability of finished surface. If surface is unacceptable, repeat surface preparation and re-application as necessary.
 - 4. After recommended surface preparation, prime coat exterior ferrous metal surfaces of pipe and fittings in the shop in accordance with Section 09900, Painting.
 - 5. Field painting shall comply with Section 09900, Painting.
- B. Buried Pipe and Fittings:
 - 1. Asphaltic Coating: Where specified in piping schedule in Section 15051, Buried Piping Installation, coat pipe and fittings with an asphaltic coating approximately one-mil thick, in accordance with ANSI/AWWA C151, ANSI/AWWA C115, ANSI/AWWA C110, and ANSI/AWWA C153, as applicable.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Inspect piping to assure that piping is free from defects in material and workmanship. Verify compatibility of pipe, fittings, gaskets, linings, and coatings.
- B. Visually inspect at the Site coated or lined pipe and fittings with Engineer and compare to approved Samples to verify lining continuity, surface gloss, and color, as applicable. Notify pipe manufacturer of damaged or unacceptable products. Pipe manufacturer shall visit the Site and perform testing to verify conformance with the Contract Documents to determine if products require replacement or repair. Repair or replace unacceptable products at no cost to Owner.

3.02 INSTALLATION AND FIELD QUALITY CONTROL

- A. For buried piping installation and testing, refer to Section 15051, Buried Piping Installation.
- B. For exposed piping installation and testing, refer to Section 15052, Exposed Piping Installation.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Beam clamps.
- B. Pipe hangers.
- C. Pipe supports, guides, shields, and saddles.
- D. Seismic bracing hardware.
- E. Anchors and fasteners.

1.02 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping; 2022.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
- G. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2022).
- H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.
- J. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- K. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.
- L. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2022.
- M. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a.
- N. FM (AG) - FM Approval Guide; Current Edition.
- O. MFMA-4 - Metal Framing Standards Publication; 2004.
- P. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).
- Q. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- R. UL (DIR) - Online Certifications Directory; Current Edition.
- S. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:

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1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured.

1.04 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.
1. Fiberglass Strut Channel Framing Systems: Include requirements for strength derating according to ambient temperature.
- B. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
1. Application of protective inserts, saddles, and shields at pipe hangers for each type of insulation and hanger.
- C. Derating Calculations for Fiberglass Strut Channel Framing Systems: Indicate load ratings adjusted for applicable service conditions.
- D. Evaluation Reports: For products specified as requiring evaluation and recognition by ICC Evaluation Service, LLC (ICC-ES), provide current ICC-ES evaluation reports upon request.
- E. Installer's Qualifications: Include evidence of compliance with specified requirements.
- F. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.05 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Installer Qualifications for Powder-Actuated Fasteners (when specified): Certified by fastener system manufacturer with current operator's license.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Provide required hardware to hang or support piping, equipment, or fixtures with related accessories as necessary to complete installation of plumbing work.
- B. Provide hardware products listed, classified, and labeled as suitable for intended purpose.

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- C. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
- D. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
- E. Fire Resistance: Provide hardware rated for 60 minutes resistance unless specifically indicated by the authority having jurisdiction.
- F. Materials for Metal Fabricated Supports:
 - 1. Zinc-Plated Steel: Electroplated in accordance with ASTM B633 unless stated otherwise.
 - 2. Galvanized Steel: Hot-dip galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M unless stated otherwise.
- G. Corrosion Resistance: Use corrosion-resistant metal-based materials fully compatible with exposed piping materials and suitable for the environment where installed.
 - 1. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
 - 2. Outdoor, Damp, or Wet-Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.

2.02 BEAM CLAMPS

- A. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.
- B. C-Clamp: MSS SP-58 type 23, malleable iron and steel with plain, stainless steel, and zinc finish.
- C. Small or Junior Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish. For inverted usage provide manufacturer listed size(s).
- D. Wide Mouth Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish.
- E. Centerload Beam Clamp with Extension Piece: MSS SP-58 type 30, malleable iron with plain finish.
- F. FM (AG) and UL (DIR) Approved Beam Clamp: MSS SP-58 type 19, plain finish.
- G. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
- H. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

2.03 PIPE HANGERS

- A. Band Hangers, Adjustable:
 - 1. MSS SP-58 type 7 or 9, zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
- B. J-Hangers, Adjustable:
 - 1. MSS SP-58 type 5, zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
- C. Swivel Ring Hangers, Adjustable:
 - 1. MSS SP-58 type 10, epoxy-painted, zinc-colored.
 - 2. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
 - 3. FM (AG) and UL (DIR) listed for specific pipe size runs and loads.
 - 4. Felt-Lined: Provide for uninsulated pipe to reduce noise and prevent static issues.
- D. Clevis Hangers, Adjustable:
 - 1. Copper Tube: MSS SP-58 type 1, epoxy-plated copper.
 - 2. Felt-Lined: MSS SP-58 type 1, zinc-plated, silicone-free carbon steel.
 - 3. Light-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.
 - 4. Standard-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.
 - 5. UL (DIR) listed: Pipe sizes 1/2 to 4 inch (15 to 100 mm, DN).

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6. FM (AG) listed: Pipe sizes 1/2 to 4 inch (15 to 100 mm, DN).
- E. Nonmetallic Pipe Hangers:
 1. CPVC fabricated, snap-action hanger for pendant or sidewall applications.

2.04 PIPE CLAMPS

- A. Riser Clamps:
 1. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
 2. MSS SP-58 type 1 or 8, carbon steel or steel with epoxy plated, plain, stainless steel, or zinc plated finish.
 3. Medium Split Horizontal Pipe Clamp: MSS SP-58 type 4, carbon steel or stainless steel with epoxy plated, plain, stainless steel, or zinc plated finish.
 4. Copper Tube Pipe Clamp: MSS SP-58 type 8, epoxy plated copper.
 5. UL (DIR) listed: Pipe sizes 1/2 to 8 inch (15 to 200 mm, DN).
- B. Extension Split Pipe Clamp:
 1. MSS SP-58 type 12, hinged split ring and yoke roller hanger with epoxy copper or plain finish.
 2. Material: ASTM A47/A47M malleable iron or ASTM A36/A36M carbon steel.
 3. Provide hanger rod and nuts of the same type and material for a given pipe run.
 4. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.
- C. Offset Pipe Clamps: Double-leg design two-piece pipe clamp.
- D. Strut Clamps:
 1. Pipe Clamp: Two-piece rigid, universal, or outer diameter type, carbon steel with epoxy copper or zinc finish.
 2. Cushioned Pipe or Tubing Strut Clamp: Provide strut clamp with thermoplastic elastomer cushion having dielectric strength of 670 V/mil (26,398,000 V/m).
 3. Service Temperature Range: Minus 65 to 275 degrees F (Minus 53.8 to 135 degrees C).
- E. Insulation Coupling:
 1. Two bolt-type clamps designed for installation under insulation.
 2. Material: Carbon steel with epoxy copper or zinc finish.

2.05 PIPE SUPPORTS, GUIDES, SHIELDS, AND SADDLES

- A. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.
- B. Stanchions:
 1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
 2. Provide coated or plated saddles to isolate steel hangers from dissimilar metal tube or pipe.
 3. For pipe runs, use stanchions of same type and material where vertical adjustment is required for stationary pipe.
- C. U-Bolts:
 1. MSS SP-58 type 24, carbon steel u-bolt for pipe support or anchoring.
- D. Intermediate Anchors and Pipe Alignment Guides:
 1. Pipe Sizes 6 inch (150 mm, DN) and Smaller: Minimum clearance of 0.16 inch (4 mm).
 2. Pipe Size 8 inch (200 mm, DN): 0.625 inch (16 mm) U-bolt with double nuts providing minimum clearance of 0.28 inch (7 mm).
 3. Pipe Size 10 inch (250 mm, DN): 0.75 inch (19 mm) U-bolt.
 4. Pipe Sizes 12 to 16 inch (300 to 400 mm, DN): 0.875 inch (24 mm) U-bolt.
 5. Pipe Sizes 18 to 30 inches (450 to 750 mm, DN): 1 inch (25 mm) U-bolt.
 6. Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.

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- E. Pipe Alignment Guides, Galvanized steel:
 - 1. Pipe Sizes 8 inch (200 mm, DN) and Smaller: Spider or sleeve type.
 - 2. Pipe Sizes 10 inch (250 mm, DN) and Larger: Roller type.
- F. Pipe Shields for Insulated Piping:
 - 1. MSS SP-58 type 40, ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
 - 2. General Construction and Requirements:
 - a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
 - b. Shields Material: UV-resistant polypropylene with glass fill.
 - c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch (321 mm).
 - d. Service Temperature: Minus 40 to 178 degrees F (Minus 40 to 81 degrees C).
 - e. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
- G. Pipe Supports:
 - 1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
 - 2. Liquid Temperatures Up to 122 degrees F (50 degrees C):
 - a. Overhead Support: MSS SP-58 types 1, 3 through 12 clamps.
 - b. Support From Below: MSS SP-58 types 35 through 38.
 - 3. Operating Temperatures from 122 to 446 degrees F (50 to 230 degrees C):
 - a. Overhead Support: MSS SP-58 type 1 or 3 through 12 clamps with appropriate saddle of MSS SP-58 type 40 for insulated pipe.
 - b. Roller Chair: MSS SP-58 types 41 or 43 through 46 roller chair support with appropriate saddle of MSS SP-58 type 39 for insulated pipe.
 - c. Sliding Support: MSS SP-58 types 35 through 38.
- H. Pipe Supports, Thermal Insulated:
 - 1. General Requirements:
 - a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
 - b. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.
 - c. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
 - d. Provide pipe supports for 1/2 to 30 inch (15 to 750 mm, DN) iron pipes.
 - e. Insulation inserts to consist of rigid phenolic foam insulation surrounded by 360 degree, PVC jacketing.
 - 2. PVC Jacket:
 - a. Pipe insulation protection shields to be provided with ball bearing hinge and locking seam.
 - b. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
 - c. Maximum Service Temperature: 180 degrees F (82 degrees C).
 - d. Moisture Vapor Transmission: 0.0071 perm inch (0.0092 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
 - e. Minimum Thickness: 60 mil, 0.06 inch (1.524 mm).
 - f. Connections: Brush-on welding adhesive.

2.06 SEISMIC BRACING HARDWARE

- A. Cable Suspension Systems:
 - 1. Strut channel or bracket-fitted fitting with locking mechanism for pipe or equipment suspension using cable wires extended to surface-mounted end-fixing fittings.
 - 2. Provide cable wire and end-fixing as required to hold minimum weight of 120 lb (54.4 kg).
- B. Cable Sway Bracing Systems:

SECTION 15062 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

1. Cable wire hanger with fix and release spring mechanism enclosed using zinc housing with 302 stainless steel components for pipe or equipment suspension to surface-mounted end-fixing fittings.
2. Provide cable wire and end-fixing as required to hold minimum weight of 25 lb (11.3 kg).

2.07 ANCHORS AND FASTENERS

- A. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
- B. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
- C. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
- D. Hollow Masonry: Use toggle bolts.
- E. Hollow Stud Walls: Use toggle bolts.
- F. Steel: Use beam ceiling clamps, beam clamps, machine bolts, or welded threaded studs.
- G. Beam Ceiling Flanges: ASTM A47/A47M Grade 32510, malleable iron or stainless steel with copper, plain, stainless steel, or zinc finish.
- H. Sheet Metal: Use sheet metal screws.
- I. Wood: Use wood screws.
- J. Plastic and lead anchors are not permitted.
- K. Powder-actuated fasteners are not permitted.
- L. Hammer-driven anchors and fasteners are not permitted.
- M. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
- N. Preset Concrete Inserts: Continuous metal strut channel and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 1. Channel Material: Use galvanized steel.
 2. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch (2.66 mm) minimum base metal thickness.
 3. Manufacturer: Same as manufacturer of metal strut channel framing system.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- H. Equipment Support and Attachment:

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1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- I. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.
- J. Secure fasteners according to manufacturer's recommended torque settings.
- K. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

- A. Inspect support and attachment components for damage and defects.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 15070 – SOUND, VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Seismic control requirements.
 - 1. Includes requirements for seismic qualification of equipment not specified in this section.
- B. Seismic restraint systems.

1.02 DEFINITIONS

- A. Plumbing Component: Where referenced in this section in regards to seismic controls, applies to any portion of the plumbing system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., piping).
- B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.03 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASCE 19 - Structural Applications of Steel Cables for Buildings; 2016.
- C. FEMA 412 - Installing Seismic Restraints for Mechanical Equipment; 2014.
- D. FEMA 413 - Installing Seismic Restraints for Electrical Equipment; 2004.
- E. FEMA 414 - Installing Seismic Restraints for Duct and Pipe; 2004.
- F. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage; 2012.
- G. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. ICC-ES AC156 - Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components; 2010, with Editorial Revision (2015).
- I. MFMA-4 - Metal Framing Standards Publication; 2004.
- J. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Seismic Controls:
 - a. Coordinate the arrangement of seismic restraints with piping, conduit, equipment, and other potential conflicts installed under other sections or by others.
 - b. Coordinate the work with other trades to accommodate relative positioning of essential and nonessential components in consideration of seismic interaction.
 - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 3000.

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1.05 SUBMITTALS

- A. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
 - 1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.
 - 2. Seismic Controls: Include seismic load capacities.
- C. Shop Drawings - Vibration Isolation Systems:
 - 1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
 - 2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.
- D. Shop Drawings - Seismic Controls:
 - 1. Include dimensioned plan views and sections indicating proposed plumbing component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.
 - 2. Identify mounting conditions required for equipment seismic qualification.
 - 3. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
 - 4. Indicate proposed arrangement of distributed system trapeze support groupings.
 - 5. Indicate proposed locations for distributed system flexible fittings and/or connections.
 - 6. Indicate locations of seismic separations where applicable.
 - 7. Include point load drawings indicating design loads transmitted to structure at each attachment location.
- E. Seismic Design Data:
 - 1. Compile information on project-specific characteristics of actual installed plumbing components necessary for determining seismic design forces required to design appropriate seismic controls, including but not limited to the following.
 - a. Component operating weight and center of gravity.
 - b. Component elevation in the building in relation to the roof elevation (z/h).
 - c. Component importance factor (I_p).
 - d. For distributed systems, component materials and connection methods.
 - e. Component amplification factor (a_p) and component response modification factor (R_p), determined in accordance with ASCE 7 tables.
 - f. Applicability of overstrength factor (for certain anchorage in concrete and masonry).
 - 2. Include structural calculations, stamped or sealed by seismic controls designer, demonstrating suitability of seismic controls for seismic design forces.
- F. Certification for seismically qualified equipment; identify basis for certification.
- G. Evaluation Reports: For products specified as requiring evaluation and recognition by a qualified evaluation service, provide current evaluation reports.
- H. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- I. Evidence of qualifications for seismic controls designer.
- J. Evidence of qualifications for manufacturer.
- K. Manufacturer's detailed field testing and inspection procedures.
- L. Field quality control test reports.

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1.06 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Seismic Controls Designer Qualifications: Registered professional engineer licensed in the State in which the Project is located and with minimum five years experience designing seismic restraints for nonstructural components.
 - 1. Designer may be employed by the manufacturer of the seismic restraint products.
- D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SEISMIC CONTROL REQUIREMENTS

- A. Design and provide plumbing component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor plumbing components.
- B. Seismic Design Criteria: Obtain from project Structural Engineer of Record.
- C. Component Importance Factor (Ip): Plumbing components to be assigned a component importance factor (Ip) of 1.5 unless otherwise indicated.
- D. Seismic Qualification of Equipment:
 - 1. Provide special certification for plumbing equipment furnished under other sections and assigned a component importance factor (Ip) of 1.5, certifying that equipment will remain operable following a design level earthquake.
 - 2. Seismic qualification to be by shake table testing in accordance with recognized testing standard procedure, such as ICC-ES AC156, acceptable to authorities having jurisdiction.
 - 3. Notify Architect and obtain direction where mounting restrictions required by conditions of seismic certification conflict with specified requirements.
 - 4. Seismically qualified equipment to be furnished with factory-installed labels referencing certificate of compliance and associated mounting restrictions.
- E. Premanufactured Modular Plumbing Equipment: Where not otherwise seismically qualified, premanufactured modules 6 feet (1.8 m) high and taller furnished under other sections to be designed in accordance with seismic provisions for nonbuilding structures.
- F. Seismic Restraints:
 - 1. Provide seismic restraints for plumbing components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
 - 2. Seismic Restraint Exemptions:
 - a. Exemptions for Seismic Design Category C:
 - 1) Plumbing components where either of the following apply:
 - (a) The component importance factor (Ip) is 1.0 and the component is positively attached to the structure.
 - (b) The component weighs 20 pounds (89 N) or less or, in the case of a distributed system, 5 pounds per foot (73 N/m) or less.
 - 2) Plumbing piping with component importance factor (Ip) of 1.5 and nominal pipe size of 2 inch (50 mm) or less, where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, and where piping is positively attached to the structure; exemption does not apply to

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- piping constructed of low-deformability materials (e.g., cast iron, glass, nonductile plastics).
- b. Exemptions for Seismic Design Category D, E, and F:
- 1) Discrete plumbing components that are positively attached to the structure where either of the following apply:
 - (a) The component weighs 400 pounds (1,780 N) or less, has a center of mass located 4 feet (1.22 m) or less above the adjacent floor level, flexible connections are provided between the component and associated ductwork, piping, and conduit, and the component importance factor (I_p) is 1.0.
 - (b) The component weighs 20 pounds (89 N) or less or, in the case of a distributed system, 5 pounds per foot (73 N/m) or less.
 - 2) Plumbing piping with component importance factor (I_p) of 1.0 and nominal pipe size of 3 inch (80 mm) or less, or with component importance factor (I_p) of 1.5 and nominal pipe size of 1 inch (25 mm) or less, where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, and where piping is positively attached to the structure; exemption does not apply to piping constructed of low-deformability materials (e.g., cast iron, glass, nonductile plastics).
- c. Plumbing Piping Exemptions, All Seismic Design Categories:
- 1) Plumbing piping where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, where piping is positively attached to the structure, and where one of the following apply:
 - (a) Trapeze supported piping weighing less than 10 pounds per foot (146 N/m), where all pipes supported meet size requirements for exemption as single pipes described under specific seismic design category exemptions above.
 - (b) Trapeze supported piping with trapeze assemblies using 3/8 inch (10 mm) diameter rod hangers not exceeding 12 inches (305 mm) in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (I_p) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 100 pounds (445 N) or less.
 - (c) Trapeze supported piping with trapeze assemblies using 1/2 inch (13 mm) diameter rod hangers not exceeding 12 inches (305 mm) in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (I_p) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 200 pounds (890 N) or less.
 - (d) Trapeze supported piping with trapeze assemblies using 1/2 inch (13 mm) diameter rod hangers not exceeding 24 inches (610 mm) in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (I_p) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 100 pounds (445 N) or less.
 - (e) Hanger supported piping with individual rod hangers 3/8 inch (10 mm) or 1/2 inch (13 mm) in diameter not exceeding 12 inches (305 mm) in length from support point connection to the supporting structure, where pipe has a component importance factor (I_p) of 1.0 and meets size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single rod is 50 pounds (220 N) or less.

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3. Comply with applicable general recommendations of the following, where not in conflict with applicable codes, seismic design criteria, or other specified requirements:
 - a. FEMA 412.
 - b. FEMA 413.
 - c. FEMA 414.
 - d. FEMA E-74.
 - e. SMACNA (SRM).
4. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third-party registered professional engineer acceptable to authorities having jurisdiction.
5. Seismic Restraint Systems:
 - a. Except where otherwise restricted, use of either cable or rigid restraints is permitted.
 - b. Use only cable restraints to restrain vibration-isolated plumbing components, including distributed systems.
 - c. Use only one restraint system type for a given plumbing component or distributed system (e.g., piping) run; mixing of cable and rigid restraints on a given component/run is not permitted.
 - d. Size restraint elements, including anchorage, to resist seismic loads as necessary to restrain plumbing component in all lateral directions; consider bracket geometry in anchor load calculations.
 - e. Use rod stiffener clips to attach bracing to hanger rods as required to prevent rod buckling from vertical (upward) compressive load introduced by cable or rigid restraints loaded in tension, in excess of downward tensile load due to supported plumbing component weight.
 - f. Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported plumbing component weight.
 - g. Clevis hangers may only be used for attachment of transverse restraints; do not use for attachment of longitudinal restraints.
 - h. Where seismic restraints are attached to clevis hangers, provide clevis bolt reinforcement accessory to prevent clevis hanger deformation.
 - i. Do not introduce lateral loads on open bar joist chords or the weak axis of beams, or loads in any direction at other than panel points unless approved by project Structural Engineer of Record.
- G. Seismic Attachments:
 1. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
 2. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) or qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
 3. Do not use power-actuated fasteners.
 4. Do not use friction clips (devices that rely on mechanically applied friction to resist loads). Beam clamps may be used for supporting sustained loads where provided with restraining straps.
 5. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
 6. Concrete Housekeeping Pads:
 - a. Increase size of pad as required to comply with anchor requirements.
 - b. Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.
- H. Seismic Interactions:

SECTION 15070 – SOUND, VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1. Include provisions to prevent seismic impact between plumbing components and other structural or nonstructural components.
 2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.
- I. Seismic Relative Displacement Provisions:
1. Use suitable fittings or flexible connections to accommodate:
 - a. Relative displacements at connections between components, including distributed systems (e.g., piping); do not exceed load limits for equipment utility connections.
 - b. Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
 - c. Design displacements at seismic separations.
 - d. Anticipated drifts between floors.
 2. Include provisions to prevent interruption of utility service due to seismic displacements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 CODE-REQUIRED SPECIAL INSPECTIONS

- A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect in accordance with Section 01 4533 and statement of special inspections as required by applicable building code.
- B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.
 1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
 2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.
- C. Seismic special inspections include, but are not limited to:
 1. Seismically Qualified Equipment: Verification that label, anchorage, and mounting comply with the certificate of compliance.
 2. Installation and anchorage of piping systems designed to carry hazardous materials and their associated mechanical units for Seismic Design Categories C, D, E, and F; periodic inspection.
 3. Installation and anchorage of vibration isolation systems for Seismic Design Categories C, D, E, and F where the approved Contract Documents require a nominal clearance of 1/4 inch (6.4 mm) or less between equipment support frame and seismic restraint; periodic inspection.
 4. Verification of required clearances between plumbing equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs for Seismic Design Categories C, D, E, and F; periodic inspection.
- D. Prior to starting work, Contractor to submit written statement of responsibility to authorities having jurisdiction and to Owner acknowledging awareness of special requirements contained in the statement of special inspections.
- E. Special Inspection Agency services do not relieve Contractor from performing inspections and testing specified elsewhere.

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3.03 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Secure fasteners according to manufacturer's recommended torque settings.
- D. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- E. Seismic Controls:
 - 1. Provide specified snubbing element air gap; remove any factory-installed spacers, debris, or other obstructions.
 - 2. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.
 - 3. Where mounting hole diameter exceeds bolt diameter by more than 0.125 inch (3 mm), use epoxy grout, elastomeric grommet, or welded washer to reduce clearance to 0.125 inch (3 mm) or less.
 - 4. Equipment with Sheet Metal Housings:
 - a. Use Belleville washers to distribute stress over a larger surface area of the sheet metal connection interface as approved by manufacturer.
 - b. Attach additional steel as approved by manufacturer where required to transfer loads to structure.
 - c. Where mounting surface is irregular, do not shim housing; reinforce housing with additional steel as approved by manufacturer.
 - 5. Concrete Housekeeping Pads:
 - a. Size in accordance with seismic design to meet anchor requirements.
 - b. Install pad reinforcement and doweling in accordance with seismic design to ensure integrity of pad and associated connection to slab.
 - 6. Seismic Restraint Systems:
 - a. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
 - b. Install restraints within permissible angles in accordance with seismic design.
 - c. Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
 - d. Install cable restraints for vibration-isolated components slightly slack to prevent short-circuiting of isolation.
 - e. Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

3.04 FIELD QUALITY CONTROL

- A. Inspect vibration isolation and/or seismic control components for damage and defects.
- B. Provide manufacturer representative or authorized technician services to assist with inspection and testing of vibration isolation systems and seismic controls. Submit a detailed copy of manufacturer recommended inspection, testing, and field report procedures.
- C. Vibration Isolation Systems:
 - 1. Verify isolator static deflections.
 - 2. Verify required clearance beneath vibration-isolated equipment support bases.
 - 3. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.
- D. Seismic Controls:
 - 1. Verify snubbing element air gaps.
- E. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

SECTION 15070 – SOUND, VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

- F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. This Section describes the marking and identification materials for identifying mechanical equipment, ductwork and piping systems.
- B. Mark and identify all mechanical equipment, ductwork and piping systems described herein, and as shown and specified in the Contract Documents.

1.02 REFERENCES

- A. ANSI A13.1 - Scheme for the Identification of Piping Systems.
- B. Z53.1 - Safety Color Code for Marking Physical Hazards.
- C. OSHA 29 CFR 1910 - Subpart J, General Environmental Controls

1.03 SUBMITTALS

- A. Identification Scheme - Submit scheme of identification codes.
- B. Valve Schedules - Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Samples - Submit samples of tags, attachments, labeled and identified.
- D. Equipment Schedules - Submit mechanical equipment schedules, listing proposed equipment numbers, and their location and function.
- E. Product Data: Provide manufacturers catalog literature for each product required.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Seton
- B. Bunting
- C. W.H. Brady Company
- D. Or approved equal.

2.02 VALVE TAGS

- A. Provide valve tags for all valves installed for this project. Valve tags shall be constructed of 316 stainless steel, with stamped letters and service designation tag size minimum 1-1/2 inches (38 mm) diameter with smooth edges, 316 stainless steel S hook.
- B. Valve tags shall be permanently stamped and marked with a service designation, normal valve position, and an identifying number as large as possible. Each valve shall have a separate and distinct number coordinated with the service designations shown on the Drawings and the Owners existing valve numbering system. Coordinate with the Architect/Engineer and Owner before finalizing the valve tag numbering system.

2.03 PIPE MARKERS

- A. All accessible piping installed indoors for this project, insulated and uninsulated shall be identified with wraparound pipe markers. Pipe markers shall be factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. "Accessible" piping shall include exposed piping, and piping located above lay-in ceilings. Markers shall include system name, flow arrow, and color code and pipe diameter.
- B. All piping installed outdoors for this project, insulated and uninsulated, shall be identified with wraparound pipe markers. Pipe markers shall be factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. The marker shall be printed with weather-resistant ink.
- C. Where pipes are too small or not readily accessible for application of pipe markers, a 316 stainless steel identification tag at least 1 ½ inches in diameter, with depressed ½ inch high black letters and numerals, shall be securely fastened at locations specified for pipe markers.

SECTION 15075 – MECHANICAL SYSTEM IDENTIFICATION

- D. See pipe marker schedule for size requirements of pipe markers.

2.04 MECHANICAL EQUIPMENT MARKERS

- A. Identify all mechanical equipment, bare or insulated, installed in the rooms or on the roof, by means of lettered and numbered nameplate (not stenciled) identifying the equipment and service. Refer to the Drawings for equipment identifications. Nameplates shall be aluminum with permanent 1 ½ inch high white letters on a black background, mechanically affixed and installed in a readily visible location on the equipment. Coordinate the final equipment designation with the Owner.
- B. In addition to markers, all mechanical equipment shall be furnished with the manufacturer's identification plate showing the name of equipment, manufacturer's name and address, date of purchase, model number and performance data.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Apply piping system markers and valve tags in the following locations:
1. Adjacent to each valve and fitting.
 2. At each branch location and riser take-off
 3. At each side of a pipe passage through floors, walls, ceiling and partitions.
 4. At each pipe passage to and from underground areas.
 5. Every 20 feet on all horizontal and vertical pipe runs.
- B. Provide arrow markers showing direction of flow incorporated into or adjacent to each piping system marker. Use double-headed arrows if flow is in both directions.
- C. Apply all piping system markers where view is unobstructed; markers and legends shall be clearly visible from operating positions.
- D. Apply all tags and piping system markers in accordance with the manufacturer's instructions. Do not attach tags to valve handle such that the normal or emergency operation of the valve will be hindered.

3.02 SCHEDULES

- A. Pipe Marker Letter Size Schedule:

Outside diameter of insulation or pipe (Inches)	Letter height (Inches)	Color field (Inches)
3/4-1 to 1/4	1/2	8
1-1/2 to 2	3/4	8
2-1/2 to 6	1-1/4	12
8 to 10	2-1/2	24
Over 10	3-1/2	24

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Pipe markers.

1.02 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2020.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

1.03 SUBMITTALS

- A. Schedules:
 - 1. Submit plumbing component identification schedule listing equipment, piping, and valves.
 - 2. Detail proposed component identification data in terms of of wording, symbols, letter size, and color coding to be applied to corresponding product.
 - 3. Valve Data Format: Include id-number, location, function, and model number.
- B. Product Data: Provide manufacturers catalog literature for each product required.
- C. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- D. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 PLUMBING COMPONENT IDENTIFICATION GUIDELINE

- A. Nameplates:
 - 1. Heat exchangers, water heaters, and other heat transfer products.
 - 2. Control panels, transducers, and other related control equipment products.
 - 3. Pumps, tanks, filters, water treatment devices, and other plumbing equipment products.
- B. Tags:
 - 1. Piping: 3/4 inch (20 mm) diameter and smaller.
- C. Pipe Markers: 3/4 inch (20 mm) diameter and higher.

2.02 NAMEPLATES

- A. Description: Laminated piece with up to three lines of text.
 - 1. Letter Color: White.
 - 2. Letter Height: 1/4 inch (6 mm).
 - 3. Nameplate Material:
 - a. Flexible: Vinyl with adhesive backing per ASTM D709.
 - b. Metal: Brass with center-side holes for screw fastening.

2.03 TAGS

- A. Flexible: Vinyl with engraved black letters on light contrasting background color with up to three lines of text. Minimum tag size 1-1/2 inch (40 mm) in diameter.
- B. Metal: Brass, 19 gauge 1-1/2 inch (40 mm) in diameter with smooth edges, blank, smooth edges, and corrosion-resistant ball chain. Up to three lines of text.
- C. Piping: 3/4 inch (20 mm) diameter and smaller. Include corrosion resistant chain. Identify service, flow direction, and pressure.

2.04 PIPE MARKERS

- A. Comply with ASME A13.1.
- B. Flexible Marker: Factory fabricated, semi-rigid, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid conveyed.
- C. Flexible Tape Marker: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

SECTION 15076 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

- D. Underground Flexible Marker: Bright-colored continuously printed ribbon tape, minimum 6 inches (150 mm) wide by 4 mil, 0.004 inch (0.10 mm) thick, manufactured for direct burial service.
- E. Identification Scheme, ASME A13.1:
 - 1. Secondary: Color scheme per fluid service.
 - a. Water; Potable, Cooling, Boiler Feed, and Other: White text on green background.
 - 2. Tertiary: Other Details.
 - a. Directional flow arrow.

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive identification products.

3.02 INSTALLATION

- A. Install flexible nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags in clear view and align with axis of piping.
- C. Install plastic pipe markers in accordance with manufacturer's instructions.
- D. Install plastic tape pipe marker around pipe in accordance with manufacturer's instructions.
- E. Install underground plastic pipe markers 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried pipe.
- F. Apply ASME A13.1 Pipe Marking Rules:
 - 1. Place pipe marker adjacent to changes in direction.
 - 2. Place pipe marker adjacent each valve port and flange end.
 - 3. Place pipe marker at both sides of floor and wall penetrations.
 - 4. Place pipe marker every 25 to 50 feet (7.6 to 15.2 m) interval of straight run.
- G. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Glass fiber insulation.
- B. Weather barrier coatings.
- C. Jacketing and accessories.

1.02 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- B. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019.
- D. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2019).
- E. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2019).
- F. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- G. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2017.
- H. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2023.
- I. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.
- J. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2022.
- K. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
- L. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2022.
- M. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing; 2022.
- N. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation; 2022.
- O. ASTM C610 - Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation; 2017.
- P. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2018).
- Q. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation; 2021.
- R. ASTM C1410 - Standard Specification for Cellular Melamine Thermal and Sound-Absorbing Insulation; 2017.
- S. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation; 2021.
- T. ASTM C1695 - Standard Specification for Fabrication of Flexible Removable and Reusable Blanket Insulation for Hot Service; 2022.
- U. ASTM C1775 - Standard Specification for Laminate Protective Jacket and Tape for Use Over Thermal Insulation for Outdoor Applications; 2022.
- V. ASTM D93 - Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester; 2020.

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- W. ASTM D1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber; 2020.
- X. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2019.
- Y. ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay; 2017 (Reapproved 2021).
- Z. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2022.
- AA. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
- AB. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a.
- AC. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- AD. SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth ; 2016b.
- AE. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- B. Samples: Submit two samples of any representative size illustrating each insulation type.
- C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section and approved by manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.06 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER INSULATION

- A. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
 - 1. K (Ksi) Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
 - 2. Maximum Service Temperature: 850 degrees F (454 degrees C).
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible, with wicking material to transport condensed water to the outside of the system for evaporation to the atmosphere.
 - 1. K (Ksi) Value: ASTM C177, 0.23 at 75 degrees F (0.034 at 24 degrees C).

SECTION 15080 - PLUMBING PIPING INSULATION

2. Maximum Service Temperature: 220 degrees F (104 degrees C).
3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
 1. K (Ksi) Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
 2. Maximum Service Temperature: 650 degrees F (343 degrees C).
 3. Maximum Moisture Absorption: 0.2 percent by volume.
- D. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm (0.029 ng/(Pa s m)).
- E. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.
- F. Vapor Barrier Lap Adhesive: Compatible with insulation.
- G. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
- H. Fibrous Glass Fabric:
 1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.
 2. Blanket: 1.0 pcf (16 kg/cu m) density.
 3. Weave: 5 by 5.
- I. Indoor Vapor Barrier Finish:
 1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.
 2. Vinyl emulsion type acrylic, compatible with insulation, black color.
- J. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- K. Outdoor Breather Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- L. Insulating Cement: ASTM C449.

2.03 WEATHER BARRIER COATINGS

- A. Weather-Resistive Barrier Coating: Fire-resistive, UV resistant, water-based mastic for use over closed cell polyethylene and polyurethane foam insulation; applied with glass fiber or synthetic reinforcing mesh.
 1. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A, when tested in accordance with ASTM E84.
 2. Water Vapor Permeance: Greater than 1.0 perm (57 ng/(Pa s m)) in accordance with ASTM E96/E96M.
 3. Resistance to Fungal Growth: No growth when tested in accordance with ASTM D5590.
 4. Color: As selected by Architect.

2.04 JACKETING AND ACCESSORIES

- A. PVC Plastic Jacket:
 1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F (Minus 18 degrees C).
 - b. Maximum Service Temperature: 150 degrees F (66 degrees C).
 - c. Moisture Vapor Permeability: 0.002 perm inch (0.0029 ng/(Pa s m)), maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil, 0.010 inch (0.25 mm).
 - e. Connections: Brush on welding adhesive.
 2. Covering Adhesive Mastic: Compatible with insulation.
- B. ABS Plastic Jacket:
 1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
 - b. Maximum Service Temperature: 180 degrees F (82 degrees C).

SECTION 15080 - PLUMBING PIPING INSULATION

- c. Moisture Vapor Permeability: 0.012 perm inch (0.018 ng/(Pa s m)), when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 30 mil, 0.03 inch (0.75 mm).
 - e. Connections: Brush on welding adhesive.
- C. Canvas Jacket: UL listed 6 oz/sq yd (220 g/sq m) plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.
 - 1. Lagging Adhesive: Compatible with insulation.
- D. Aluminum Jacket:
 - 1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch (0.41 mm) with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
 - 2. Thickness: 0.016 inch (0.40 mm) sheet.
 - 3. Finish: Smooth.
 - 4. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
 - 5. Fittings: 0.016 inch (0.40 mm) thick die-shaped fitting covers with factory-attached protective liner.
 - 6. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.015 inch (0.38 mm) thick aluminum.
- E. Aluminum-Foil Laminate Jacket:
 - 1. Factory-applied, pressure sensitive adhesive jacketing on paper release liner.
 - 2. Finish: Aluminum smooth.
 - 3. Comply with ASTM C1775.
- F. Stainless Steel Jacket: ASTM A666, Type 304 stainless steel.
 - 1. Thickness: 0.010 inch (0.25 mm).
 - 2. Finish: Smooth.
 - 3. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.010 inch (0.25 mm) thick stainless steel.
- G. Reinforced Tape:
 - 1. FSK tape suitable for sealing seams between insulation, insulated pipe bends, and fittings resulting in a tight, smooth surface without wrinkles.
 - 2. Comply with UL 723 or ASTM E84.
 - 3. Moisture Vapor Permeability: 0.00 perm inch (0.00 ng/(Pa s m)), when tested in accordance with ASTM E96/E96M.
 - 4. Finish: Match insulation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- E. Install cellular melamine with factory-applied jackets with a manufacturer-approved adhesive along seams, both straight lap joints and circumferential lap joints.
 - 1. Install seal over seams with factory-approved room temperature vulcanization (RTV) silicone sealant to ensure a positive vapor barrier seal in outdoor and sanitary washdown environments.

SECTION 15080 - PLUMBING PIPING INSULATION

- F. Glass fiber insulated pipes conveying fluids below ambient temperature:
 - 1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
 - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- G. For hot piping conveying fluids 140 degrees F (60 degrees C) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- H. For hot piping conveying fluids over 140 degrees F (60 degrees C), insulate flanges and unions at equipment.
- I. Glass fiber insulated pipes conveying fluids above ambient temperature:
 - 1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- J. Inserts and Shields:
 - 1. Application: Piping 1-1/2 inches (40 mm) diameter or larger.
 - 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 - 3. Insert Location: Between support shield and piping and under the finish jacket.
 - 4. Insert Configuration: Minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 - 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- K. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions.
- L. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet (3 meters) above finished floor): Finish with canvas jacket sized for finish painting.
- M. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil, 0.001 inch (0.025 mm) thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

END OF SECTION

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Scope:
 - 1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install valves and appurtenances, complete and operational.
 - 2. Valves excluded from this Section include valves for plumbing work, heating and ventilation work, those for fuel oil piping, and valves y included with equipment.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before process valves work.
- C. Related Sections:
 - 1. Section 02200, Earthwork.
 - 2. Section 03300, Cast-in-Place Concrete.
 - 3. Section 05051, Anchor Systems.
 - 4. Section 09900, Painting.
 - 5. Section 15051, Buried Piping Installation.
 - 6. Section 15052, Exposed Piping Installation.
 - 7. Section 15061, Ductile Iron Pipe.

1.02 REFERENCES

- A. Standards referenced in this Section are listed below:
 - 1. AISI 1144, Carbon Steel, as Rolled.
 - 2. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings.
 - 3. ANSI B16.5, Pipe Flanges and Flanged Fittings.
 - 5. ASTM A126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
 - 6. ASTM A380, Practice for Cleaning, Descaling and Passivation of Stainless Steel Parts, Equipment and Systems.
 - 7. ASTM A536, Specification for Ductile Iron Castings.
 - 8. ASTM B98/B98M, Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
 - 9. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron and Pressure Pipe and Fittings.
 - 10. ASTM D429, Test Methods for Rubber Property - Adhesion to Rigid Substrates.
 - 11. ASTM D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
 - 14. AWWA C508, Swing-Check Valves for Waterworks Service, 2-inch through 24-inch NPS.
 - 18. AWWA C540, Power-Actuating Devices for Valve and Slide Gates.
 - 19. AWWA C550, Protective Interior Coatings for Valves and Hydrants.
 - 20. SSPC SP-6, Commercial Blast Cleaning.
 - 21. SSPC SP-10, Near White Blast Cleaning.

1.03 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 - 1. Manufacturer shall have minimum of five years of experience producing substantially similar materials and equipment to that required and be able to provide evidence of at least five installations in satisfactory operation for at least five years.
- B. Component Supply and Compatibility:
 - 1. Obtain each type of equipment and appurtenances included in this Section, regardless of the component manufacturer, from a single manufacturer of the type of process valve. For each type of valve, do not furnish valves of more than one manufacturer.

SECTION 15100 – PROCESS AND CIVIL VALVES

2. Supplier of each type of equipment specified shall review and approve or prepare all Shop Drawings and other submittals for all components associated with the type of process valve Supplier is furnishing.
 3. Components shall be suitable for use in the specified service conditions. Components shall be integrated into the overall assembly by the manufacturer.
- C. Design Criteria
1. All valves and appurtenances shall be new and in perfect working condition. Valves shall be designed for continuous use with a minimum of maintenance and service required and shall perform the required function without exceeding the safe limits for stress, strain or vibration. In no case will used or damaged valves be acceptable.

1.04 SUBMITTALS

- A. Action Submittals: Submit the following:
1. Shop Drawings: Submit the following for Valves Four Inches and Larger:
 - a. Installation drawings showing orientation of valve in both plan and elevation view. Drawings shall clearly identify valve and its appurtenances, including controls, actuators, valve stems, and other components. Show dimensions of valves and appurtenances in relation to piping and structural and architectural components, where applicable.
 - b. Controls for and control characteristics of modulating valves.
 - c. Power and control wiring diagrams, including terminals numbers for electric-motor actuators.
 - d. Calculations for sizing of electric actuators.
 - e. Calculations for sizing of operating mechanism with extension stems.
 - f. Calculations for sizing of gear actuators.
 2. Product Data:
 - a. Product data sheets.
 - b. Complete catalog information, including dimensions, weight, specifications, and identification of materials of construction of all parts.
 - c. Corrosion resistance information to confirm suitability of valve materials for the application. Furnish information on chemical resistance of elastomers from elastomer manufacturer.
 - d. Cv values and hydraulic headloss curves (for Valves 4 Inches and Larger).
 3. Testing Plans: Submit plan for shop testing of each valve for which shop testing is specified, including testing plan's and test facility's limitations proposed.
- B. Informational Submittals: Submit the following for Valves 4 Inches and Larger:
1. Certificates:
 - a. Certificates of compliance with referenced standards, where applicable, including those of AWWA, NSF, and others required by Engineer. For each valve specified to be manufactured and/or installed in accordance with AWWA and other standards, submit an affidavit of compliance with the appropriate standards, including certified results of required tests and certification of proper installation.
 2. Manufacturer Instructions: Submit manufacturer's instructions for handling, storing, and installing valves and appurtenances. Provide templates and setting drawings for valves and appurtenances that require anchor bolts or similar anchorages.
 3. Source Quality Control Submittals:
 - a. Submit four copies of shop test results and inspection data, certified by manufacturer.
 4. Field Quality Control Submittals: Submit results of field tests required.
 5. Supplier's Reports: When requested by Engineer, submit written report of results of each visit to Site by Supplier's serviceman, including purpose and time of visit, tasks performed and results obtained.

SECTION 15100 – PROCESS AND CIVIL VALVES

6. Qualifications Statements: When requested by Engineer, submit manufacturer's qualifications demonstrating compliance with the Specifications, including list of existing installations with contact names and telephone number(s) for each.
- C. Closeout Submittals: Submit the following for Valves 4 Inches and Larger:
 1. Operations and Maintenance Data:
 - a. Furnish operation and maintenance manuals in accordance with Section 017830, Operation and Maintenance Data.
 - b. Furnish complete nameplate data for each valve and electric actuator in operations and maintenance manuals.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling, and Unloading:
 1. Deliver materials and equipment to Site to ensure uninterrupted progress of the Work. Deliver anchorage products that are to be embedded in concrete in ample time to prevent delaying the Work.
 2. Inspect boxes, crates, and packages upon delivery to Site and notify Engineer in writing of loss or damage to materials and equipment. Promptly remedy loss and damage to new condition in accordance with manufacturer's instructions.
- B. Furnish covers for all openings.
 1. All valves 3-in and larger shall be shipped and stored on site until time of use with wood or plywood covers on each valve end.
 2. All valves smaller than 3-in shall be shipped and stored as above except that heavy card board covers may be furnished instead of wood.
- C. Storage and Protection:
 1. Keep products off ground using pallets, platforms, or other supports. Store equipment in covered storage and prevent condensation and damage by extreme temperatures.
 2. Store in accordance with manufacturer's recommendations. Protect steel, packaged materials, and electronics from corrosion and deterioration.
 3. Store equipment to permit easy access for inspection and identification.
 4. Any corrosion in evidence at the time of Owner acceptance shall be removed, or the valve shall be removed from the job.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Valves, General:
 1. Provide each valve with manufacturer's name and rated pressure cast in raised letters on valve body.
 2. Provide valves with Type 316 stainless steel nameplate attached with Type 316 stainless steel screws. Nameplates shall have engraved letters displaying the following minimum information:
 - a. Valve size.
 - b. Pressure and temperature ratings.
 - c. Application (other than water and wastewater).
 - d. Date of manufacture.
 - e. Manufacturer's name.
 3. Provide valves to turn clockwise to close, unless otherwise specified.
 4. Provide valves with permanent markings for direction to open.
 5. Manually operated valves, with or without extension stems, shall require not more than 40-pound pull on manual operator to open or close valve against specified criteria. Gear actuator and valve components shall be able to withstand minimum pull of 200 pounds on manual operator and input torque of 300-foot pounds to actuator nut. Manual operators include handwheel, chainwheel, crank, lever, and T-handle wrench.
 6. All buried valves shall open clockwise.

SECTION 15100 – PROCESS AND CIVIL VALVES

B. Valve Materials:

1. Valve materials shall be suitable for the associated valve's service or application, as shown.
2. Protect wetted parts from galvanic corrosion caused by contact of different metals.
3. Clean and descale fabricated stainless steel items in accordance with ASTM A380 and the following:
 - a. Passivate all stainless steel welded fabricated items after manufacture by immersing in pickling solution of six percent nitric acid and three percent hydrofluoric acid. Temperature and detention time shall be sufficient for removing oxidation and ferrous contamination without etching surface. Perform complete neutralizing operation by immersing in trisodium phosphate rinse followed by clean water wash.
 - b. Scrub welds with same pickling solution or pickling paste and clean with stainless steel wire brushes or by grinding with non-metallic abrasive tools to remove weld discoloration, and then neutralize and wash clean.

C. Valve Joints:

1. Exposed Valves: Unless otherwise specified, provide with flanged ends conforming to ANSI B16.1. Pressure class of flanges shall be equal to or greater than specified pressure rating of the associated valve.
2. Buried Valves: Unless otherwise specified, provide with restrained mechanical or flanged joints, as required by piping with which valve is installed.
3. For stainless steel bolting, except where nitrided nuts are required, use graphite-free anti-seize compound to prevent galling. Strength of joint shall not be affected by using anti-seize compound.

2.02 VALVE BOXES

- A. All buried valves shall be provided with extension shafts, operating nuts and valve boxes as follows:
1. Top of the operating nut shall be located 6 in. below the rim of the valve box.
 2. Valve boxes shall be the "Dwyer" style, with 8-3/8-in or 6-3/8-in cover, as manufactured by Bibby Ste. Croix of Hamilton, Ontario, Canada; Bingham & Taylor of Culpepper, Virginia; or equal and shall be a heavy-pattern cast iron, three-piece, telescoping type box with dome base suitable for installation on the buried valves.
 3. Inside diameter shall be at least 4-1/2-in.
 4. Barrel length shall be adapted to the depth of cover, with a lap of at least 6-in when in the most extended position.
 5. Covers shall be cast iron with integrally-cast direction-to-open arrow. Aluminum or plastic are not acceptable. A means of lateral support for the valve extension shafts shall be provided in the top portion of the valve box.
 6. The upper section of each box shall have a top flange of sufficient bearing area to prevent settling. The bottom of the lower section shall enclose the stuffing box and operating nut of the valve and shall be oval.
 7. An approved operating key or wrench shall be furnished.

2.03 RESILIENT-SEATED GATE VALVES

- A. Valves 3-in through 30-in shall be manufactured in accordance with AWWA C509 and as specified herein. Valves shall be:
1. The RS series resilient wedge gate valve (available in 3-in through 12-in) by M&H Valve Company of Anniston, Alabama;
 2. The Series 2360 resilient wedge gate valve (available in 2-in through 12-in) by Mueller Company of Decatur, Illinois;
 3. Or equal.
- B. General:
1. Type:

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- a. For interior and exposed service, provide outside screw and yoke (OS&Y) rising-stem valves, unless otherwise specified.
- b. Provide position indicators for NRS valves used in exposed service.

2.04 ECCENTRIC PLUG VALVES

- A. Manufacturers: Provide products of one of the following:
 1. DeZurik.
 2. Clow Valve Company (a division of McWane).
 3. Or equal.
- B. General:
 1. Provide eccentric-type plug valves each with rectangular ports conforming to AWWA C517 and as specified in this Section.
 2. Sizes: Four-inch diameter and larger.
 3. **Minimum Rated Working Pressure: 175 psig for valves at Knott Drive, Morgan Park, and Viola Drive Pump Stations.**
 4. **Minimum Rated Working Pressure: 300 psig for valves at Roslyn Village Pump Station**
 5. Maximum Fluid Temperature: 180 degrees F.
 6. Minimum Port Area: 80 percent of nominal pipe area.
 7. Packing and packing gland shall be externally adjustable and accessible without disassembling valve and without removing the actuator.
 8. Valves shall provide drip-tight, one-directional shutoff at rated pressures.
 9. Plug shall have cylindrical seating surface eccentrically offset from center of plug shaft. Interface between plug face and body seat, with plug in closed position, shall be externally adjustable in the field with valve in the line while under pressure.
 10. Plug shall be supported to top bearing by using spring that is externally adjustable.
 11. End connections: 250 lb. flanged unless otherwise shown or specified.
- C. Materials of Construction:
 1. Body: Cast Iron ASTM A126 Class B, or Ductile-iron ASTM A536 Grade 65-45-12.
 - a. Valves shall be coated inside. Steel, cast-iron, and ductile iron surfaces, except machined surfaces, shall be epoxy-coated in accordance with AWWA C550.
 2. Plug:
 - a. Core shall be one piece with integral shafts: Cast Iron ASTM A126 Class B, or Ductile-iron, ASTM A536 Grade 65-45-12.
 - b. Plug Facing: Neoprene or Buna-N.
 - c. For valves up to eight-inch diameter, plugs shall be fully encapsulated with rubber. For valves larger than eight-inch diameter, provide plugs with rubber facing. Minimum thickness of rubber lining shall be 1/8-inch. Rubber hardness shall be a minimum of 70 (Shore A) durometer. Rubber-to-metal bond shall withstand minimum 75-pound pull conforming to ASTM D429 Method B.
 3. Seats: Minimum 1/8-inch welded overlay of minimum 90 percent pure nickel on surfaces contacting plug face. Seats shall provide contact area of at least 1/2-inch width all around.
 4. Stem Bearings: Sintered, oil impregnated, permanently lubricated of Type 316 stainless steel.
 5. Stem Seal: Multiple neoprene V-ring type.
 6. All internal and external bolting and other hardware including pins, set screws, plug, studs, bolts, nuts and washers shall be Type 316 stainless steel.
- D. Shop Testing:
 1. Operational Tests:
 - a. To demonstrate that complete assembly is workable, successfully operate each valve (with actuator mounted directly on valve) three times from fully closed to fully open position and reverse under no-flow condition.
 2. Leakage Tests:

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- a. Test each valve for leaks while valve is in closed position.
- b. Test valves at rated pressures. During test, valves shall be drip-tight. Test duration shall be at least five minutes for valves up to 20-inch diameter and ten minutes for valves larger than 20-inch diameter. Tests shall be repeated successfully with pressure in the unseating direction.
3. Hydrostatic Test: Test valves to an internal hydrostatic pressure equivalent to twice rated pressure of valve. During hydrostatic test, there shall be no leakage through metal, end joints, and shaft seal, nor shall any part be permanently deformed. Duration of hydrostatic test shall be sufficient to allow visual examination for leakage. Test duration shall be at least one minute for valves eight-inch diameter and smaller, three minutes for valves 10-inch through 20-inch diameter, and ten minutes for valves 24-inch diameter and larger.
- E. Gear Actuators for Manually Operated Valves:
 1. Provide gear actuators on buried and exposed valves, except valves four-inch diameter and smaller located less than five feet above operating floor.
 2. Size gear actuators for valves eight-inch diameter and smaller for 175 psig differential pressure.
 3. Provide actuators capable of holding associated valves in any intermediate position without creeping or vibrating.
 4. Provide valve position indicator on each actuator. Provide stop-limiting devices for open and closed position. For buried and submerged service actuators, provide position indicators in valve box.
 5. Provide adjustable stop to adjust seating pressure.
 6. Make packing accessible for adjustment without requiring removal of actuator from valve, except for valves in buried and submerged service.
 7. Diameter ratio of handwheel or chainwheel and gear sector shall be less than two.
 8. For buried and submerged valves, gear actuator shall be grease-packed and designed to withstand submersion, and shall be drip-tight in water 20 feet deep, with self-adjusting packing.
 9. Provide each actuator with gearing totally enclosed.
 10. Operator shaft and gear sector shall be supported on permanently lubricated bronze or stainless steel bearings.
 11. Provide metal-encased spring loaded seals in top and bottom covers of gear housing, or O-ring seals.
 12. Actuators shall be provided to produce indicated torque with maximum pull of 80 pounds on handwheel or chainwheel and maximum input of 150-foot pounds on operating nuts, for both seating and unseating heads equal to maximum differential pressure rating of valve.
 13. Actuator components between input and stops shall be designed to withstand, without damage, a pull of 200 pounds for handwheel or chainwheel actuators and input torque of 300-foot pound for operating nuts when operating against stops.
 14. Materials of Construction:
 - a. Housing: Cast-iron, ASTM A126 Class B.
 - b. Gear Sector: Cast-iron ASTM A126 Class B, or ductile iron ASTM A536.
 - c. Worm Shaft: Steel, AISI 1144, hardened and tempered to an average Rc 40 and within range of Rc 35-45.
 - d. Bearings: Bronze oil-impregnated, or stainless steel.
 - e. Hardware, including bolts, nuts, washers, set screws, and pins, shall be Type 316 stainless steel.

2.05 BALL VALVES

- A. Manufacturers: Provide products of one of the following:
 1. Henry Pratt Co.
 2. Or equal.

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- B. General:
 - 1. Type: Quarter turn, full port ball valve.
 - 2. Inlet & outlet port opening: As specified in AWWA Standard 507, Table 1.
 - 3. Design pressure rating: 300 psig.
 - 4. End Connections: ANSI B16.1 Class 250.
 - 5. Valve seats shall be capable of being replaced or adjusted without removing the valve from the line. Valves shall be double seated and provide drip-tight closure in both directions.
- C. Materials of Construction:
 - 1. Body and ball: Cast iron or Ductile iron.
 - 2. Seats: Synthetic rubber compound suitable for use with sewage
 - 3. Ball shaft: Stainless Steel.
- D. Gear Actuators for Manually Operated Valves:
 - 1. Type: Worm gear operator with handwheel.
 - 2. Actuators shall be capable of holding valve in any intermediate position without creeping.
 - 3. Provide valve position indicator on each actuator.
 - 4. Provide stop-limiting devices for open and closed position.
- E. Shop testing:
 - 1. All valves shall be subjected to hydrostatic, shop leakage and performance tests as specified in Section 5.2 of AWWA Standard C507.

2.06 ELECTRIC ACTUATORS (OPEN/CLOSE)

- A. Manufacturers: Provide products of one of the following:
 - 1. Limitorque
 - 2. Rotork.
 - 2. Or equal
- B. Application Criteria:
 - 1. Ambient Temperature Rating: -20 to +158 degrees F.
 - 2. Ambient Humidity: 100 percent.
 - 3. Application: Refer to Schedule of Valves at the end of this Section.
 - 4. Power Supply: 460-volt, three-phase, 60 Hertz.
 - 5. Control Voltage: 120 VAC, single phase, 60 Hertz.
 - 6. Torques: As determined by valve manufacturer/gate manufacturer.
 - 7. Duty Cycle: Sixty starts per hour, minimum.
- C. General:
 - 1. Conform to AWWA C540 and this Section.
 - 2. Provide actuator operable with handwheel or chainwheel, even after disengaging and removing electric motor.
 - 3. Provide valves with electric actuators that are located more than five feet above operating floor with separate control panels installed so that panel controls and indicators are approximately five feet above operating floor, at location approved by Engineer. Modify electrical wiring as required for remote location of control panels.
 - 4. Coordinate sizing of each electric actuator with valve manufacturer, who shall furnish valve and associated electric actuator and appurtenances as a unit.
 - 5. Electric actuators shall be suitable for valve orientation as shown.
- D. Electric Motor:
 - 1. General:
 - a. Provide motors suitable for "open/close" service, with high torque characteristics and minimum 70 degree C temperature rating.
 - 2. Motor Construction:
 - a. Enclosure: NEMA 4X, unless NEMA 7 is required for duty in the actuator location.
 - b. Insulation: Class F.

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- c. Service Factor: 1.5 times valve torque requirement.
 - d. Provide winding thermostats for overcurrent protection.
 - e. Bearings: Anti-friction with minimum B-10 life of 100,000 hours, lifetime pre-lubricated and sealed.
- E. Actuator Gearing:
 - 1. Housing: Die-cast aluminum or cast-iron.
 - 2. Close-coupled to electric motor.
 - 3. Input Shaft Gearing: Spur or bevel gear assembly.
 - 4. Output Shaft Gearing: Self-locking worm gears with minimum gear backlash to prevent valve disc chatter or vibration.
 - 5. Gearing shall be of hardened alloy steel or combination of hardened alloy steel and alloy bronze, accurately cut by hobbing machine.
 - 6. Lubrication: Oil bath.
 - 7. Bearings: Ball or roller with minimum B-10 life of 100,000 hours, lifetime pre-lubricated and sealed.
 - 8. Input Shaft: Hardened alloy steel.
 - 9. Provide mechanical stops adjustable to plus-or-minus five degrees at each end of travel.
- F. Limit Switches:
 - 1. Provide each actuator with “end of travel” limit switches to allow control of desired end position for each direction of travel.
 - 2. Provide open and close limit switches geared to drive mechanism and in step at all times, whether unit is operated electrically or manually, and whether or not actuator is powered by electric power supply. Friction devices or set-screw arrangements shall not be used to maintain the setting.
 - 3. Limit switch gearing shall be appropriately lubricated.
 - 4. Provide driven mechanism totally enclosed to prevent entrance of foreign matter and loss of lubricant.
- G. Torque Switches:
 - 1. Provide adjustable torque switches with each valve actuator. Torque switches shall operate during complete valve cycle without using auxiliary relays, linkages, latches, or other devices.
 - 2. Wire torque switches to de-energize valve actuator motor when excessive torque is developed during each direction of travel.
 - 3. It shall be possible to select the torque switches to control open and close limit positions in each direction of valve travel.
- H. Handwheel and Chainwheel Operation:
 - 1. Provide actuator with handwheel (or chainwheel as required) for manual operation, so connected that operation by motor will not cause handwheel or chainwheel to rotate.
 - 2. Should electric power be returned to motor while handwheel or chainwheel is in use, unit shall prevent transmission of motor torque to handwheel or chainwheel.
 - 3. Handwheel or chainwheel shall require no more than 80-pound effort on rim for seating or unseating load, and no more than 60 pounds on running load.
 - 4. Handwheel or chainwheel shall have an arrow and the word “OPEN” or “CLOSE” indicating required rotation. Handwheel or chainwheel shall operate in clockwise direction to close.
 - 5. Chain Operators:
 - 6. Valves more than five feet above operating floor level shall be equipped with chain operators.
 - 7. Handwheels and chain operators shall be as specified in Article 2.18 of this Section.
 - 8. Provide stem covers for rising stem gate valves as specified in Article 2.18 of this Section.
- I. Controls:
 - 1. Provide the following controls in separate compartment integral with actuator.
 - 2. Enclosure: NEMA 4X.

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3. Starter: Actuator shall include reversing motor controls. Supply a fused disconnect switch in a separate NEMA 4X, 316 SS enclosure.
 4. Control Power Transformer: Provide transformer to transform rated three-phase, 60 Hertz power to 120 volts, single-phase. Transformer shall be complete with grounded and fused secondary and dual primary fuses.
 5. Provide “LOCAL/OFF/REMOTE” selector switch. In “LOCAL” position actuator shall be operated by “OPEN/CLOSE” pushbuttons. In “OFF” position, actuator shall be disabled from local and remote operation. In “REMOTE” position, “open/close” control from remote source shall be enabled. Remote operation shall be from the emergency storage chamber control panel.
 6. Provide “OPEN/CLOSE” pushbuttons with hold-to-run or momentary contact selection.
 7. Provide “OPEN/CLOSE” indicating lights and zero-to-100 percent position indication in liquid crystal display window.
 8. Provide thermal overload and single-phasing protection of motor.
 9. Actuator circuit boards shall be rated for high temperature service, minimum 55 degrees C.
- J. Testing
1. Test each actuator in manufacturer’s shop in conformance with AWWA C540.

2.07 SWING CHECK VALVES

- A. Manufacturers: Provide products of one of the following:
1. Dezurik APCO CVS-6000/6100 series
 3. Milliken Cone
 4. Or equal
- B. General:
1. Provide valves conforming to AWWA C508 and as specified herein.
 2. Sizes: As shown on the plans.
 3. Type: Resilient-seated.
 4. **Minimum Rated Working Pressure: 150 psig for check valves at Knott Drive, Morgan Park, and Viola Drive Pump Stations.**
 5. **Minimum Rated Working Pressure: 200 psig for check valves at Roslyn Village Pump Station**
 6. Check valves shall have clear waterway with full-open area equal to nominal pipe size.
 7. Check valves shall have outside adjustable weight and lever.
 8. **Check valves at Knott Drive, Morgan Park, and Viola Drive Pump Station shall have adjustable air cushion chambers for closure control.**
 9. **Check valves at Roslyn Village Pump Station shall have a side mounted oil cylinder closure control device. The device shall have three stage closing control. Each stage shall be independently adjustable.**
 10. Valve seats shall be mechanically attached and shall be field replaceable.
- C. Materials of Construction: All materials of construction shall conform to AWWA C508 and shall be as follows:
1. Body, Disc, Cover and Gland: Cast-iron or ductile iron.
 2. Disc Arm: Ductile iron.
 3. Hinge Shaft: Stainless steel.
 4. Hinge Shaft Bushings: Bronze, or Type 316 stainless steel for sewage service.
 5. Shaft End Plate: Type 316 stainless steel.
 6. Body Seat: Type 316 stainless steel.
 11. Internal and external bolting and other hardware; including pins, set screws, studs, bolts, nuts, and washers shall be Type 316 stainless steel.
 12. Gland Packing: Graphite and Kevlar.

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- D. Interior Coating:
 - 1. Valves shall be coated inside and outside. Steel, cast-iron and ductile iron surfaces, except machined surfaces, shall be epoxy coated in accordance with AWWA C550.
- E. Testing:
 - 1. Test each valve in manufacturer's shop in accordance with AWWA C508.
 - 2. Allowable Leakage at Rated Pressures: Zero.

2.08 QUICK DISCONNECT COUPLINGS

- A. 6-inch Quick Disconnect Couplings:
 - 1. Manufacturers: Provide products of one of the following:
 - a. Dixon Valve and Coupling Company,
 - b. United Pacific Distributors Supply, Inc.,
 - c. Or equal.
 - 2. General:
 - a. Coupling shall be of the twin cam type manufactured to the dimensional specifications of MIL-C-27487. The coupler shall be of the female type to receive a male hose coupler from a septage hauler truck. The coupler shall be of stainless steel construction, with Buna-N gaskets.
 - b. Provide a separate adapter to permit connection to the female coupler by a septage hauler with a female hose coupler.
- B. Quick Disconnect Couplings (smaller than 6-inch):
 - 1. Stainless Steel Construction – General Requirements:
 - a. All coupling assemblies shall have a minimum pressure and temperature rating of 300 pounds per square inch and 225 degrees F.
 - b. Provide finger rings for all sizes 1-1/2 inch and above.
 - c. Size and Location: As shown on the Drawings and as specified.
 - d. Provide increaser or reducer fittings when connection is required for dissimilar size.
 - 2. Adapter with Male NPT:
 - a. Construction: Stainless steel.
 - b. Manufacturer and Model No.:
 - 1) Dover Corp. OPW Division, 633-F,
 - 2) Dixon Valve and Coupling Company, Global F-SS,
 - 3) Or equal.
 - 3. Adapter with Female NPT:
 - a. Construction: Stainless steel.
 - b. Manufacturer and Model No.:
 - 1) Dover Corp. OPW Division, 633-A,
 - 2) Dixon Valve and Coupling Company, Global A-SS,
 - 3) Or equal.
 - 4. Adapter with Hose Shank:
 - a. Construction: Stainless steel.
 - b. Manufacturer and Model No.:
 - 1) Dover Corp. OPW Division, 633-E,
 - 2) Dixon Valve and Coupling Company, Global E-SS,
 - 3) Or equal.
 - 5. Coupler with Male NPT:
 - a. Construction: Stainless steel.
 - b. Gasket: Buna-N or other material as required to be compatible with fluid being handled..
 - c. Manufacturer and Model No.:
 - 1) Dover Corp. OPW Division, 633-B,
 - 2) Dixon Valve and Coupling Company, Global B-SS,

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- 3) Or equal.
6. Coupler with Hose Shank:
 - a. Construction: Stainless steel.
 - b. Gasket: Buna-N or other material as required to be compatible with fluid being handled.
 - c. Manufacturer and Model No.:
 - 1) Dover Corp. OPW Division, 633-C,
 - 2) Dixon Valve and Coupling Company, Global C-SS,
 - 3) Or equal.
7. Coupler with Female NPT:
 - a. Construction: Stainless steel.
 - b. Gasket: Buna-N or other material as required to be compatible with fluid being handled..
 - c. Manufacturer and Model No.:
 - 1) Dover Corp. OPW Division, 633-D,
 - 2) Dixon Valve and Coupling Company, Global D-SS,
 - 3) Or equal.
8. Coupler Plug:
 - a. Construction: Stainless steel.
 - b. Manufacturer and Model:
 - 1) Dover Corp. OPW Division, 634-A,
 - 2) Dixon Valve and Coupling Company, Global A-SS,
 - 3) Or equal.
9. Adapter Cap:
 - a. Construction: Stainless steel.
 - b. Manufacturer and Model:
 - 1) Dover Corp. OPW Division, 634-B,
 - 2) Dixon Valve and Coupling Company, Global B-SS,
 - 3) Or equal.

2.09 APPURTENANCES FOR METALLIC VALVES

- A. General:
 1. For valves located less than five feet above operating floor, provide handwheels on all valves, unless otherwise shown or specified.
 2. For valves located five feet or more above operating floor, provide chain operators.
 3. Where indicated, provide extension stems and floorstands.
- B. Handwheels:
 1. Conform to applicable AWWA standards.
 2. Material of Construction: Ductile iron, or cast aluminum.
 3. Arrow indicating direction of opening and word "OPEN" shall be cast on trim of handwheel.
 4. Maximum Handwheel Diameter: 2.5 feet.
- C. Chain Operators:
 1. Chains shall extend to three feet above operating floor.
 2. Provide 1/2-inch stainless steel hook bolt to keep chain out of walking area.
 3. Materials of Construction:
 - a. Chain: Type 316L stainless steel.
 - b. Chainwheel: Recessed groove type made out of Type 316 stainless steel.
 - c. Guards and Guides: Type 316L stainless steel.
 4. Chain Construction:
 - a. Chain shall be of welded link type with smooth finish. Chain that is crimped or has links with exposed ends is unacceptable.
 5. Provide geared operators where required to position chainwheels in vertical position.

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- D. Crank Operator:
 - 1. Crank operator shall be removable and fitted with rotating handle.
 - 2. Maximum Radius of Crank: 15 inches.
 - 3. Materials:
 - a. Crank: Cast-iron or ductile iron.
 - b. Handle: Type 304 stainless steel.
 - c. Hardware: Type 304 stainless steel.
- E. Extension Stems and Floor Stands:
 - 1. Conform to the applicable requirements of AWWA C501 for sizing of complete lifting mechanism.
 - 2. Bench and Pedestal Floor Stands:
 - a. For valves requiring extension stems, provide bench or pedestal floor stands with handwheel or crank as indicated. Provide provisions for using portable electric actuator for opening and closing of valves.
 - b. Type: Heavy-duty with tapered roller bearings enclosed in a weatherproof housing, provided with positive mechanical seals around lift nut and pinion shaft to prevent loss of lubrication and to prevent moisture from entering housing. Provide lubrication fitting for grease. For valves conveying water that is potable or that will be treated to become potable, grease shall be food-grade and ANSI/NSF 61-listed. Base shall be machined.
 - c. Materials of Construction:
 - 1) Housing: Cast-iron, ASTM A126, Class B.
 - 2) Lift Nut: Cast bronze, ASTM B98/B98M.
 - 3) Grease Fitting: Stainless steel.
 - 4) Bolting: Type 316 stainless steel.
 - 3. Wall brackets for floor stands shall be Type 316L stainless steel construction.
 - 4. Extension Stems:
 - a. Materials of Stems and Stem Couplings: Type 316 stainless steel.
 - b. Maximum Slenderness Ratio (L/R): 100.
 - c. Minimum Diameter: 1.5-inch.
 - d. Threads: Acme.
 - e. Provide stem couplings where stems are furnished in more than one piece. Couplings shall be threaded and keyed or threaded and bolted and shall be of greater strength than the stem.
 - f. Weld to bottom of extension stem a Type 316 stainless steel cap suitable for square end of valve stem.
 - 5. Bottom Couplings: Ductile iron with Type 316 stainless steel pin and set screw.
 - 6. Stem Guides:
 - a. Material: Type 316 cast stainless steel with bronze bushing for stem. For submerged service, Type 316 cast stainless steel with stainless steel bushing for stem.
 - b. Maximum Stem Length Between Guides: Seven feet.
 - c. Stem guides shall be adjustable in two directions.
 - 7. Furnish stem cover of clear butyrate plastic or Grade 153 Lexan with cast adapter for mounting cover to bench and floor stands. Provide stem cover with gasketing and breathers to eliminate water intrusion into operator and condensation within cover. Provide stem cover with mylar tape with legible markings showing valve position at one-inch intervals and open and close limits of valve.

2.10 ANCHORAGES AND MOUNTING HARDWARE

- A. General:
 - 1. Comply with Section 05051, Anchor Systems, except as modified in this Section.
 - 2. Obtain bolts, nuts, and washers for connection of valve and appurtenances to concrete structure or other structural members from valve Supplier.

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3. Bolts, nuts, and washers shall be of ample size and strength for purpose intended. Anchorages in concrete shall be at least 5/8-inch diameter.
4. Provide stem guide anchorages of required strength to prevent twisting and sagging of guides under load.
5. Materials: Provide bolts and washers of Type 316 stainless steel and nitrided nuts. Bolts shall have rolled threads. Bolts and nuts shall be electropolished to remove burrs.

2.11 TOOLS, LUBRICANTS AND SPARE PARTS

- A. Provide T-handle operating wrenches for buried valves.
- B. Lubricants: For valves, actuators, and appurtenances requiring lubricants, provide suitable lubricants for initial operation and for first year of use following Substantial Completion.
- C. List of spare parts recommended by the manufacturer. The list shall describe each part, the quantity recommended, and the unit price of each part.

2.12 PAINTING OF EXPOSED VALVES, HYDRANTS AND APPURTENANCES

- A. Exterior steel, cast-iron, and ductile iron surfaces, except machined surfaces of exposed valves and appurtenances, shall be finish painted in manufacturer's shop. Surface preparation, priming, finish painting, and field touch-up painting shall conform to Section 09900, Painting, unless otherwise specified.

2.13 PAINTING OF BURIED VALVES AND HYDRANTS

- A. The interior ferrous metal surfaces, except finished or bearing surfaces, shall be blast cleaned in accordance with SSPC SP-10 and painted with two coats of an approved two-component epoxy coating specifically formulated for potable water use. The coating shall be NSF certified to Standard 61.
- B. Exterior ferrous metal surfaces of all buried valves and hydrants shall be blast cleaned in accordance with SSPC SP-6 and given two shop coats of an approved two-component coal tar epoxy paint.

2.14 INSPECTION AND WITNESS SHOP TESTS

- A. Allow for Engineer and Owner to inspect and witness valve tests at valve manufacturer's facility.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Examine conditions under which materials and equipment are to be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.
- B. During installation of all valves and appurtenances, verify that all items are clean, free of defects in material and workmanship and function properly.
- C. All valves shall be closed and kept closed until otherwise directed by the Construction Manager.

3.02 INSTALLATION

- A. General:
 1. Install valves and appurtenances in accordance with:
 - a. Supplier's instructions and the Contract Documents.
 - b. Requirements of applicable AWWA standards.

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- c. Applicable requirements of Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
 2. Install valves plumb and level. Install all valves to be free from distortion and strain caused by misaligned piping, equipment, and other causes.
 3. Position swing check valves so that, when valve is fully open, valve disc does not conflict with piping system elements upstream and downstream of valve.
- B. Exposed Valves:
 1. Provide supports for large or heavy valves and appurtenances as shown or required to prevent strain on adjoining piping.
 2. Operators:
 - a. Install valves so that operating handwheels or levers can be conveniently turned from operating floor without interfering with access to other valves, piping, structure, and equipment, and as approved by Engineer.
 - b. Avoid placing operators at angles to floors or walls.
 - c. Orient chain operators out of way of walking areas.
 - d. Install valves so that indicator arrows are visible from floor level.
 - e. For motor-operated valves located lower than five feet above operating floor, orient motor actuator to allow convenient access to pushbuttons and handwheel.
 3. Floor Stands and Stems:
 - a. Install floor stands as shown and as recommended by manufacturer.
 - b. Provide lateral restraints for extension bonnets and extension stems as shown and as recommended by manufacturer.
 - c. Provide sleeves where operating stems pass through floor. Extend sleeves two inches above floor.
- C. Buried Valves:
 1. Clean and manually operate buried valves before installation.
 2. Install valve boxes plumb and centered, with soil carefully tamped to a lateral distance of four feet on all sides of box, or to undisturbed trench face if less than four feet.
 3. Set buried valves with the stem vertically aligned in the center of the valve box.
 4. Before backfilling, coat all exposed portions of any bolts with two coats of bituminous paint.
 5. Support the valve box during backfilling and maintain in vertical alignment with the top flush with finish grade. Set the valve box so as not to transmit traffic loads to the valve.
 6. Provide flexible coupling next to each buried valve.
- D. Plug Valves:
 1. Install plug valves that are in horizontal liquid piping with stem horizontal and plugs on top when valve is open. Plug shall be on upstream end when valve is closed.
 2. Install plug valves that are in vertical liquid piping with plug at top when closed or as recommended by valve Supplier.
 3. Supplier shall tag or mark plug valves to indicate proper mounting position.
- E. Tapping Sleeves and Valves
 1. The proper authority shall be contacted and their permission granted prior to tapping a "live" line. The required procedures and time table shall be followed exactly.
 2. Installation shall be made under pressure and flow shall be maintained. The diameters of the tap shall be not less than 1/4-in less than the inside diameter of the branch line.
 3. The entire operation shall be conducted by workers experienced in the installation of tapping sleeves and valves. The tapping machine shall be furnished by the Contractor.
 4. Determine the location of the line to be tapped to confirm that the proposed location will be satisfactory and that no interference will be encountered such as joints or fittings. No tap or sleeve will be made closer than three feet from a pipe joint.
 5. Tapping sleeve and valve with boxes shall be set squarely centered on the line to be tapped. Adequate support shall be provided under the sleeve and valve during the tapping operation. Thrust blocks or other permanent restraint acceptable to the

SECTION 15100 – PROCESS AND CIVIL VALVES

Construction Manager shall be provided behind all tapping sleeves. Proper tamping of supporting pipe bedding material around and under the valve and sleeve is mandatory for buried installations.

6. After completing the tap, the valve shall be flushed to ensure that the valve seat is clean. All proper regulatory procedures (including disinfection) shall be followed exactly.

3.03 FIELD QUALITY CONTROL

- A. Field Tests:
 1. Adjust all parts and components as required to provide correct operation of valves.
 2. Conduct functional field test on each valve in presence of Engineer to demonstrate that each valve operates correctly.
 3. Verify satisfactory operation and controls of motor operated valves.
 4. Demonstrate satisfactory opening and closing of valves at specified criteria requiring not more than 40 pounds effort on manual actuators.
 5. Test ten percent of valves of each type by applying 200 pounds effort on manual operators. There shall be no damage to gear actuator or valve.
 6. All testing equipment required shall be furnished by the Contractor.

3.04 MANUFACTURER'S SERVICES

- A. Furnish the services of a qualified representative of the tapping equipment manufacturer to provide on-site instruction during wet tapping of the existing water mains indicated on the Drawings.
- B. Provide services of qualified factory-trained service technicians to check and approve installation of valves:
 1. Supplier's serviceman shall perform the following:
 - a. Supervise unloading of the equipment.
 - b. Instruct Contractor in installing equipment.
 - c. Supervise installation of equipment.
 - d. Inspect and adjust equipment after installation and ensure proper operation.
 - e. Instruct Owner's personnel in operating and maintaining the equipment.
 2. Manufacturer's representative shall make a minimum of 4 visits, with a minimum of 4 hours onsite for each visit. First visit shall be for unloading supervision (if specified) and instruction of Contractor in installing equipment; second visit shall be for assistance in installing equipment; third visit shall be for checking completed installation and start-up of system; fourth visit shall be to instruct operations and maintenance personnel. Representative shall revisit the Site as often as necessary until installation is acceptable.
 3. Training: Furnish services of Supplier's qualified factory trained specialists to instruct Owner's operations and maintenance personnel in recommended operation and maintenance of equipment.
 4. All costs, including expenses for travel, lodging, meals and incidentals, and cost of travel time, for visits to the Site shall be included in the Contract Price.

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Angle valves.
- B. Ball valves.
- C. Check valves.
- D. Gate valves.

1.02 ABBREVIATIONS AND ACRONYMS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Non-rising stem.
- E. OS&Y: Outside screw and yoke.
- F. PTFE: Polytetrafluoroethylene.
- G. RS: Rising stem.
- H. TFE: Tetrafluoroethylene.
- I. WOG: Water, oil, and gas.

1.03 REFERENCE STANDARDS

- A. API STD 594 - Check Valves: Flanged, Lug, Wafer, and Butt-Welding; 2022.
- B. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
- C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- D. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2022.
- E. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- F. ASME B16.34 - Valves — Flanged, Threaded, and Welding End; 2020.
- G. ASME B31.9 - Building Services Piping; 2020.
- H. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.
- I. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.
- J. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2019).
- K. ASTM A216/A216M - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service; 2021.
- L. ASTM A351/A351M - Standard Specification for Castings, Austenitic, for Pressure-Containing Parts; 2018, with Editorial Revision (2019).
- M. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2022).
- N. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).
- O. ASTM B61 - Standard Specification for Steam or Valve Bronze Castings; 2015 (Reapproved 2021).
- P. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.
- Q. MSS SP-45 - Drain and Bypass Connections; 2020.
- R. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends; 2011.

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- S. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends; 2018.
- T. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.
- U. MSS SP-85 - Gray Iron Globe and Angle Valves, Flanged and Threaded Ends; 2011.
- V. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .
- W. MSS SP-125 - Check Valves: Gray Iron and Ductile Iron, In-Line, Spring-Loaded, Center-Guided; 2018.
- X. NSF 61 - Drinking Water System Components - Health Effects; 2022, with Errata.
- Y. NSF 372 - Drinking Water System Components - Lead Content; 2022.

1.04 SUBMITTALS

- A. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- B. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.
- D. Maintenance Materials: Furnish Owner with one wrench for every five plug valves, in each size of square plug valve head.

1.05 QUALITY ASSURANCE

- A. Manufacturer:
 - 1. Obtain valves for each valve type from single manufacturer.
 - 2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Welding Materials and Procedures: Comply with ASME BPVC-IX.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
 - 2. Protect valve parts exposed to piped medium against rust and corrosion.
 - 3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
 - 4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
 - 5. Secure check valves in either the closed position or open position.
 - 6. Adjust butterfly valves to closed or partially closed position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection and protect flanges and specialties from dirt.
 - a. Provide temporary inlet and outlet caps.
 - b. Maintain caps in place until installation.
 - 2. Store valves in shipping containers and maintain in place until installation.
 - a. Store valves indoors in dry environment.
 - b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

1.07 EXERCISE THE FOLLOWING PRECAUTIONS FOR HANDLING:

- A. Handle large valves with sling, modified to avoid damage to exposed parts.
- B. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 PRODUCTS

2.01 APPLICATIONS

- A. See drawings for specific valve locations.
- B. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).

SECTION 15110 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

- C. Provide the following valves for the applications if not indicated on drawings:
 - 1. Shutoff: Ball, butterfly, gate or plug.
 - 2. Dead-End: Single-flange butterfly (lug) type.
 - 3. Throttling: Provide globe, angle, ball, or butterfly.
 - 4. Swing Check (Pump Outlet):
 - a. 2 inch (50 mm, DN) and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
 - b. 2-1/2 inch (65 mm, DN) and Larger for Domestic Water: Iron swing check valves with closure control, metal or resilient seat check valves.
 - c. 2-1/2 inch (65 mm, DN) and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- D. Substitutions of valves with higher CWP classes or WSP ratings for same valve types are permitted when specified CWP ratings or WSP classes are not available.
- E. Domestic, Hot and Cold Water Valves:
 - 1. 2 inch (50 mm, DN) and Smaller:
 - a. Bronze: Provide with solder-joint ends.
 - b. Bronze Angle: Class 125, bronze disc.
 - c. Ball: One piece, full port, brass with brass trim.
 - d. Bronze Swing Check: Class 125, bronze disc.
 - e. Bronze Gate: Class 125, NRS.
 - f. Bronze Globe: Class 125, bronze disc.

2.02 GENERAL REQUIREMENTS

- A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- B. Valve Sizes: Match upstream piping unless otherwise indicated.
- C. Valve Actuator Types:
 - 1. Hand Lever: Quarter-turn valves 6 inch (150 mm, DN) and smaller.
- D. Insulated Piping Valves: With 2 inch (50 mm, DN) stem extensions and the following features:
 - 1. Gate Valves: Rising stem.
 - 2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
- E. Valve-End Connections:
 - 1. Threaded End Valves: ASME B1.20.1.
 - 2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
 - 3. Pipe Flanges and Flanged Fittings 1/2 inch (15 mm, DN) through 24 inch (600 mm, DN): ASME B16.5.
 - 4. Solder Joint Connections: ASME B16.18.
- F. General ASME Compliance:
 - 1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
 - 2. Solder-joint Connections: ASME B16.18.
 - 3. Building Services Piping Valves: ASME B31.9.
- G. Potable Water Use:
 - 1. Certified: Approved for use in compliance with NSF 61 and NSF 372.
 - 2. Lead-Free Certified: Wetted surface material includes less than 0.25 percent lead content.
- H. Valve Bypass and Drain Connections: MSS SP-45.
- I. Source Limitations: Obtain each valve type from a single manufacturer.

2.03 BRONZE, ANGLE VALVES

- A. Class 125; CWP Rating: 200 psi (1380 kPa):

SECTION 15110 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

1. Comply with MSS SP-80, Type 1.
2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
3. End Connections: Pipe thread.
4. Stem: Bronze.
5. Disc: Bronze.
6. Packing: Asbestos free.
7. Handwheel: Bronze or aluminum.

2.04 BRONZE, BALL VALVES

- A. General:
 1. Fabricate from dezincification resistant material.
 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. One Piece, Full Port with Bronze Trim:
 1. Comply with MSS SP-110.
 2. WSP Rating: 400 psi (2760 kPa).
 3. CWP Rating: 600 psi (4140 kPa).
 4. Body: Bronze.
 5. End Connections: Pipe press.
 6. Seats: PTFE.
 7. Stem: Bronze.
 8. Ball: Chrome plated brass.
 9. Operator: Provide lockable handle.

2.05 BRONZE, SWING CHECK VALVES

- A. General:
 1. Fabricate from dezincification resistant material.
 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. Class 125:
 1. Pressure and Temperature Rating: MSS SP-80, Type 3.
 2. Design: Y-pattern, horizontal or vertical flow.
 3. WOG Rating: 200 psi (1380 kPa).
 4. Body: Bronze, ASTM B62.
 5. End Connections: Threaded.
 6. Disc: Bronze.

2.06 BRONZE, GATE VALVES

- A. General:
 1. Fabricate from dezincification resistant material.
 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. Non-Rising Stem or NRS
 1. Pressure-Temperature Range: MSS SP-80, Type I.
 2. Class 125:
 - a. WSP Rating: 125 psi (861.8 kPa), saturated.
 - b. CWP Rating: 200 psi (1380 kPa).
 3. Class 150: CWP Rating; 300 psi (2070 kPa).
 4. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
 5. Ends Connections: Threaded or solder.
 6. Stem: Bronze.
 7. Disc: Solid wedge; bronze.
 8. Packing: Asbestos free.
 9. Handwheel Operator: Malleable iron.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.
- B. Verify valve parts to be fully operational in all positions from closed to fully open.
- C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
- D. Should valve is determined to be defective, replace with new valve.

3.02 INSTALLATION

- A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
- B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
- C. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- D. Install check valves where necessary to maintain direction of flow as follows:
 - 1. Swing Check: Install horizontal maintaining hinge pin level.

END OF SECTION

SECTION 15120 – COUPLINGS, ADAPTERS, AND SPECIALS FOR PIPING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install all couplings, adapters, and specials for piping.
- B. Coordination: Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before couplings, adapters, and specials for piping work.
- C. Related Sections:
 - 1. Section 09900 - Painting.
 - 2. Section 15051 - Buried Piping Installation.
 - 3. Section 15052 - Exposed Piping Installation.

1.02 REFERENCES

- A. Standards referenced in this Section are:
 - 1. ANSI B16.39 - Malleable Iron Threaded Pipe Unions.
 - 2. ASTM F593 - Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
 - 3. AWWA C606 - Grooved and Shouldered Joints.

1.03 QUALITY ASSURANCE

- A. Qualifications: Manufacturer shall have at least five years experience producing substantial similar products to those specified and shall be able to provide documentation of at least five installations in satisfactory operation for at least five years each.
- B. Component Supply and Compatibility:
 - 1. Obtain each type of coupling, adapter, and special for piping product included in this Section, regardless of component manufacturer, from a single couplings, adapters, and specials manufacturer.
 - 2. Supplier shall prepare, or review, and approve all submittals for components furnished under this Section.
 - 3. Components shall be suitable for specified service conditions and be integrated into overall assembly by the Supplier.

1.04 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings: Submit piping layout Shop Drawings in accordance with Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
 - 2. Product Data: Submit product data on each type of coupling, expansion joint, and other piping specialties and accessories, including gaskets, hardware, and appurtenances sufficient to demonstrate compliance with the Contract Documents.
- B. Informational Submittals: Submit the following:
 - 1. Certificates: When requested by Engineer submit certificate attesting to compliance with standards referenced in this Section, signed by manufacturer.
 - 2. Manufacturer's Instructions: Provide instructions for handling, storing, installing, and adjusting of products.
 - 3. Source Quality Control: When requested by Engineer, submit results of source quality control tests.
 - 4. Qualifications Statements: Submit qualifications of manufacturer when requested by Engineer.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.

PART 2 – PRODUCTS

2.01 COUPLINGS

- A. Sleeve-type, Flexible Couplings:
 - 1. Pressure and Service: Same as connected piping.
 - 2. Products and Manufacturers: Provide products of one of the following:
 - a. Style 253/38, as manufactured by Dresser Piping Specialties, part of Dresser, Inc.
 - b. No. 441/411/413, by Smith Blair, Inc.
 - c. Style FC Series, by Ford.
 - d. Or equal.
 - 3. Material: Ductile Iron.
 - 4. Gaskets: Suitable for specified service, as recommended by manufacturer.
 - 5. Bolts and Nuts: Alloy steel, corrosion-resistant, primer-coated. For buried or submerged applications, provide stainless steel bolts complete with washers complying with ASTM F593, AISI Type 316 and with nitrided stainless nuts.
 - 6. Harnessing:
 - a. Harness couplings to restrain pressure piping. For pipelines that will be under pressure, test pressures are specified in piping schedules in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
 - b. Tie adjacent flanges with bolts of corrosion-resistant alloy steel. Provide flange-mounted stretcher bolt plates to be designed by manufacturer, unless otherwise approved. For buried or submerged applications, provide external bolting and other hardware of Type 316 stainless steel, including tie bolts, bolt plates, lugs, nuts, and washers.
 - c. On plain-end piping, for harnessing couplings, provide anchor restraint system such as Dresser Piping Specialties STAR Anchor Style 443, or equal.
 - d. Conform to dimensions, size, spacing, and materials for lugs, bolts, washers, and nuts as recommended by manufacturer and approved by Engineer for pipe size, wall thickness, and test pressure required. Provide minimum 5/8-inch diameter bolts.
 - 7. Remove pipe stop(s) if used, unless otherwise shown or specified.
- B. Flanged Coupling Adapters:
 - 1. Description: One end of adapter shall be flanged and opposite end shall have sleeve-type flexible coupling.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Style 227, as manufactured by Dresser Piping Specialties, part of Dresser, Inc.
 - b. Style 912, by Smith Blair, Inc.
 - c. Or equal.
 - 3. Pressure and Service: Same as connected piping.
 - 4. Material: Ductile iron.
 - 5. Gasket: Recommended by the manufacturer.
 - 6. Bolts and Nuts: Alloy steel, corrosion-resistant, primer-coated. For buried or submerged applications, provide stainless steel bolts complete with washers complying with ASTM F593, AISI Type 316 and nitrided stainless nuts.
 - 7. Harnessing:
 - a. Harness adapters to restrain pressure piping. For pressure pipelines, test pressures are included in piping schedules in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
 - b. For flanged adapters 12-inch diameter and smaller, provide 1/2-inch diameter (minimum) Type 316 stainless steel anchor studs installed in pressure-tight anchor boss. For buried or submerged applications, provide external bolting and other hardware of Type 316 stainless steel, including tie bolts, bolt plates, lugs, nuts, and washers. Provide number of studs required to restrain test pressure and service conditions. Harness shall be as designed and recommended by flanged adapter manufacturer. Provide the following minimum anchor studs unless otherwise approved by Engineer.

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- 1) Six-inch Diameter and Smaller: Two
 - 2) Eight-inch Diameter and Smaller: Four
 - 3) Ten-inch Diameter and Smaller: Six
 - 4) Twelve-inch Diameter and Smaller: Eight
 - c. For adapters larger than 12-inch diameter, provide split-ring harness clamps with minimum of four corrosion-resistant alloy steel bolts. For buried or submerged applications, provide external bolting and other hardware of Type 316 stainless steel, including tie bolts, bolt plates, lugs, nuts, and washers. Harness assembly shall be as designed and recommended by flanged adapter manufacturer. Dimensions, sizes, spacing and materials shall be suitable for service and conditions encountered and shall be approved by Engineer.
- C. Split-type Grooved or Shouldered End Couplings:
1. Pressure and Service: Same as connected piping. Use shouldered end where required by pressure rating.
 2. Products and Manufacturers:
 - a. For coupling of cast-iron or ductile iron pipe, provide products of one of the following:
 - 1) Style 31, as manufactured by Victaulic Company.
 - 2) Series 500, as manufactured by Tyler Pipe, Gustin Bacon Division.
 - 3) Gruvlok Figure 705, as manufactured by Grinnell Mechanical Products, division of Tyco.
 - 4) Or equal.
 - b. For coupling of standard steel pipe, where joint deflection is desired or allowed, provide products of one of the following:
 - 1) Style 77, as manufactured by Victaulic Company.
 - 2) Series 1000, as manufactured by Tyler Pipe, Gustin Bacon Division.
 - 3) Or equal.
 - c. For coupling of standard steel pipe, where joint deflection is not desired or allowed, provide products of one of the following:
 - 1) Style HP-70, as manufactured by Victaulic Company.
 - 2) Series 110, as manufactured Tyler Pipe, Gustin Bacon Division.
 - 3) Or equal.
 - d. For coupling of stainless steel pipe, provide products of one of the following:
 - 1) Style 77-S, as manufactured by Victaulic Company.
 - 2) Or equal.
 - e. For coupling of thermoplastic pipe, provide products of one of the following:
 - 1) Style 774, as manufactured by Victaulic Company.
 - 2) Or equal.
 3. Couplings shall conform to applicable requirements of AWWA C606.
 4. Housing Material:
 - a. For coupling of cast-iron pipe, ductile iron pipe, steel pipe, and thermoplastic pipe: Malleable iron or ductile iron.
 - b. For coupling of stainless steel pipe: Type 304 stainless steel, or equal.
 - c. For coupling of aluminum pipe: Aluminum alloy 356-T6.
 5. Gaskets: Recommended by the manufacturer.
 6. Bolts and Nuts: Heat-treated carbon steel track bolts, plated. For buried or submerged applications, provide stainless steel bolts complete with washers complying with ASTM F593, AISI Type 316 and with nitrided stainless nuts.

2.02 EXPANSION COUPLINGS

- A. Rubber-type Expansion Couplings:
1. General: Use rubber-type expansion couplings at all locations, except where other types are shown or specified.
 2. Manufacturers: Provide products of one of the following:
 - a. Mercer Rubber Company.

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- b. U.S. Rubber Supply Company, USA
 - c. Or equal.
- 3. Liquid Service:
 - a. Construct expansion couplings of neoprene or Buna-N suitable for temperatures up to 180 degrees F.
 - b. Expansion couplings shall be filled arch type. Provide backup or retaining rings as recommended by manufacturer.
 - c. Expansion couplings shall be yoked in manner to provide transmission of tension loading to which expansion coupling may be subjected during system operation. Compressive or lateral movement of expansion coupling shall not be impaired by yoking system. Yoking details shall be submitted to Engineer for approval.
- 4. Harnessing:
 - a. Where shown on Drawings, harness each expansion coupling against thrust for test pressure in piping, as specified in piping schedules in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
 - b. Harnessing shall be by control units consisting of two or more tie rods connected between flanges, set for maximum allowable elongation of expansion coupling.
 - c. Provide epoxy-coated triangular plates to connect tie rods to flanges. Tie rods shall be Series 300 stainless steel. Rubber washers shall be used between triangular plates and tie rods.
 - d. Provide control units in accordance with recommendations of manufacturer.

2.03 MISCELLANEOUS SPECIALTIES AND ACCESSORIES

- A. Dielectric Connections:
 - 1. General: Where copper pipe connects to steel pipe, cast-iron pipe, or ductile iron pipe, provide either dielectric union or an insulating section of rubber or plastic pipe. When used, insulating section shall have minimum length of 12 pipe diameters.
 - 2. Manufacturers: Provide products of one of the following:
 - a. Epco Sales, Inc.
 - b. Watts Regulator Company.
 - c. Capitol Manufacturing Company.
 - d. Or equal.
 - 3. Dielectric Unions: Rated for 250 psi, ANSI B16.39.
 - 4. Insulating Sections: Rated for same pressure as associated piping test pressure. Material shall be suitable for the application and service.

2.04 PAINTING

- A. Shop Painting:
 - 1. Clean and prime-coat ferrous metal surfaces of products in the manufacturer's shop in accordance with Section 09900 - Painting, unless otherwise specified in this Section
 - 2. Coat machined, polished and non-ferrous surfaces bearing surfaces and similar unpainted surfaces with corrosion prevention compound that shall be maintained during storage and until products are placed into operation.
- B. Field painting shall conform to Section 09900 - Painting.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Inspect materials for defects in material and workmanship. Verify compatibility of products with pipe, fittings, valves, and appurtenances.

3.02 INSTALLATION

- A. Installation:
 - 1. Install piping specialties in accordance with the Contract Documents and manufacturer's instructions.
 - 2. For buried installations, refer to Section 15051, Buried Piping Installation.

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3. For exposed installations, refer to Section 15052, Exposed Piping Installation.
- B. Adjust expansion joints as required to ensure that expansion joints will be fully extended when ambient temperature is at minimum operating temperature, and fully compressed at maximum operating temperature for the system in which expansion joints are installed.

END OF SECTION

SECTION 15121 – WALL PIPES, FLOOR PIPES, AND PIPE SLEEVES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope:
 - 1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all floor pipes, pipe sleeves, wall pipes, other wall pieces, and escutcheons to complete the Work.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate with the installation of floor pipes, pipe sleeves, wall pipes, other wall pieces and escutcheons that must be installed with or within formwork, walls, partitions, ceilings and panels.
- C. Related Sections:
 - 1. Section 03300, Cast-In-Place Concrete.
 - 2. Division 15, Sections on Piping, Valves, and Specials.

1.02 REFERENCES

- A. Standards referenced in this Section are listed below:
 - 1. American National Standards Institute, (ANSI).
 - 2. American Water Works Association, (AWWA).

1.03 QUALITY ASSURANCE

- A. Component Supply and Compatibility:
 - 1. Obtain all equipment included in this Section regardless of the component manufacturer from a single wall pipes, floor pipes and pipe sleeves manufacturer.
 - 2. The wall pipes, floor pipes and pipe sleeves manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 - 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the wall pipes, floor pipes and pipe sleeves manufacturer.

1.04 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - 2. Detailed drawings and data on all wall and floor pipe, and pipe sleeves. Submit and coordinate these with Shop Drawings required for all piping systems.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Wall and Floor Pipes:
 - 1. Material: Same as specified for the piping connected to wall or floor pipe, unless otherwise approved by ENGINEER.
 - 2. End Connections: As shown.
 - 3. Thickness: Same as specified for the piping connected to wall or floor pipe.
 - 4. Collars: Provide collars at mid-point of wall for anchorage and watertightness.
 - 5. Pipes ends shall be flush with wall face, unless otherwise shown.
 - 6. Drill and tap flanged ends and mechanical joint bells for studs. Provide studs of same material as connected piping, except submerged and buried studs shall be of Type 316 stainless steel.
- B. Pipe Sleeves:
 - 1. Wall sleeves shall be Schedule 40.
 - 2. Shall be of sufficient size to pass the pipe and the insulation covering the pipe.
 - 3. Shall extend 2-inches above the finished floor.
 - 4. Shall be provided with split type escutcheon plates at the floor and wall openings.

SECTION 15121 – WALL PIPES, FLOOR PIPES, AND PIPE SLEEVES

5. Shall terminate flush with walls and ceilings.
 6. Shall not be required in existing concrete walls where walls are core drilled and the resulting hole has a smooth inside surface.
 7. Shall be caulked with a fire retardant caulking compound at firewalls and a gas tight caulking compound at gas tight walls.
- C. Sleeves and Wall Pipes:
1. General:
 - a. Wall pipes and wall sleeves shall be provided in accordance with the following schedule when passing through new or existing concrete or masonry structures, except where noted otherwise:

FROM	TO	FITTING
DRY AREA	WET AREA	WALL PIPE
DRY AREA	EARTH EXTERIOR	WALL PIPE
DRY AREA	DRY AREA	PLAIN SLEEVE
EARTH	EARTH	PLAIN SLEEVE
EXTERIOR	EXTERIOR	PLAIN SLEEVE

- A. Material of construction shall be Type 316 stainless steel.
- B. Link Seals:
1. General Use: Provide link type modular mechanical seals of EPDM material, suitable for 20 psi working pressure, corrosive service and accessible from one side, with glass-reinforced nylon pressure plate and stainless steel bolts and nuts.
 2. Seals shall continuously fill annular space between the pipe and wall opening. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut. Bolts and nuts shall be Type 18-8 stainless steel.
 3. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and wall opening under 40 feet of head. Seal shall be suitable for a temperature range of - 40°F to 250°F and submergence in groundwater.
 4. Products and Manufacturers: Provide one of the following:
 - a. Link-Seal Model C, as manufactured by Thunderline Corporation.
 - b. Pen Seal Model ES, as manufactured by Proco Products, Inc.
 - c. Or equal.

2.02 HOUR FIRE RATED WALL PENETRATIONS:

- A. Provide link type mechanical seals of Silicone material, suitable for 20 psi working pressure, with glass-reinforced nylon pressure plate and stainless steel bolts and nuts.
- B. Products and Manufacturers: Provide one of the following:
1. Link-Seal Model T, as manufactured by Thunderline Corporation.
 2. Pen Seal Model KS, as manufactured by Proco Products, Inc.
 3. Or equal.
 4. 2-Hour and 3-Hour Fire Rated Wall Penetrations: Provide double link type mechanical seals of Silicone material, suitable for 20 psi working pressure, accessible from one side, with glass-reinforced nylon pressure plate and stainless steel bolts and nuts.
- C. Products and Manufacturers: Provide one of the following:
1. Link-Seal Model FS, as manufactured by Thunderline Corporation.
 2. Pen Seal Model KS, as manufactured by Proco Products, Inc.
 3. Or equal.
- D. Wall and Ceiling Plates:

SECTION 15121 – WALL PIPES, FLOOR PIPES, AND PIPE SLEEVES

1. Bare pipes passing through walls and ceilings in finished rooms: Provide escutcheon plates of cast brass or cast-iron nickel plated, clevis or split ring and hinged with set screws.
2. Provide plated escutcheon plates of 18-gauge steel for insulated pipes passing through walls and ceilings in finished rooms.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Wall and Floor Pipes: Install as shown and in accordance with approved Shop Drawings.
- B. Pipe Sleeves:
 1. Use sleeves wherever pipes pass through walls, partitions, floors, and roofs, unless otherwise shown.
 2. Extend all sleeves through floor slabs a minimum of 2-inches above finished floor.
 3. Anchor sleeves to concrete and masonry walls as shown or otherwise approved.
 4. All sleeves through walls shall be flush with wall face.
 5. All pipe joints and annular spaces in exterior walls or walls subjected to hydrostatic pressure shall be completely watertight.
 6. Use link type seals to seal sleeve against hydrostatic pressure. Size sleeves to provide annular space required to suit the link type mechanical seals that are used.
 7. Do not install sleeves and pipes through structural members, unless specifically shown and approved by ENGINEER.
 8. Size sleeves to provide annular space as follows:

Pipe Size:	Sleeve ID Minus Pipe Or Insulation OD:
Less than 2-inches	1/2-inches to 3/4-inches
2-inches to 4-inches	3/4 inches to 1-1/4-inches
6-inches to 12-inches	1-1/4 inches to 2-inches
Over 12-inches	2-inches to 3-inches

- C. Install wall and ceiling plates in accordance with the manufacturer's recommendations and approved Shop Drawings.
- D. Pipe Seals:
 1. Examination: Determine the required inside diameter of each individual wall opening or sleeve. The inside diameter of each wall opening shall be sized as recommended by the manufacturer to fit the pipe and pipe penetration seal to assure a watertight joint. Sizing for correct pipe penetration seal model and number of links per seal may be obtained through manufacturer's catalog. If pipe outer diameter is nonstandard due to coating or insulation, consult manufacturer for engineering assistance and recommendation before proceeding with wall opening detail.
 2. Installation: Install and tighten seal to provide a watertight pipe penetration in accordance with manufacturer's instructions.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Drains.
- B. Cleanouts.
- C. Hose bibbs.
- D. Backflow preventers.
- E. Floor drain trap seals.
- F. Exterior penetration accessories.

1.02 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers; 2017.
- C. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Prevention Assemblies; 2021.
- D. ASTM B75/B75M - Standard Specification for Seamless Copper Tube; 2020.
- E. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- F. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- G. NSF 61 - Drinking Water System Components - Health Effects; 2022, with Errata.
- H. NSF 372 - Drinking Water System Components - Lead Content; 2022.

1.03 SUBMITTALS

- A. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- B. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
- C. Certificates: Certify that grease interceptors meet or exceed specified requirements.
- D. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.
- E. Sustainable Design Documentation: Submit appropriate evidence that materials used in potable water systems comply with the specified requirements.
- F. Manufacturer's qualification statement.
- G. Operation Data: Indicate frequency of treatment required for interceptors.
- H. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
- I. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, and water hammer arrestors.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Loose Keys for Outside Hose Bibbs: One.
 - 2. Extra Hose End Vacuum Breakers for Hose Bibbs: One.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

SECTION 15122 - PLUMBING PIPING SPECIALTIES

2.02 FLOOR DRAINS

- A. Refer to Plumbing Fixture Schedule on Plan P 132 for floor drain specifications.

2.03 CLEANOUTS

- A. Refer to Plumbing Fixture Schedule on Plan P 132 for cleanout specifications.

2.04 HOSE BIBBS

- A. Refer to Plumbing Fixture Schedule on Plan P 132 for hose bibb specifications.

2.05 BACKFLOW PREVENTERS

- A. Reduced Pressure Backflow Preventer Assembly:
 - 1. ASSE 1013; cast bronze body and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure, and non-threaded vent outlet.
 - 2. Maximum Working Parameters: 175 psi (1,207 kPa) at 180 degrees F (82.2 degrees C).

2.06 FLOOR DRAIN TRAP SEALS

- A. Description: Push-fit EPDM or silicone fitting with a one-way membrane.

2.07 EXTERIOR PENETRATION ACCESSORIES

- A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.
- B. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for piping, cables, and roofing system to be installed; designed to accommodate existing penetrations where applicable.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- C. Encase exterior cleanouts in concrete flush with grade.
- D. Install floor cleanouts at elevation to accommodate finished floor.
- E. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.
- F. Pipe relief from backflow preventer to nearest drain.
- G. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatory sinks.
- H. Install air chambers on hot and cold water supply piping to each fixture or group of fixtures (each washroom). Fabricate same size as supply pipe or 3/4 inch (20 mm) minimum, and minimum 18 inches (450 mm) long.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe sleeves.
- B. Pipe sleeve-seals.

1.02 REFERENCE STANDARDS

- A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2022a.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- C. FM (AG) - FM Approval Guide; Current Edition.
- D. UL (DIR) - Online Certifications Directory; Current Edition.

1.03 SUBMITTALS

- A. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
- B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Valve Stem Packings: Two for each type and size of valve.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified this section.
 - 1. Minimum three years experience.
 - 2. Approved by manufacturer.
- C. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

1.06 WARRANTY

- A. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 PIPE SLEEVES

- A. Vertical Piping:
 - 1. Sleeve Length: 1 inch (25 mm) above finished floor.
 - 2. Provide sealant for watertight joint.
 - 3. Blocked Out Floor Openings: Provide 1-1/2 inch (40 mm) angle set in silicon adhesive around opening.
 - 4. Drilled Penetrations: Provide 1-1/2 inch (40 mm) angle ring or square set in silicone adhesive around penetration.
- B. Plastic or Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.
- C. Pipe Passing Through Below Grade Exterior Walls:
 - 1. Zinc coated or cast iron pipe.
 - 2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.

SECTION 15123 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

- D. Pipe Passing Through Concrete Beam Flanges, except where Brass Pipe Sleeves are Specified:
 - 1. Galvanized steel pipe or black iron pipe with asphalt coating.
 - 2. Connect sleeve with floor plate except in mechanical rooms.
- E. Pipe Passing Through Mechanical, Laundry, and Animal Room Floors above Basement:
 - 1. Galvanized steel pipe or black iron pipe with asphalt coating.
 - 2. Connect sleeve with floor plate except in mechanical rooms.
- F. Penetrations in concrete beam flanges are permitted but are prohibited through ribs or beams without prior approval from the Architect.
- G. Clearances:
 - 1. Provide allowance for insulated piping.
 - 2. Wall, Floor, Partitions, and Beam Flanges: 1 inch (25 mm) greater than external pipe diameter.
 - 3. All Rated Openings: Caulked tight with fire stopping material complying with ASTM E814 to prevent the spread of fire, smoke, and gases.

2.02 PIPE-SLEEVE SEALS

- A. Modular Mechanical Sleeve-Seal:
 - 1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
 - 2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
 - 3. Size and select seal component materials in accordance with service requirements.
 - 4. Service Requirements:
 - a. Corrosion resistant.
 - b. Oil, fuel, gas, and solvent resistant.
 - c. Underground, buried, and wet conditions.
 - d. Fire Resistant: 1 hour, UL (DIR) approved.
 - e. High Temperature, up to 400 degrees F (204 degrees C).
 - f. Low temperature, down to minus 67 degrees F (minus 55 degrees C).
 - 5. Glass-reinforced plastic pressure end plates.
- B. Sealing Compounds:
 - 1. Provide packing and sealing compound to fill pipe to sleeve thickness.
 - 2. Combined packing and sealing compounding to match partition fire-resistance hourly rating.
- C. Pipe Sleeve Material:
 - 1. Bearing Walls: Steel, cast iron, or terra-cotta pipe.
 - 2. Masonry Structures: Sheet metal or fiber.
- D. Wall Sleeve: PVC material with waterstop collar, and nailer end-caps.
- E. Sleeve-Forming Disk: Non-conductive plastic-based material, 3 inch (76.2 mm) thick.
- F. Pipeline-Casing Seals:
 - 1. Coated boltless casing-spacer for 4 inch (100 mm) carrier pipe.
 - 2. Coated boltless modular seal for 6 inch (150 mm) carrier pipe.
 - 3. Carbon steel band with risers for 12 inch (305 mm) carrier pipe.
 - 4. End Seals: 1/8 inch (3.1 mm), pull-on type, rubber or synthetic rubber based.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.

3.02 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

SECTION 15123 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

- B. Install piping to conserve building space, to not interfere with use of space and other work.
- C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- D. Inserts:
 - 1. Provide inserts for placement in concrete formwork.
 - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- E. Structural Considerations: Do not penetrate building structural members unless indicated.
- F. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
 - 1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
 - 2. Aboveground Piping:
 - a. Pack solid using mineral fiber complying with ASTM C592.
 - b. Fill space with an elastomer caulk to a depth of 0.50 inch (15 mm) where penetrations occur between conditioned and unconditioned spaces.
 - 3. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.
- G. Manufactured Sleeve-Seal Systems:
 - 1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
 - 2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
 - 3. Locate piping in center of sleeve or penetration.
 - 4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
 - 5. Tighten bolting for a water-tight seal.
 - 6. Install in accordance with manufacturer's recommendations.
- H. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.03 CLEANING

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION

SECTION 15124 - METERS AND GAUGES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Water meters.
- B. Pressure gauges.
- C. Thermometers.
- D. Pressure-temperature test plugs.

1.02 REFERENCE STANDARDS

- A. AGA/ANSI B109 Set - INCLUDES ANSI B109.1, ANSI B109.2, ANSI B109.3, ANSI B109.4; 2000.
- B. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks; 2020, with Errata and Amendments (2022).
- C. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2022.
- D. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014 (Reapproved 2020).
- E. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014 (Reapproved 2021).
- F. AWWA C700 - Cold-Water Meters -- Displacement Type, Metal Alloy Main Case; 2020.
- G. AWWA C701 - Cold-Water Meters -- Turbine Type, for Customer Service; 2019.
- H. AWWA C702 - Cold-Water Meters -- Compound Type; 2019.
- I. AWWA C707 - Encoder-Type Remote-Registration Systems for Cold-Water Meters; 2010 (Reaffirmed 2016).
- J. AWWA M6 - Water Meters -- Selection, Installation, Testing, and Maintenance; 2012, with Addendum (2018).
- K. Bluetooth CS - Bluetooth Core Specification; 2016, Addendum 2017.
- L. FieldComm Group (FFTS) - Foundation Fieldbus Technical Specifications; 2014.
- M. FM (AG) - FM Approval Guide; Current Edition.
- N. IEEE 802.3 - IEEE Standard for Ethernet; 2022.
- O. IEEE 802.11 - IEEE Standard for Information Technology--Telecommunications and Information Exchange between Systems - Local and Metropolitan Area Networks--Specific Requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications; 2020 (Corrigendum 2022).
- P. IEEE 802.15.4 - IEEE Standard for Low-Rate Wireless Networks; 2020, with Amendment (2021).
- Q. LonMark Interoperability Guide - LonMark Application-Layer Interoperability Guide and LonMark Layer 1-6 Interoperability Guide; Version 3.4; 2005.
- R. Modbus (PS) - The Modbus Organization Communications Protocol; Latest Update.
- S. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- T. NSF 61 - Drinking Water System Components - Health Effects; 2022, with Errata.
- U. NSF 372 - Drinking Water System Components - Lead Content; 2022.
- V. ODVA (CIP) - The Common Industrial Protocol (CIP) Standards: EtherNet/IP, DeviceNet, ControlNet, and CompoNet; Current Edition.
- W. ProfiBus/ProfiNet SSG - ProfiBus, ProfiNet, and IO-Link Specifications, Standards and Guidelines; Current Edition.
- X. UL (DIR) - Online Certifications Directory; Current Edition.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Utility Service Metering: Coordinate and apply Utility Service Provider requirements in terms of meter type, size, physical location, pipe size, upstream/downstream pipe lengths required, and other installation details.
- B. Preinstallation Meeting: Conduct a preinstallation meeting prior to the start of the work of this section; require attendance by all affected installers.

1.04 SUBMITTALS

- A. Product Data: Provide red-marked product data sheets for each furnished item with associated components and accessories.
- B. Project Record Documents: Record actual locations of components and instrumentation.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Pressure Gauges: One of each type and size.

PART 2 PRODUCTS

2.01 WATER METERS

- A. Coordinate with water utility company for water meter requirements.

2.02 THERMOMETERS

- A. General:
 - 1. Product Compliance: ASTM E1.
 - 2. Lens: Clear glass, except where stated.
 - 3. Accuracy: One percent, when tested in accordance with ASTM E77, except where stated.
 - 4. Scale: Black markings depicting single scale in degrees F where expected process value falls half-span of standard temperature range.
- B. Thermometers - Straight: 5 inch (127 mm) v-shape lead-free brass case with clear glass window scale, 2 inch (50.8 mm) NPT stem, 3-1/4 inch (82.5 mm) NPT thermowell, and red or blue non-toxic organic liquid filled glass tube.
- C. Thermometers - Adjustable Angle: 7 inch (177.8 mm) v-shape aluminum case with clear glass window scale, 6 inch (152.4 mm) NPT stem, red or blue organic non-toxic liquid filled glass tube, and adjustable joint with positive locking device allowing 360 degrees in horizontal plane or 180 degrees in vertical plane adjustments.
- D. Thermometers - Dial Type:
 - 1. Fixed: 5 inch (125 mm) diameter dial with black pointer, stainless steel case, silicone damping bimetal element, hermetically sealed lens, recalibrating screw, and 2-1/2 inch (63.5 mm) NPT stem.
 - a. Remote-Local Reading: Include built-in platinum RTD probe for remote reading.
 - 2. Adjustable Angle: 5 inch (125 mm) diameter dial with black pointer, stainless steel case, silicone damping bimetal element, hermetically sealed lens, recalibrating screw, and 2-1/2 inch (63.5 mm) NPT stem.
 - 3. Vapor (Gas) Actuated: 4-1/2 inch (115 mm) glass-reinforced phenolic case, aluminum dial with black pointer, recalibrating screw, 2 inch (50.8 mm) brass thermowell, adjustable joint with positive locking device allowing 180 degrees in vertical plane adjustment and capillary.

2.03 PRESSURE-TEMPERATURE TEST PLUGS:

- A. Size: 500 psi (34.5 bar) capacity; 1/2 inch (13 mm) MPT brass fitting with gasket, cap, and retaining strap for 1/8 inch (3 mm) pressure gauge or temperature probe.
- B. Wetted Materials per Temperature Range:
 - 1. Up to 200 degrees F (93 degrees C): Brass probe with neoprene core.
 - 2. 200 to 350 degrees F (93 to 176 degrees C): Brass probe with EPDM core.
 - 3. 350 to 400 degrees F (176 to 204 degrees C): Brass probe with synthetic rubber core.
- C. Accessories: Brass, lever-handle cock and snubber-filter.

SECTION 15124 - METERS AND GAUGES FOR PLUMBING PIPING

- D. Test Kit: Internally padded carrying case fitted with two 2-1/2 inch (60 mm) diameter pressure gauges, adapters, two 1/8 inch (3 mm) probes, and 1 inch (25 mm) dual-scale dial thermometers.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Verify Utility Service Provider piping readiness to receive meter.
- B. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports, and test plugs.

3.02 INSTALLATION

- A. Install metering products in accordance with manufacturer's instructions for intended fluid type and service.
- B. Install water meters with inlet and outlet isolation valves in compliance with AWWA M6.
- C. Install thermometers as follows:
 - 1. Hot Water Heaters: Place upstream and downstream of heater. Add one on the inlet end when using steam as the water heating medium.
 - 2. Piping: Install thermometers in branch butt weld connection fitting or socket-weld thermowell. Enlarge pipes smaller than 2-1/2 inch (60 mm) to accommodate sockets. Ensure sockets are above insulation clearance.

END OF SECTION

SECTION 15140 - PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sanitary waste piping, buried within 5 feet (1500 mm) of building.
- B. Sanitary waste piping, above grade.
- C. Domestic water piping, buried within 5 feet (1500 mm) of building.
- D. Domestic water piping, above grade.
- E. Pipe flanges, unions, and couplings.

1.02 REFERENCE STANDARDS

- A. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- C. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2021.
- D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- E. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- F. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings: DWV; 2021.
- G. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings—DWV; 2017.
- H. ASME B31.9 - Building Services Piping; 2020.
- I. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; 2023.
- J. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.
- K. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- L. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- M. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2021.
- N. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- O. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2023.
- P. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2022.
- Q. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).
- R. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.
- S. ASTM B32 - Standard Specification for Solder Metal; 2020.
- T. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2020.
- U. ASTM B68/B68M - Standard Specification for Seamless Copper Tube, Bright Annealed; 2019.
- V. ASTM B75/B75M - Standard Specification for Seamless Copper Tube; 2020.
- W. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- X. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.

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- Y. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2020.
- Z. ASTM B302 - Standard Specification for Threadless Copper Pipe, Standard Sizes; 2017.
- AA. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV); 2020.
- AB. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2016.
- AC. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2016.
- AD. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2020a.
- AE. ASTM C1277 - Standard Specification for Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings; 2020.
- AF. ASTM C1540 - Standard Specification for Heavy-Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings; 2020.
- AG. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2021a.
- AH. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2020.
- AI. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2021.
- AJ. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2020.
- AK. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2020.
- AL. ASTM D2680 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping; 2020.
- AM. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2021.
- AN. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020.
- AO. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2021.
- AP. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2022.
- AQ. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe; 2014 (Reapproved 2021).
- AR. ASTM F679 - Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings; 2021.
- AS. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 1992 (Reapproved 2022).
- AT. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing; 2023.
- AU. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems; 2023.
- AV. ASTM F1281 - Standard Specification for Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Pressure Pipe; 2023.

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- AW. ASTM F1960 - Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-Linked Polyethylene (PEX) and Polyethylene of Raised Temperature (PE-RT) Tubing; 2023.
- AX. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2019.
- AY. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2022).
- AZ. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2021.
- BA. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2017.
- BB. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2017, with Errata (2018).
- BC. AWWA C550 - Protective Interior Coatings for Valves and Hydrants; 2017.
- BD. AWWA C606 - Grooved and Shouldered Joints; 2015.
- BE. AWWA C651 - Disinfecting Water Mains; 2014, with Addendum (2020).
- BF. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. through 60 In. (100 mm through 1500 mm); 2022.
- BG. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2021.
- BH. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2020.
- BI. FM (AG) - FM Approval Guide; Current Edition.
- BJ. FM 1680 - Approval Standard for Couplings Used in Hubless Cast Iron Systems for Drain, Waste or Vent, Sewer, Rainwater or Storm Drain Systems Above and Below Ground, Industrial/Commercial and Residential; 1989.
- BK. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2015.
- BL. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2015.
- BM. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2015.
- BN. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2016.
- BO. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).
- BP. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends; 2011.
- BQ. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends; 2018.
- BR. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.
- BS. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .
- BT. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- BU. NSF 61 - Drinking Water System Components - Health Effects; 2022, with Errata.
- BV. NSF 372 - Drinking Water System Components - Lead Content; 2022.
- BW. PPI TR-4 - PPI HSB Listing of Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB) and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe; 2021.
- BX. UL (DIR) - Online Certifications Directory; Current Edition.
- BY. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- B. Welders' Certificates: Submit certification of welders' compliance with ASME BPVC-IX.
- C. Shop Drawings: For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacings.
- D. Sustainable Design Documentation: For soldered copper joints, submit installer's certification that the specified installation method and materials were used.
- E. Sustainable Design Documentation: For products meeting regulatory lead-content restrictions.
- F. Project Record Documents: Record actual locations of valves.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.
- D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.
- E. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.06 FIELD CONDITIONS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.
- B. Plenum-Installed Acid Waste Piping: Flame-spread index equal or below 25 and smoke-spread index equal or below 50 according to ASTM E84 or UL 723 tests.

2.02 SANITARY WASTE PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

- A. Cast Iron Pipe: ASTM A74 extra heavy weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.
- B. Cast Iron Pipe: CISPI 301, hubless.
 - 1. Fittings: Cast iron.
 - 2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.
- C. PVC Pipe: ASTM D2665 or ASTM D3034.
 - 1. Fittings: PVC.
 - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.03 SANITARY WASTE PIPING, ABOVE GRADE

- A. Cast Iron Pipe: ASTM A74, service weight.

SECTION 15140 - PLUMBING PIPING

1. Fittings: Cast iron.
2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.
- B. Cast Iron Pipe: CISPI 301, hubless, service weight.
 1. Fittings: Cast iron.
 2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.
- C. PVC Pipe: ASTM D2729.
 1. Fittings: PVC.
 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.04 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

- A. Copper Pipe: ASTM B88 (ASTM B88M), Type K (A), Drawn (H).
 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 2. Joints: ASTM B32, alloy Sn95 solder.

2.05 DOMESTIC WATER PIPING, ABOVE GRADE

- A. Copper Pipe: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).
 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 2. Joints: ASTM B32, alloy Sn95 solder.
 3. Mechanical Press Sealed Fittings: Double-pressed type, NSF 61 and NSF 372 approved or certified, utilizing EPDM, nontoxic, synthetic rubber sealing elements.

2.06 PIPE FLANGES, UNIONS, AND COUPLINGS

- A. Unions for Pipe Sizes 3 inch (80 mm, DN) and Under:
 1. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.
- B. No-Hub Couplings:
 1. Testing: In accordance with ASTM C1277 and CISPI 310.
 2. Gasket Material: Neoprene complying with ASTM C564.
 3. Band Material: Stainless steel.
 4. Eyelet Material: Stainless steel.
- C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- G. Provide access where valves and fittings are not exposed.

SECTION 15140 - PLUMBING PIPING

- H. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.
- I. Provide support for utility meters in accordance with requirements of utility companies.
- J. Install bell and spigot pipe with bell end upstream.
- K. Install water piping to ASME B31.9.
- L. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.
- M. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
- N. Sleeve pipes passing through partitions, walls, and floors.

3.04 APPLICATION

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- C. Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.

3.05 TOLERANCES

- A. Drainage Piping: Establish invert elevations within 1/2 inch (10 mm) vertically of location indicated and slope to drain at minimum of 1/4 inch per foot (1:50) slope.
- B. Water Piping: Slope at minimum of 1/32 inch per foot (1:400) and arrange to drain at low points.

3.06 FIELD TESTS AND INSPECTIONS

- A. Verify and inspect systems according to requirements by the Authority Having Jurisdiction. In the absence of specific test and inspection procedures proceed as indicated below.
- B. Domestic Water Systems:
 - 1. Perform hydrostatic testing for leakage prior to system disinfection.
 - 2. Test Preparation: Close each fixture valve or disconnect and cap each connected fixture.
 - 3. General:
 - a. Fill the system with water and raise static head to 10 psi (345 kPa) above service pressure. Minimum static head of 50 to 150 psi (345 to 1,034 kPa). As an exception, certain codes allow a maximum static pressure of 80 psi (551.6 kPa).
- C. Test Results: Document and certify successful results, otherwise repair, document, and retest.

3.07 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flushed, and clean.
- B. Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- C. Inject disinfectant, free chlorine in liquid, powder, tablet, or gas form throughout system to obtain 50 to 80 mg/L residual.
- D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- E. Maintain disinfectant in system for 24 hours.
- F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.08 SERVICE CONNECTIONS

- A. Provide new sanitary sewer services. Before commencing work, check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
- B. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves.
 - 1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.
 - 2. Provide 18 gauge, 0.0478-inch (1.21 mm) galvanized sheet metal sleeve around service main to 6 inch (150 mm) above floor and 6 feet (1800 mm) minimum below grade. Size for minimum of 2 inches (50 mm) of loose batt insulation stuffing.

END OF SECTION

SECTION 15190 - FACILITY FUEL OIL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Piping and fittings.
- B. Flanges and piping components.
- C. Pipe hangers and supports.
- D. Valves.
- E. Strainers.
- F. Flexible connectors.
- G. Aboveground fuel storage tanks.
- H. Fuel oil pumps.
- I. Transfer system.

1.02 REFERENCE STANDARDS

- A. API Spec 5L - Line Pipe; 2018, with Errata.
- B. API Std 2000 - Venting Atmospheric and Low-Pressure Storage Tanks; 2014 (Reaffirmed 2020).
- C. ASME BPVC - Boiler and Pressure Vessel Code; 2023.
- D. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.
- E. ASME B1.1 - Unified Inch Screw Threads (UN, UNR, and UNJ Thread Forms); 2019.
- F. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- G. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard; 2020.
- H. ASME B16.9 - Factory-Made Wrought Buttwelding Fittings; 2018.
- I. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded; 2021.
- J. ASME B16.39 - Malleable Iron Threaded Pipe Unions: Classes 150, 250, and 300; 2019.
- K. ASME B18.2.1 - Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series); 2012 (Reaffirmed 2021).
- L. ASME B18.2.2 - Nuts for General Applications: Machine Screw Nuts; and Hex, Square, Hex Flange, and Coupling Nuts (Inch Series); 2022.
- M. ASME B31.1 - Power Piping; 2022.
- N. ASME B31.3 - Process Piping; 2022.
- O. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- P. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- Q. ASTM A105/A105M - Standard Specification for Carbon Steel Forgings for Piping Applications; 2021.
- R. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- S. ASTM A182/A182M - Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service; 2022a.
- T. ASTM A193/A193M - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications; 2023.

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- U. ASTM A194/A194M - Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both; 2022a.
- V. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2023.
- W. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2022b.
- X. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2022.
- Y. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- Z. ASTM A312/A312M - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes; 2022a.
- AA. ASTM A358/A358M - Standard Specification for Electric-Fusion-Welded Austenitic Chromium-Nickel Stainless Steel Pipe for High-Temperature Service and General Applications; 2019.
- AB. ASTM A403/A403M - Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings; 2022b.
- AC. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric); 2021a.
- AD. ASTM A733 - Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples; 2016 (Reapproved 2022).
- AE. ASTM B32 - Standard Specification for Solder Metal; 2020.
- AF. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.
- AG. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).
- AH. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.
- AI. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .
- AJ. NACE SP0286 - Electrical Isolation of Cathodically Protected Pipelines; 2007.
- AK. UL 142 - Steel Aboveground Tanks for Flammable and Combustible Liquids; Current Edition, Including All Revisions.
- AL. UL 567 - Emergency Breakaway Fittings, Swivel Connectors and Pipe Connection Fittings for Petroleum Products and LP-Gas; Current Edition, Including All Revisions.
- AM. UL 1316 - Glass-Fiber-Reinforced Plastic Underground Storage Tanks for Petroleum Products, Alcohols, and Alcohol-Gasoline Mixtures; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting prior to the start of the work of this section; require attendance by all affected installers.

1.04 SUBMITTALS

- A. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- B. Shop Drawings: Indicate tanks, system layout, pipe sizes, location, and elevations. For fuel oil tanks, indicate dimensions and accessories, including manholes and hold down straps.
- C. Certificates: Certify that products meet or exceed specified requirements.
- D. Project Record Documents: Record actual locations of piping system, storage tanks, and system components.
- E. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

SECTION 15190 - FACILITY FUEL OIL SYSTEMS

- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- G. Manufacturer's qualification statement.
- H. Installer's qualification statement.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Valve Repacking Kits: One for each type and size of valve.

1.05 QUALITY ASSURANCE

- A. Welding Materials and Procedures: Comply with ASME BPVC.
- B. Welders Certification: In accordance with ASME BPVC-IX.
- C. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- D. Installer Qualifications: Company specializing in performing the type of work specified in this section with minimum 3 years of documented experience and approved by manufacturer.
- E. Valves: Manufacturer's name and pressure rating marked on valve body.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain in place until installation.

PART 2 PRODUCTS

2.01 PIPING AND FITTINGS

- A. Regulatory Requirements:
 - 1. Comply with the material, fabrication, and operating requirements of ASME B31.3, except as modified herein.
 - 2. Comply with ASME B31.1 for installation of fuel oil piping.
 - 3. Comply with applicable regulations for installation of fuel oil system.
 - 4. Provide certificate of compliance from Authority Having Jurisdiction indicating approval of installation of fuel oil system.
 - 5. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.
- B. Comply with the material, fabrication, and operating requirements of ASME B31.3, except as modified herein.

2.02 FLANGES, COUPLINGS, AND PIPING COMPONENTS

- A. Piping Components:
 - 1. Provide components that meet the material, fabrication, and operating requirements of ASME B31.3, except as modified herein.
 - 2. Pressure Design Class: Class 150, as defined in ASME B16.5.
 - 3. Threaded Unions:
 - a. Comply with ASME B16.39, Class 150.
 - b. Materials: Comply with ASTM A312/A312M, Grade 304 or 316.
 - c. Dielectric Unions: Comply with dimensional, strength, and pressure requirements of ASME B16.39, Class 150.
 - d. Provide galvanized or plated steel parts.
 - e. Furnish water-impervious insulation barrier capable of limiting galvanic current to one percent of the short-circuit current in a corresponding bimetallic joint and withstand a 600-volt breakdown test when dry.
 - 4. Joint Compound: Resistant to water and suitable for use with fuel containing 40 percent aromatics.

2.03 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with MSS SP-58.

SECTION 15190 - FACILITY FUEL OIL SYSTEMS

1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
- B. Hangers for Pipe Sizes 1/2 to 1-1/2 Inches (15 to 40 mm): Malleable iron, adjustable swivel, split ring.
- C. Hangers for Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.
- D. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- E. Wall Support for Pipe Sizes to 3 Inches (80 mm): Cast iron hook.
- F. Vertical Support: Steel riser clamp.
- G. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

2.04 GATE VALVES

- A. MSS SP-80, Class 125, bronze body, bronze trim, rising stem, handwheel, inside screw, solid wedge disc, solder ends.

2.05 BALL VALVES

- A. MSS SP-110, Class 150, 400 psi CWP (Class 150, 2760 kPa CWP), bronze, two piece body, chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder.

2.06 SWING CHECK VALVES

- A. MSS SP-80, Class 125, bronze body and cap, bronze swing disc, solder ends.

2.07 RELIEF VALVES

- A. Bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated at maximum 60 psi (400 kPa), UL listed for fuel oil, capacities ASME certified and labelled.

2.08 STRAINERS

- A. Threaded brass body for 175 psi (1200 kPa) CWP, Y pattern with 1/32 inch (0.8 mm) stainless steel perforated screen.

2.09 FLEXIBLE CONNECTORS

- A. Bronze inner hose and braided exterior sleeve, suitable for minimum 200 psi (1380 kPa) CWP and 250 degrees F (121 degrees C).

2.10 ABOVEGROUND FUEL STORAGE TANKS

- A. Interior tank FT-1:
 1. Tank: UL 142, welded steel, single walled, oval with steel support saddles, tappings for accessories, threaded connections.
 2. Accessories: Tank fill, level sensor, level switch, primary and emergency vents, and supply and return outlet connections.
 3. Level gauge: Remote reading, electronic, for two-wire, 24-volt power, for use with cabinet-mounted tank monitoring panel.
- B. Interior tank FT-2:
 1. Tank: UL 142, welded steel, rectangular top-diked tank with steel support beams, tappings for accessories, threaded connections.
 2. Accessories: Level sensor, level switch, primary and emergency vents, and supply and return outlet connections.

2.11 FUEL OIL PUMPS

- A. Main Fuel Oil Transfer Pump TP-1:
 1. Pumpset shall be duplex.
 2. Casing: Bronze, rated for 125 psi (860 kPa) working pressure with integral pressure relief valve.
 3. Impeller: Bronze gears, positive displacement.

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4. Drive: Direct connected with flexible coupling.
 5. Accessories: Adjustable pressure control valve, bleed valve, mechanical seal, duplex strainer, duplex strainer differential pressure switch, and pump set leak detection switch.
 6. Performance:
 - a. Flow: 54 gph (3.4 L/min), at 50 psi (344.7 kPa) head.
 - b. Motor: 1/3 hp (.25 kW), 120 volt, single phase, 60 Hz.
- B. Fuel Oil Return Pump RP-1:
1. Pumpset shall be simplex.
 2. Casing: Bronze, rated for 125 psi (860 kPa) working pressure with integral pressure relief valve.
 3. Impeller: Bronze gears, positive displacement.
 4. Drive: Direct connected with flexible coupling.
 5. Accessories: Adjustable pressure control valve, bleed valve, mechanical seal, duplex strainer, duplex strainer differential pressure switch, and pump set leak detection switch.
 6. Performance:
 - a. Flow: 100 gph (6.3 L/min), at 50 psi (344.7 kPa) head.
 - b. Motor: 1/3 hp (.25 kW), 115 volt, single phase, 60 Hz.
- C.

2.12 TRANSFER SYSTEM

- A. System: Float valves and relays to energize transfer pumps to fill day tank from main storage tank automatically.
1. Low level: Energize pumps when tank level drops below 50 percent of full volume.
 2. Full level: De-energize pumps when full.
 3. Alarm: Sound audible alarm when fuel overflows into return line.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that excavations are to required grade, are dry, and have not been over-excavated.

3.02 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.03 PIPING INSTALLATION

- A. Install in accordance with manufacturer's instructions and API RP 1615.
- B. Provide nonconducting dielectric connections wherever jointing dissimilar metals. Install to NACE SP0286.
- C. Route piping in orderly manner and maintain gradient.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Provide clearance for installation of insulation and access to valves and fittings.
- G. Install firestopping to preserve fire-resistance rating of partitions and other elements.
- H. Provide access where valves and fittings are not exposed.
- I. Where pipe support members are welded to structural building framing, scrape, brush clean, weld, and apply one coat of zinc-rich primer.
- J. Identify piping systems, including underground piping.
- K. Install valves with stems upright or horizontal, not inverted.

SECTION 15190 - FACILITY FUEL OIL SYSTEMS

- L. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

3.04 FUEL TANK INSTALLATION

- A. Install tanks in accordance with manufacturer's instructions and API RP 1615.
- B. Clean and flush aboveground tanks after installation. Seal until pipe connections are made.
- C. Provide piping connections to tanks with unions and swing joints. Provide venting to API Std 2000.
- D. Mount aboveground tanks on steel support saddles and stands as indicated.
- E. Clean and flush day tank after installation. Seal until pipe connections are made.
- F. Fill tanks at project turn-over with appropriate fuel.

END OF SECTION

SECTION 15400 - PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tankless electric water heaters.

1.02 REFERENCE STANDARDS

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015 (Reaffirmed 2020).
- B. ABMA STD 11 - Load Ratings and Fatigue Life for Roller Bearings; 2014 (Reaffirmed 2020).
- C. AHRI 550/590 (I-P) - Performance Rating of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle; 2020, with Addendum (2022).
- D. AHRI 575 - Method of Measuring Machinery Sound Within an Equipment Space; 2017.
- E. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); Current Edition.
- F. ANSI Z21.10.3 - Gas-Fired Water Heaters, Volume III, Storage Water Heaters with Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous; 2019.
- G. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2021.
- H. NFPA 31 - Standard for the Installation of Oil-Burning Equipment; 2020.
- I. UL 174 - Standard for Household Electric Storage Tank Water Heaters; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.04 SUBMITTALS

- A. Product Data:
 - 1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
 - 2. Indicate pump type, capacity, power requirements.
 - 3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
- B. Shop Drawings:
 - 1. Indicate heat exchanger dimensions, size of tapings, and performance data.
 - 2. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tapings, and drains.
- C. Project Record Documents: Record actual locations of components.
- D. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- F. Project Record Documents: Record actual locations of components.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Water Softener Salt: 50 pounds (22.7 kg).

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Certifications:

SECTION 15400 - PLUMBING EQUIPMENT

1. Water Heaters: NSF approved.
 2. Gas Water Heaters: AHRI Directory of Certified Product Performance.
 3. Electric Water Heaters: UL listed and labeled to UL 174.
 4. Oil-Fired Water Heaters: To NFPA 31.
 5. Pressure Vessels for Heat Exchangers: ASME labeled to ASME BPVC-VIII-1.
 6. Water Tanks: ASME labeled to ASME BPVC-VIII-1.
 7. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.
- C. Identification: Provide pumps with manufacturer's name, model number, and rating/capacity identified by permanently attached label.
- D. Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.07 WARRANTY

- A. Provide five year manufacturer warranty for domestic water heaters.

PART 2 PRODUCTS

2.01 WATER HEATERS

- A. Refer to Water Heater Schedule on Plan P 132 for water heater specifications.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.
- B. Coordinate with plumbing piping and related electrical work to achieve operating system.

END OF SECTION

SECTION 15410 - PLUMBING FIXTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flush valve water closets.
- B. Lavatories.
- C. Under-lavatory pipe supply covers.

1.02 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASME A112.6.1M - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use; 1997 (Reaffirmed 2017).
- C. ASME A112.18.1 - Plumbing Supply Fittings; 2018, with Errata.
- D. ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures; 2011 (Reaffirmed 2022).
- E. ASME A112.19.2 - Ceramic Plumbing Fixtures; 2018, with Errata.
- F. ASME A112.19.4M - Porcelain Enameled Formed Steel Plumbing Fixtures; 1994 (Reaffirmed 2009).
- G. ASME A112.19.5 - Flush Valves and Spuds for Water Closets, Urinals, and Tanks; 2022.
- H. ASSE 1014 - Performance Requirements for Backflow Prevention Devices for Hand-Held Showers; 2020.
- I. ASSE 1070 - Performance Requirements for Water Temperature Limiting Devices; 2020.
- J. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019.
- K. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- L. ASTM C1822 - Standard Specification for Insulating Covers on Accessible Lavatory Piping; 2021.
- M. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- N. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- O. NSF 61 - Drinking Water System Components - Health Effects; 2022, with Errata.
- P. NSF 372 - Drinking Water System Components - Lead Content; 2022.
- Q. UL (DIR) - Online Certifications Directory; Current Edition.

1.03 SUBMITTALS

- A. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- B. Samples: Submit two lavatory supply fittings.
- C. Manufacturer's Instructions: Indicate installation methods and procedures.
- D. Sustainable Design Documentation: Submit appropriate evidence that materials used in potable water systems comply with the specified requirements.
- E. Maintenance Data: Include fixture trim exploded view and replacement parts lists.
- F. Waterless Urinals: Submit recommended frequency of maintenance and parts replacement, methods of cleaning, sources of replacement supplies and parts.
- G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Faucet Washers: One set of each type and size.

SECTION 15410 - PLUMBING FIXTURES

2. Extra Lavatory Supply Fittings: One set of each type and size.
3. Extra Shower Heads: One of each type and size.
4. Extra Toilet Seats: One of each type and size.
5. Flush Valve Service Kits: One for each type and size.
6. Extra Waterless Urinal Trap Seals and Supplies: One year's worth, based on normal, expected use of facility of this type.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.05 MOCK-UP

- A. Provide mock-up of typical bathroom group.
- B. Mock-up may remain as part of the Work.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept fixtures on-site in factory packaging. Inspect for damage.
- B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.
- B. Water Efficiency: EPA WaterSense label is required for all water closets, urinals, lavatory faucets, and showerheads.
- C. Maximum Fixture or Faucet Supply Pressure: 60 psi (4.1 bar) unless stated otherwise.

2.02 REGULATORY REQUIREMENTS

- A. Comply with applicable codes for installation of plumbing systems.
- B. Comply with UL (DIR) requirements.
- C. Perform work in accordance with local health department regulations.
- D. Provide certificate of compliance from Authority Having Jurisdiction indicating approval of installation.

2.03 FLUSH VALVE WATER CLOSETS

- A. Refer to Plumbing Fixture Schedule on Plan P 132 for water closet specifications.

2.04 LAVATORIES

- A. Refer to Plumbing Fixture Schedule on Plan P 132 for lavatory specifications.

2.05 UNDER-LAVATORY PIPE SUPPLY COVERS

- A. Basis of Design: Plumberex Specialty Products, Inc; www.plumberex.com/#sle.
 1. Fusion Molded Under-Lavatory Insulators (Non-Sewn): Plumberex Handy-Shield Maxx.
 2. Slim Fit Under-Lavatory Insulators (Non-Sewn): Plumberex Trap Gear.
 3. Under-Lavatory Covers with Snap-Lock Fasteners (Molded): Plumberex Pro-Extreme.
- B. General:
 1. Insulate exposed drainage piping including hot, cold and tempered water supplies under lavatories or sinks per ADA Standards.
 2. Adhesives, sewing threads and two ply laminated materials are prohibited.
 3. Exterior Surfaces: Smooth nonabsorbent with no finger recessed indentations for easy cleaning.
 4. Construction: 1/8 inch (3.2 mm) PVC with antimicrobial, antifungal and UV resistant properties.

SECTION 15410 - PLUMBING FIXTURES

- a. Provide one piece injected molded design with internal bridge at top of J-bend to prevent separating.
- b. Comply with ASTM C1822 Type I for covers on accessible lavatory piping.
- c. Comply with ASME A112.18.9 for covers on accessible lavatory piping.
- d. Comply with ICC A117.1.
- e. Thermal Resistance: R value of 0.504 or lower when tested by ASTM C177.
- f. Thermal Conductivity: K value of 0.358 or density of 21.61 pcf per ASTM C518.
- g. Microbial and Fungal Resistance for Interior and Exterior: Comply with ASTM G21.
5. Color: High gloss white.
6. Fasteners: Reusable, snap-locking fasteners with no sharp or abrasive external surfaces. No cable ties allowed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
- B. Verify that electric power is available and of the correct characteristics.
- C. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.02 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.03 INSTALLATION

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome-plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.
- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall supports and bolts.
- E. Solidly attach water closets to floor with lag screws. Lead flashing is not intended to hold fixture in place.

3.04 INTERFACE WITH WORK OF OTHER SECTIONS

- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.05 ADJUSTING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.06 CLEANING

- A. Clean plumbing fixtures and equipment.

3.07 PROTECTION

- A. Protect installed products from damage due to subsequent construction operations.
- B. Do not permit use of fixtures by construction personnel.
- C. Repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

15768 - ELECTRIC HEATERS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Electric Unit Heaters.
- B. Washdown Corrosion Resistant Electric Unit Heaters.

1.02 REFERENCES

- A. Electric unit heaters shall meet the requirements of the National Electric Code (NEC) and shall be UL listed.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01330 - SUBMITTALS.
- B. Submit manufacturer's product data and installation instructions to Engineer.
- C. Submittal data shall include capacity and size of each heater and wiring instructions.

PART 2 - PRODUCTS

2.01 ELECTRIC UNIT HEATERS

- A. Electric unit heater shall be Model HVH as manufactured by Chromalox or approved equal. Heater shall be suitable for horizontal or vertical mount. Refer to the drawings for mounting type.
- B. Heater to be of the KW rating, voltage and phase specified in the schedule.
- C. Unit cabinet shall be 20 gauge die formed furniture grade steel with integral adjustable louvers to provide control of discharged air. All metal surfaces of the case shall be phosphate coated to resist corrosion, and finished in attractive two-tone powder coated paint.
- D. The electric heating bank shall be metal sheath fintube heating elements with furnace brazed fins for improved heat transfer. Automatic reset thermal overload protection shall be wired for instantaneous de-energizing of built-in control of contactor holding coil in case of thermal overload.
- E. Motor shall be of the totally enclosed continuous fan-duty sleeve bearing type equipped with built-in thermal overload protection. Each unit shall be equipped with a combination motor support resiliently mounted at four points to absorb any motor vibration. Fans shall be aluminum, directly connected to fan motor, dynamically balanced and designed specifically for unit heater application.
- F. Electrical: All units shall have built-in contactors and low voltage control circuit transformers to provide single-source power connection. Factory mounted disconnect switches shall be provided. A wiring diagram and grounding lug shall be included in each control compartment.
- G. Supports: Stainless steel hanger rods, double nuts, and ceiling/wall bracket.
- H. All options and accessories shall be as called for on the equipment schedules.

2.02 WASHDOWN CORROSION RESISTANT ELECTRIC UNIT HEATERS

- A. Electric unit heater shall be Model HD3D as manufactured by Chromalox or approved equal.
- B. Heaters capacities and electrical characteristics shall be as called for on the equipment schedules. Heaters shall be forced fan hose-down corrosion resistant type.
- C. The heating elements shall be type 316 stainless steel of finned tubular construction with stainless steel fittings.
- D. The motor shall be UL listed, totally enclosed with permanently lubricated ball bearings, designed to resist moisture and corrosion, fitted with an epoxy coated fan blade and factory wired to NEMA 4X stainless steel enclosure.
- E. Heating elements and motor shall be enclosed in a round heavy 20 gauge stainless steel shroud, with stainless steel louvered outlet grille and plated rear grille.
- F. Each unit shall be provided with a NEMA 4X enclosure to house element terminals and following controls:
 - 1. Automatic reset overtemperature outlet,
 - 2. Fan delay relay,
 - 3. Heater contactor
 - 4. Motor contactor
 - 5. Terminal block for field wiring by the Contractor.
- G. Supports: Factory provided swivel bracket suitable for wall mounting.
- H. All options and accessories shall be as called for on the equipment schedules.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install unit in accordance with manufacturer's published installation instructions.
- B. Do not install horizontal unit heaters closer than 12 inches to combustible materials in any direction.
- C. Do not install vertical unit heaters closer than 18 inches from ceiling and 24 inches horizontally from combustible materials in any direction. The bottom of the unit must be a minimum of 8 feet above the floor.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish and install, as shown on the Plans and specified herein, one (1) wet well air supply fan at each of the Knott Drive, Morgan Park, and Viola Drive Pumping Stations wet wells.

1.02 RELATED WORK

- A. Section 08315 – Access Doors
- B. Section 15010 – General Mechanical Requirements
- C. Division 16 - Electrical

1.03 SUBMITTALS

- A. Submit information in accordance with the requirements in Section 01300.
- B. Shop drawings, showing all weights and dimensions necessary for the installation including: fan curves with specified operating points, power requirements, RPM, electrical characteristics, and connection requirements
- C. Storage, handling, and installation instructions.

1.07 WARRANTY

- A. The wet well air supply fans shall be guaranteed against defects in material or materials and/or workmanship for a period of 2 years.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Wet well air supply fans shall be Series 20 as manufactured by Plastec Ventilation Inc., Bradenton, Florida, or approved equal.

2.02 WET WELL VENTILATION SYSTEM

- A. General:
 - 1. The contractor shall install a complete operational wet well ventilation system including a top slab mounted intake supply air fan, circular exhaust air vent with discharge cap and automatic limit switches on hatches to activate the supply air system upon opening any wet well hatch.
 - 2. The system capacity shall be as required to ensure a minimum air change of 30 air changes per hour. Unless otherwise specified the capacity shall be 500 cfm at a static pressure of 1.0" WG.
- B. Fan:
 - 1. The fan shall be a centrifugal direct-drive type design.
 - 2. The fan motor shall be explosion proof.
 - 3. The fan motor shall be located in a corrosion resistant aluminum enclosure and stand.
 - 4. All hardware to be 316 stainless-steel.
 - 5. Fan shall bear the AMCA Certified Rating Seals for sound and air performance.
 - 6. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.
 - 7. Motor shall be heavy duty ball bearing type, carefully matched to the fan load and furnished at the specified voltage, phase and enclosure.
 - 8. The fan shall be fitted with an insect screen of 316 Stainless steel hardware cloth.

SECTION 15800 – WET WELL AIR SUPPLY FAN

C. PVC Ducts:

1. The supply fan duct and exhaust vent shall be constructed of schedule 40 PVC piping. Unless otherwise shown on the plans the vents shall be a minimum diameter of 8". The exhaust vent shall be fitted with an 8" diameter gooseneck connection a minimum of 12" above the wet well top slab. The vent shall be fully supported by the top slab and anchors into the wet well wall at a minimum spacing of 4' on center.

D. Switches:

1. Provide hatch activated limit switch to operate wet well fan and light when either of the hatches are opened.
2. Provide a hand-off-automatic (HOA) switch to operate the wet well fan and light regardless of the position of the hatch limit switches.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Assemble and install wet well fan, ducts, and limit switches as shown on the plans and in accordance with manufacturers installation instructions.

+ + END OF SECTION + +

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Provide supply and exhaust fans, as specified herein, of sizes and capacities scheduled and in locations shown on drawings.

1.02 REFERENCE CODES AND STANDARDS

- A. Air Movement and Control Association Inc. (AMCA):
 - 1. 99 - Standards Handbook
 - 2. 200 - Publication, Air Systems
 - 3. 201-90 - Publication, Fans and Systems
 - 4. 202-88 - Publication, Troubleshooting
 - 5. 203-90 - Publication, Field Performance Measurement of Fan Systems
 - 6. 211-05 - Publication, Certified Ratings Program - Product Rating Manual for Fan Air Performance
 - 7. 300-96 - Standard Reverberant Room Method for Sound Testing of Fans
 - 8. 311-05 - Publication, Certified Ratings Program - Product Rating Manual for Fan Sound Performance
 - 9. 99-2408-69 - Operating Limits for Centrifugal Fans
- B. Air Movement and Control Association Inc. (AMCA), American National Standards Institute (ANSI):
 - 1. 204-05 - Standards Balance Quality and Vibration Levels for Fans
 - 2. 210-99 - Standard Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
 - 3. 11-r1999 - Method of Evaluating Load Ratings of Bearings
- C. National Fire Protection Association (NFPA):
 - 1. 70 - National Electrical Code
 - 2. 90A-02 - Standard for the Installation of Air-Conditioning and Ventilating Systems
- D. Occupational Safety and Health Administration (OSHA):
 - 1. 1910.212 - General requirements for Machine Guarding
- E. UL listed and labeled.

1.03 SUBMITTALS

- A. Shop Drawings - Show fan layout, housing, materials, gauges, dimensions, weights and installation details
- B. Product data - Manufacturer's fan performance (data includes cfm, rpm, bhp, motor nameplate data, tip speed, outlet velocity and static pressure) and sound performance (data includes sound power level ratings by octave bands) as tested in accordance with AMCA Standards 210 and 300.
- C. Fan performance curves - Submit curves for all fans with system performance shown, and for plus or minus 10 percent and plus or minus 20 percent change in fan rpm. Curves shall include plotted rpm, horsepower, cfm, static pressure, and fan surge line and operating point.
- D. Certified AMCA Ratings - Submit ratings for air and sound performance.

- E. UL Listing - Submit listing if specified.

1.04 QUALITY ASSURANCE

- A. Factory balance each fan statically and dynamically, test run before shipment, and key fan wheel to fan shaft. Fans shall operate quietly and without pulsation or vibration. Conduct sound power level tests for each type fan at the factory in accordance with AMCA 300.
- B. Fans shall operate in the stable range of their performance curves.
- C. The fan external static pressures shown in the schedules are those required by the ductwork and apparatus, and do not include the internal and intake fan losses, inlet vanes or integral outlet dampers, inlet screens, outlet velocity heads or drive losses, unless otherwise noted.
- D. Factory performance test each fan assembled in or as part of apparatus specified to be performance tested. Test shall display scheduled performance characteristics, using certified, calibrated testing instruments provided by the manufacturer of the apparatus.
- E. All fan performance ratings shall be based upon factory tests performed in accordance with AMCA 210. One fan of each type specified shall have actual factory performance tests performed prior to shipment. All fans shall be certified by AMCA and carry its seal.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer, material, products included, and location of installation
- B. Storage: Store materials in a dry area indoor, protected from damage, and in accordance with manufacturer's instructions. For long term storage follow manufacturer's Installation, Operations, and Maintenance Manual
- C. Handling: Handle and lift fans in accordance with the manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage. Follow all safety warnings posted by the manufacturer

1.06 WARRANTY

- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.
 - 1. Equipment shall be warranted to be free from defects in material and workmanship for a period of one (1) year from the date of shipment.
 - 2. Motors shall be warranted by the motor manufacturer for a period of one (1) year after shipment from the fan manufacturer.

PART 2 - PRODUCTS

2.01 DIRECT DRIVE SIDEWALL MOUNTED PROPELLER FANS

- A. General Description:
 - 1. Fan shall be model 02S as manufactured by Hartzell or approved equal.
 - 2. Fan arrangement shall be as shown on the Drawings.
 - 3. Sidewall mounted applications.
 - 4. Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number.

B. Wheel:

1. The panel fan propeller shall be an airfoil design, cast of 319 aluminum alloy in compliance with Federal Specification QQ-A-601E and ASTM B26 and epoxy coated.
2. Propellers shall be fixed or adjustable pitch to provide the specified flow and static pressure and shall be retained on the motor shaft utilizing a split taper bushing or clamp block arrangement.
3. Statically and dynamically balanced in accordance with AMCA Standard 204-05.
4. The propeller and fan inlet shall be matched and shall have precise running tolerances for maximum performance and operating efficiency.
5. The propeller shall be mounted in a high efficiency air seal fan orifice with the smaller diameter of the ring overlapping the propeller tips.

C. Motors:

1. Motor shall be accessible for maintenance.
2. Solid rolled rod motor mounts shall provide support for the motor. Steel motor base and solid steel support rods shall be oversized to provide structurally rugged construction.
3. Motors shall be totally enclosed air over type.
4. Motors shall be permanently lubricated, non-regreasable, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase.
5. Integral horsepower motors shall be supplied with regreasable bearings.

D. Options/Accessories:

1. All options and accessories shall be as called for on the equipment schedules.

2.02 UTILITY SET CENTRIFUGAL BLOWERS

A. General Description:

1. Fans shall be Model 03 as manufactured by Hartzell or approved equal.
2. Each fan shall bear a permanently affixed manufacturer's engraved metal nameplate containing the model number and individual serial number.
3. Application (supply or exhaust) shall be as called for on the equipment schedules.
4. Discharge configuration shall be as called for on the equipment schedules.

B. Wheel:

1. Non-overloading, backward curved centrifugal wheel
2. Constructed of aluminum
3. Statically and dynamically balanced in accordance to AMCA Standard 204-05
4. The wheel shall be mounted to the fan shaft with a split taper bushing.
5. Fan shafts shall be 316 stainless steel, ground and polished.
6. Fan bearings shall be heavy duty, self-aligning ball or roller type relubricatable for continuous service.

C. Motors:

1. Motor enclosure shall be Totally Enclosed Fan Cooled (TEFC) or Explosion Proof (EXP) type as called for on the equipment schedules.
2. Motors shall be permanently lubricated, heavy duty ball bearing type to match the fan load and shall be pre-wired to the specific voltage and phase.

D. Housing/Cabinet Construction

1. Construction material: The fan housing and base shall be heavy gauge aluminum and epoxy coated.
 - a. The fan shall be constructed to meet AMCA A spark resistance.
2. A bolted access door shall be factory installed and all hardware shall be 316 stainless steel.
3. Inlet and discharge flanges shall be provided and factory drilled.

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4. Extended lubrication lines to the fan bearings shall be 316 stainless steel.
 5. Belt and shaft guards shall be epoxy coated aluminum.
 6. The belts shall be an oil, heat, and static-resistant type, oversized for continuous duty.
 7. Lifting lugs and Teflon shaft seal with two shaft plates shall be factory installed.
- E. Options/Accessories:
1. All options/accessories shall be as called for on the equipment schedules.

PART 3 - EXECUTION

3.01 GENERAL

- A. Install fans, including all necessary structural supports and bracings as scheduled and located on the contract drawings in accordance with manufacturer's instructions and approved submittals.
- B. Connect duct to fans to allow for straight and smooth air flow.
- C. Provide flexible connections (minimum of 4") between fan and duct.
- D. Install fan level: +/- 5 degrees vertical. Final installation shall be free of all leaks from both fan and associated ductwork.

3.02 START-UP, TESTING, DEMONSTRATION

- A. Start-up fans after checkout to ensure proper alignment and phased electrical connections.
- B. Test fans individually and as part of system.
- C. Ensure fans are properly interlocked with intake louvers.
- D. Demonstrate operation to Owner and instruct maintenance personnel in operation of equipment.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. This Section describes the metal ductwork for HVAC duct systems in accordance with SMACNA Duct Construction Standards, except as otherwise specified.
- B. The construction material for each ductwork system shall be as listed in the "Ductwork Material Schedule" at the end of this Section.
- C. This Section also describes the fittings, access doors, hangers and supports, manual volume dampers and sealants for each ductwork system as required.

1.02 RELATED WORK

- A. Section 15990 - Balancing of Air Systems.

1.03 REFERENCES

- A. ASHRAE - Handbook Fundamentals; Latest Edition.
- B. SMACNA - HVAC Duct Construction Standards Metal And Flexible (latest issue)
- C. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- D. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- E. NFPA 96 - Standard for Commercial Cooking Operations
- F. New York State Mechanical Code.

1.04 REGULATORY REQUIREMENTS

- A. Construct ductwork to NFPA 90A and New York State Mechanical Code standards.

1.05 SUBMITTALS

- A. Ductwork shop drawings for approval:
 - 1. Coordinate layout duct drawings that differ from ductwork shown on the Drawings.
 - 2. The review of deviations will be for pressure drop only. The review will not address clearances or accessibility to maintain or balance the air systems. No dimensional or coordination check of the shop drawings will be made. The Contractor has the sole responsibility to review the Drawings, coordinate ductwork fabrication, and provide clearances and access for installation, maintenance and balancing of this work, and work of other trades. Unless specifically dimensioned, Drawings indicate approximate locations only. The Contractor has the sole responsibility to locate and route the ductwork.
 - 3. Deviations such as changing direction or transforming or dividing ductwork must maintain ductwork cross-sectional area and not exceed transformation taper of 15 degrees.
 - 4. Plans and section showing all equipment and accessories.
 - 5. Minimum 3/8 in. scale, double line, showing sizes, transverse joints, transitions, elevations, clearances and accessories; sections where required.
- B. Shop details and catalog cuts of:
 - 1. Ductwork construction, including gauge and bracing schedule.

2. Supports.
3. Dampers.
4. Turning vanes.
5. Access doors.
6. Flexible connections.
7. Other accessories.

1.06 QUALITY ASSURANCE

- A. Construct all ductwork in accordance with referenced SMACNA Standards, except as otherwise stated. Ductwork pressure classifications shall be in accordance with referenced SMACNA Standards, except as otherwise specified.
- B. For all uninsulated ductwork casings and plenums located outdoors, the reinforcement members shall be galvanized steel or stainless steel.
- C. Construction pressure classification of ductwork are shown on the Drawings. If not shown, the pressure classification shall be greater than or equal to the maximum operating static pressure (minimum 2" w.c. pressure classification).
- D. All ductwork shall be free from pulsation, chatter, vibration and objectionable noise. If any of these defects appear after a system is in operation, correct by removing and replacing, or reinforcing the ductwork, at no additional cost to the Owner.
- E. For all galvanized steel ductwork, zinc coating shall be minimum G90 per ASTM A 653.

PART 2 - PRODUCTS

2.01 GALVANIZED STEEL RECTANGULAR DUCTS AND FITTINGS

- A. Construct ducts of galvanized sheet steel meeting ASTM A 653 with G90 coating designation, and in accordance with the latest SMACNA HVAC Duct Construction Standards Metal And Flexible and pressure classifications as stated on the Drawings (minimum 2" w.c. pressure classification).
- B. No ducts shall be less than No. 22 U.S. Gauge.
- C. Piping, conduit and structure shall not penetrate ductwork. Where this condition cannot be avoided and with the written permission of the Architect/Engineer, follow SMACNA HVAC Duct Construction Standards Metal and Flexible, except that sides of transition sections shall slope a maximum of 15 degrees.
- D. Provide 90-degree full-radius elbows with a centerline radius 1.5 times the duct width in the plane of the bend.
- E. For elbows with centerline radius less than 1.5 times the width of the duct in the plane of the bend, provide turning vanes.
- F. Provide square throat elbows with manufactured turning vanes.
- G. All dissimilar metals shall be connected with flanged joints made up with fiber or neoprene gaskets to prevent contact between dissimilar metals. Flanges shall be fastened with bolts protected by ferrules and washers made of the same materials as the gaskets.
- H. For split fittings, the split shall be proportional to the air flow. Construct per SMACNA HVAC Duct Construction Standards- Metal and Flexible.

- I. Transitions and Offsets shall follow SMACNA HVAC Duct Construction Standards Metal and Flexible, except that sides of transitions shall slope a maximum of 15 degrees.
- J. All branch take-offs perpendicular to the main shall be a 45 degree entry.
- K. Longitudinal seams shall be of the Pittsburgh Lock type outlined in the SMACNA HVAC Duct Construction Standards Metal and Flexible.
- L. Duct transverse joints shall be selected and used consistent with the static pressure class, applicable sealing requirements, materials involved, duct support intervals and other provisions for proper assembly of ductwork outlined in the SMACNA HVAC Duct Construction Standards - Metal and Flexible. Transverse joints T-25a, T-25b (Ductmate) shall only be used. Metal clips will only be allowed (NO PVC). Ductmate shall not be used for the following (use transverse joints T-15 through T-24 in these cases):
 - 1. The Ductmate '45' system shall not be used for applications with duct gauges heavier than 10 or lighter than 22.
 - 2. The Ductmate '35' system shall not be used for applications with duct gauges heavier than 16 GA. or lighter than 26 GA.
 - 3. The Ductmate '25' system shall not be used for application with duct gauges heavier than 20 GA. or lighter than 26 GA.

2.02 TURNING VANES

- A. Manufactured with same material as ductwork that it is installed in and to the same pressure classification as ductwork that they are installed in.
- B. Provide turning vanes in all square duct elbows and as noted on the Drawings.
- C. Vanes shall be single thickness Small Vane as detailed in SMACNA HVAC Duct Construction Standards Metal and Flexible.
- D. Where a rectangular duct changes in size at a square-throat elbow fitting, use single thickness turning vanes with trailing edge extensions aligned with the sides of the duct.

2.03 ACCESS DOORS

- A. For access doors for use in ductwork receiving Fire Rated Blanket Insulation see Ductwork Insulation Section for requirements. Fabricate all other access doors in accordance with SMACNA Duct Construction Standards Metal And Flexible and as indicated.
- B. For HVAC duct systems, construct doors of the same material as the ductwork. Minimum size of access doors shall be 8 inches by 8 inches, unless shown otherwise.
- C. Provide walkthrough doors where shown. These doors shall have a minimum clear width of 18 inches. Provide doors with 8 inch square double pane wire glass windows. Locate windows not to exceed 5 feet-6 inches to centerline above finished floor of installed casing. Walk-through doors shall be operable from both sides of the door.
- D. Access doors shall be insulated same as duct.
- E. Provide with continuous neoprene gaskets around perimeter of access doors for airtight seal.
- F. Provide all access doors with cam lock latches.
- G. All access doors serving a fire damper shall be painted red and shall have a label with white letters not less than ½ inch high reading "FIRE DAMPER". No external ductwork insulation

shall conceal a fire damper access door unless there is a label attached to the insulation indicating the exact location of the access door.

- H. Provide access doors in following locations:
 - 1. On both sides of ducts where necessary to provide maintenance accessibility to equipment on either side.
 - 2. Fan Plenums.
 - 3. In-Line Fans (suction and discharge sides)
 - 4. Other items requiring access for service/maintenance
- I. Where duct access doors are concealed the Contractor shall furnish and pay for installation of access doors to be mounted in the fire rated walls and ductwork enclosures. The access doors must be fire resistive and minimum 6" larger on each side then the duct access door for the above mentioned applications.

2.04 MANUAL VOLUME DAMPER

- A. Fabricate in accordance with SMACNA Duct Construction Standards Metal And Flexible, and as indicated.
- B. Fabricate single blade dampers for duct sizes up to 6 inches in height.
- C. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes of 4 inches for ducts above 6 inches in height. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
- D. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.
- E. Provide locking, indicating quadrant regulators on single and multi-blade dampers. Where rod lengths exceed 30 inches, provide regulator at both ends.
- F. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
- G. Volume damper shall be provided at each duct branch and also where shown on the Drawings. Volume dampers must be installed at each branch even if they are not shown on the Drawing.
- H. Approved Manufacturers:
 - 1. Ruskin Mfr. Co.
 - 2. Arrow Damper & Louver.
 - 3. Imperial Damper Co.

2.05 BACKDRAFT DAMPERS

- A. Dampers shall be low-leakage, parallel-blade type. Damper sizes shall be suitable for duct sizes noted on the Drawings. The dampers shall be suitable for a minimum 4000 fpm velocity.
- B. Damper frames shall be minimum No. 12 gauge galvanized steel blades shall be minimum No. 16 gauge galvanized steel or Type 6063-T5 aluminum with press-fit ball bearings.
- C. Dampers shall be complete with adjustable counterweights and linkage for duty at .20 inches w.g. and 3500 fpm.
- D. Provide neoprene or silicone rubber blade seals.

- E. Approved manufacturers - Ruskin Manufacturing Company.

2.06 DUCT TEST HOLES

- A. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- B. Permanent test holes shall be factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.07 DUCT HANGERS AND SUPPORTS

- A. Provide trapeze, strap or angle iron hangers meeting SMACNA HVAC Duct Construction Standards Metal and Flexible.
- B. Materials of hangers, supports and fasteners shall conform to the manufacturer's load ratings.
- C. Hangers, supports, upper attachments and inserts shall be hot-dip galvanized steel or stainless steel.
- D. Fasteners for HVAC duct systems shall be hot-dip galvanized steel, cadmium-plated steel or stainless steel.
- E. Secure ductwork hangers attached to concrete structures and slabs with embedded inserts, anchor bolts or concrete fasteners. A safety factor of 5 should be used in selection of all inserts and expansion bolts (if applicable safety factor shall be determined by analysis of seismic loads and the greater safety factor shall be used).
- F. Provide hangers and supports not more than 12 inches from each face of a horizontal elbow.
- G. Plenums shall be supported to permit personnel to enter the plenum. If no structural steel design is shown on the Drawings, it is the responsibility of the Contractor to provide the services of a licensed structural engineer in the in which the project is to be constructed to submit a structural design for review.

2.08 SEALANTS

- A. Where ducts are not continuously welded or soldered, provide sealants and gaskets as required to meet the specified duct leakage allowance.
- B. Provide Gaskets, Sealers, Mastics and Tapes as manufactured by Ductmate.

2.09 STAINLESS STEEL DUCTWORK

- A. Fabricate ducts of minimum 20 gage AISI Type 316 stainless steel sheet metal.
- B. Use stainless steel with a No. 4 finish where installed exposed in finished rooms and No. 2B finish in other locations. Use stainless steel fasteners.
- C. Use stainless steel reinforcing members.
- D. Construct ductwork as per "GALVANIZED STEEL RECTANGULAR DUCTS AND FITTINGS" section above unless otherwise noted in this section.

2.10 FLEXIBLE CONNECTIONS

- A. Provide fabric flexible duct connections.
- B. Fabric shall be UL approved, fire-retardant, closely-woven glass, double coated with neoprene, and a minimum of 4 inches wide.
- C. Shall be installed at duct connections to all fans and where vibration will be transmitted through ductwork.
- D. Approved Manufacturers:
 - 1. "Ventglas" by Vent Fabrics, Inc.

PART 3 - EXECUTION

3.01 INSTALLATION - GENERAL

- A. Install ductwork in accordance with applicable SMACNA Duct Construction Standards Metal And Flexible and approved submittals, and as shown on the Drawings. Duct sizes shown are inside clear dimensions. Where internal duct liners are used, duct sizes shown are inside clear of liner. For ductwork located outside, provide reinforcing sufficient to support wind and snow loads.
- B. The Drawings indicate general locations of ducts. Make additional offsets or changes in direction as required at no additional cost to the Owner.
- C. Wherever ductwork is divided, maintain the cross-sectional area.
- D. Do not exceed 15-degree taper when constructing duct transitions.
- E. Close the open ends of ducts during construction to prevent debris and dirt from entering.
- F. Secure casings and plenums to curbs according to the requirements of the SMACNA HVAC Duct Construction Standards Metal and Flexible.
- G. Make changes in direction with long radius bends.
- H. All welded and scratched galvanized steel surfaces shall be touched up with zinc-rich paint.
- I. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- J. Patch and repair all wall penetrations.
- K. Insulation: Where Drawings and Specifications indicate that ducts are to be insulated make provisions for neat insulation finish around damper operating quadrants, splitter adjusting clamps, access doors, and similar operating devices. Metal collar equivalent in depth to insulation thickness and of suitable size to which insulation may be finished to be mounted on duct.

3.02 FITTING INSTALLATION

- A. Use minimum of four sheet metal screws per joint.

- B. Apply approved sealant on duct-to-duct joint before assembly. Apply additional sealant after assembly to make joint airtight.

3.03 HANGER AND SUPPORT INSTALLATION

- A. Support ductwork hung from building structure using trapeze, strap or angle iron hangers conforming to SMACNA HVAC Duct Construction Standards Metal and Flexible. Provide supplemental structural steel to span joists where required.
- B. Do not support ductwork from furring, hung ceilings, metal floor deck, metal roof deck or from another duct or pipe.
- C. Do not hang lighting fixtures or piping from ductwork.
- D. Do not use perforated band iron.
- E. Support ductwork at each change in direction.
- F. Where duct connects to or terminates at masonry openings or at floors where concrete curbs are not used, provide a continuous 1 ½ inch by 1 ½ inch by 3/16 inch galvanized steel angle support around the ductwork. Bolt and seal the supports to the building construction using expansion bolts and caulking compound. Seal shall be watertight at floor or wall and duct such that a spill will no pass down through the opening.
- G. Fasten plenums and casings connected to concrete curbs using continuous 1 ½ inch by 1 ½ inch by ¼ inch galvanized steel angle support. Set the angle support in a continuous bead of caulking compound and anchor it to the curb with 3/8 inch diameter anchors on 16 inch centers. Terminate sheet metal at curb and bolt to angle support. Seal sheet metal to curb with a continuous bead of caulking.
- H. For insulated ductwork, install hangers on the outside of the insulation. To maintain the insulation value, inset a piece of 1 inch thick, 6 pcf fiberglass board with a foil/scrim/kraft (FSK) jacket at these supports.

3.04 SEALING

- A. Where ductwork is not continuously welded, soldered or gasketed, make seams and joints airtight with sealants.
- B. Install the sealants in accordance with the sealant manufacturer's instructions and recommendations.
- C. Seal all ductwork seams, joints, fastener penetrations and fittings connections with sealants in accordance with SMACNA Seal Classifications as required by SMACNA Duct Pressure Classification. All ductwork, regardless of pressure classification, shall have a minimum Seal Class B.
- D. Completely fill all voids when liquid sealing ductwork. Several applications may be necessary to fill voids caused by shrinkage or runout of sealant.

3.05 DUCT-MOUNTED DEVICES AND ACCESS DOORS

- A. Install all dampers, coils, airflow measuring stations, humidifiers and other duct-mounted devices, specified in other sections of the specifications or as shown and provide transformations to dimensions as required. Install devices in accordance with manufacturer's recommendations. Install dampers and coils a minimum of 4 feet away from changes

indirection or transitions. Allow five (5) equivalent diameters of straight ductwork upstream and one (1) equivalent diameter of straight ductwork downstream of airflow measuring devices.

- B. Install access doors in ductwork, plenums and where specified and as shown. Provide access doors for inspection and cleaning automatic dampers, at fire dampers, and elsewhere as indicated. Provide minimum 18 x 18 inch size for shoulder access and as indicated. Install access doors in the bottom of the ductwork unless they are inaccessible in this location; then install the access doors in either the side or top of the ductwork, whichever is more accessible.
- C. Provide fire damper at locations indicated, and where outlets pass through fire rated components and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway, duct connections, corrosion resistant springs, bearings, bushings and hinges.
- D. Demonstrate re-setting of fire dampers to authorities having jurisdiction and Engineer.
- E. Provide flexible connections immediately adjacent to equipment in ducts associated with motorized equipment. Cover connections to medium pressure fans with leaded vinyl sheet, held in place with metal straps.
- F. Pilot Ports: Locate pilot ports for measuring airflow in each main supply duct at the downstream end of the straightest run of the main and before the first branch take-off. Form pilot ports by drilling 7/16 inches holes in the duct, lined up perpendicular to airflow on maximum 8-inch centers and at least three to a duct, evenly spaced. Holes to be plugged with plastic plugs. Provide access to these for future rebalancing.

3.06 DUCTWORK AND EQUIPMENT LEAK TESTING

- A. Leak test each ductwork system within ten working days of ductwork installation and before ductwork is insulated and concealed.
- B. All HVAC ductwork shall be tested. Follow general procedures and use apparatus as outlined in the SMACNA HVAC Air Duct Leakage Test Manual.
- C. Test all ductwork at 100 percent of the pressure classifications indicated.
- D. Air testing during erection shall include separate leakage air tests of air riser, horizontal distribution system, and, after all ductwork is installed and the central stations apparatus is erected, leakage testing of the whole system.
- E. Use Appendix C in the SMACNA HVAC Air Duct Leakage Test Manual to determine allowable leakage rates for each duct section tested.
- F. All devices, including access doors, airflow measuring devices, sound attenuators, damper casings, sensors, test ports, etc. that are furnished and/or installed in duct systems shall be included as part of the duct system leakage allowance. All joints shall be inspected and checked for audible leakage, repaired, if necessary, and retested. Duct leakage shall be limited to the following:

Average Size of Run Diameter or Equivalent	*A/100 ft. Run
12 inches or less	10
20 inches or less	15
30 inches or less	25
40 inches or less	30
50 inches or less	30

Average Size of Run Diameter or Equivalent	*A/100 ft. Run
* (A) = Permissible loss in cfm	

- G. Total system leakage shall not exceed 10 percent of the scheduled design capacity of the system when tested as per SMACNA testing methods.

3.07 DUCTWORK MATERIAL SCHEDULE

AIR SYSTEM	DUCTWORK MATERIAL
Dry Well Supply and Exhaust Ductwork	20 ga. Galvanized Steel
Generator Cooling Exhaust Ductwork	16 ga. Galvanized Steel
Wet Well Supply, Odor Control, and Exhaust Ductwork	20 ga. Type 316 Stainless Steel

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The Work specified as part of this Section consists of the work required to achieve operational and coordinated Sequences of Operation as described. Work includes coordination of functions of controllers supplied as part of equipment packages, interconnection of systems, provision and installation of all accessory devices required for complete system operation including devices not provided as part of equipment, coordination of start-up and testing and demonstration of the operation of Sequences of Operation to the Owner and his representatives.
- B. The control system operation of all equipment shall be subject to the operational modes, conditions and logic described in this Section and the controlled equipment manufacturer's recommendations.
- C. Training of the Owner's personnel in the operation, trouble shooting, adjustment and repair of all system controls.

1.02 RELATED SECTIONS AND WORK

- A. Division 26

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 SEQUENCE OF OPERATION - ELECTRIC UNIT HEATERS (EUH-1 THRU EUH-9)

- A. General:
 - 1. The heater shall be provided with a wired, wall-mounted thermostat.
- B. Heating:
 - 1. The heating set point temperature shall be 55°F (adjustable). When the space temperature falls below the set point temperature, the heater shall turn on in order to maintain the set point temperature.

3.02 SEQUENCE OF OPERATION - EXHAUST FAN AND SUPPLY FAN (EF-1 & SF-1)

- A. General:
 - 1. Each fan shall be provided with a 2-speed Hand-Off-Auto (HOA) motor starter.
 - 2. One (1) thermostat shall be provided to control both fans.
 - a. Hand Mode: The fans shall run continuously at high speed.
 - b. Off Mode: The fans shall be off.
 - c. Auto Mode: The fans shall run at low or high speed, as described below.
- B. Low Speed:
 - 1. With fan starters in auto mode, fans shall run at low speed continuously (24/7), unless the thermostat is demanding high speed as described below.
- C. High Speed:

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1. With fan starters in auto mode, fans shall run at high speed upon a rise in space temperature above the set point of 88°F (adjustable). Upon a drop in space temperature below this set point, the fans shall revert to continuous low speed operation.

3.03 SEQUENCE OF OPERATION - EXHAUST FAN AND SUPPLY FAN (EF-2 & SF-2)

- A. General:
 1. Each fan shall be provided with a Hand-Off-Auto (HOA) motor starter.
 2. Fans shall be provided with door contacts, starter push-buttons outside and inside the Wet Well, programmable timeclock, and 60-min run timer. These devices shall tie into both motor starters and operate the fans as one system.
 - a. Hand Mode: The fans shall run continuously.
 - b. Off Mode: The fans shall be off.
 - c. Auto Mode: The fans shall run as described below.
- B. Door Contacts:
 1. With fan starters in auto mode, fans shall run for 60-mins (adjustable) upon opening of the entrance door(s) into the Wet Well.
- C. Push Buttons:
 1. With fan starters in auto mode, fans shall run for 60-mins (adjustable) upon the pressing of either push-button.
- D. Programmable Timeclock:
 1. With fan starters in auto mode, fans shall run at the programmed times for the programmed duration, as determined by the Owner. Initial schedule (adjustable) shall be 30-mins operation at 6:30 am daily.

3.04 SEQUENCE OF OPERATION - EXHAUST FANS AND MOTORIZED LOUVERS

- A. General:
 1. This Sequence of Operations shall separately apply to the following fans and louvers:
 - a. EF-3 and L-10
 - b. EF-4 and L-2
 - c. EF-5 and L-4 & L-5
 - d. EF-6 and L-8
 2. Each fan shall be provided with a Hand-Off-Auto (HOA) motor starter and wired wall-mounted thermostat.
 - a. Hand Mode: The fan shall run continuously and the associated motorized louver(s) shall be open.
 - b. Off Mode: The fan shall be off and the associated motorized louver(s) shall be closed.
 - c. Auto Mode: The fan shall run as described below.
- B. Cooling:
 1. With fan starter in auto mode; the fan shall run and the associated motorized louver(s) shall be open upon a rise in space temperature above the set point of 88°F (adjustable). Upon temperature drop below set point, the fan shall be off and louvers closed.

3.05 SEQUENCE OF OPERATION - MOTORIZED LOUVERS AND GENERATORS

- A. General:
 1. The following louvers are fixed louvers and shall be provided with a separate motorized damper and actuator:
 - a. L-4
 - b. L-5

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- c. L-10
 - d. L-11a
 - e. L-11b
- 2. The following louvers are operable louvers and shall be provided with a motorized actuator, but do not require a separate motorized damper:
 - a. L-2
 - b. L-8
- 3. Motorized louvers shall be interlocked with the associated exhaust fans as described in the exhaust fans sequences of operation.
- 4. The following louvers shall be interlocked with the Generator in their respective spaces, in addition to the exhaust fans that they are called to be interlocked with:
 - a. L-4
 - b. L-5
 - c. L-10
 - d. L-11a
 - e. L-11b

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. This section specifies requirements for testing, adjusting, and balancing of all air distribution systems, including the equipment and devices associated with each system.
- B. The work includes setting speed and flow, adjusting equipment and devices installed for systems, recording data, conducting tests, preparing and submitting reports, and recommending modifications to the mechanical installations specified in other Sections of the Specifications.

1.02 RELATED WORK

- A. Drawings and general provisions of the Contract, including General Conditions, any Supplemental Conditions and Division 1 Specification Sections, govern the work of this section.

1.03 SUBMITTALS

- A. Submit proof that the testing, adjusting and balancing agency meets the requirements of Section 1.04 "Quality Assurance", and all other specified requirements.
- B. Prior to performing the work, submit sample blank forms of the test reports that will be submitted by the entity performing work of this Section, indicating all data and parameters included.
- C. Submit certified test reports, signed by the authorized representative of the testing and balancing agency. Certify the reports to be proof that the systems have been tested, adjusted and balanced in accordance with the selected reference standards (NEBB or AABC); are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at completion of the testing, adjusting and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Submittal of test report shall be in the following format:
 - 1. Draft Report: Upon completion of testing, adjusting and balancing procedures, prepare draft reports on the approved forms. Draft report may be handwritten, but must be complete, factual, accurate and legible. Organize and format draft reports in the same manner specified herein for the final reports. Submit two complete sets of draft reports. Only one complete set of draft reports will be returned.
 - 2. Final Report: Upon verification and approval of draft reports, prepare final reports, type written and organized and formatted as described herein. Submit two complete sets of final reports.
 - a. Report Format: Submit reports using the standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted and balanced. Include schematic systems diagrams. Enclose the report contents in a 3-ring binder. Divide the contents into the below listed divisions, separating them by divider tabs with titles descriptive of the contents:
 - 1) General Information and Summary.
 - 2) Air Systems.
 - b. Report Contents: Provide the following minimum information, forms and data:
 - 1) General Information and Summary: Identify the testing, adjusting and balancing Agency, Contractor, Owner, Architect/Engineer, and Project on the inside cover sheet. Include addresses, and contact names and telephone numbers. Include a certification sheet containing the seal and name, address, telephone number and signature of the Agency's responsible certified Test and Balance Engineer.

Include in this division a listing of the instrumentation used for the procedures, along with the proof of calibrations.

- 2) Include in the remainder of the reports the appropriate forms containing, as a minimum, the information indicated on the standard report forms prepared by AABC or NEBB, for each item of equipment and system. Prepare a schematic diagram for each item of equipment and system, to accompany each respective report form.
- c. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards within a period not exceeding six months prior to conducting the test procedures.
- d. Existing Systems: Where existing systems are to be added to or modified include in the report results of operational tests taken prior to modifications including but not limited to existing fan curves, pressure readings and flow measurements. Include in the report copies of the equipment and motor nameplate data along with equipment performance curves indicating operating points prior to any modifications and, where existing equipment is retained, operating points after system balance. Where terminals are adjusted or modified include terminal performance curves/data and final readings.

1.04 QUALITY ASSURANCE

- A. Test, adjust and balance systems and equipment by using competent mechanics regularly employed by a testing, adjusting and balancing Subcontractor whose primary business is the testing, adjusting and balancing of building mechanical systems. The testing, adjusting and balancing Subcontractor shall be a business established for a minimum of 10 years.
- B. The testing, adjusting, and balancing Subcontractor shall be certified by the Associated Air Balance Council (AABC) or the National Environmental Balancing Bureau (NEBB).
- C. Instrumentation type, quantity, and accuracy shall be as described in AABC's "National Standards for Field Measurement and Instrumentation, or Total System Balance, or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
- D. All instrumentation shall be calibrated at least every 6 months or more frequently if required by the instrument manufacturer.

1.05 PERFORMANCE REQUIREMENTS

- A. Comply with all applicable Federal, State and Local laws, ordinances, regulations and codes, and the latest industry standards including, but not limited to the entities listed below for procedures, measurements, instruments and test reports for testing, adjusting and balancing work:
 1. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
 2. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
 3. National Environmental Balancing Bureau (NEBB)
 4. Associated Air Balance Council (AABC)
- B. Set the air delivery or intake of each diffuser, grille and register to be as designed or within five percent of the air flow rates shown on the Drawings.
- C. Set the fan air flow rate to be within five percent above the design value at design speed.
- D. Leave all manual volume dampers in the full open position and balance as closely as possible to the design airflows using the fan speed dials (if present) or belt adjustments (if present). Then adjust manual volume dampers to achieve final balancing. Intent it to achieve design airflows at the slowest possible fans speeds.

1.06 JOB CONDITIONS

- A. Require the testing and balancing specialist to review his work with the respective manufacturers of the equipment and devices involved, and coordinate and schedule all work.
- B. Furnish and install balancing dampers, pressure taps, gauges, and other components as required for a properly balanced system, whether or not specified herein or shown on the Drawings, all at no additional cost to the Owner. Make all adjustment or replacement parts recommended by the testing and balancing specialist in strict accordance with the respective equipment manufacturer's recommendations.
- C. Coordinate with the control manufacturer's representative to set the adjustment of the automatically operated dampers to operate as required.

1.07 GENERAL

- A. The Owner will occupy the building during the entire testing, adjusting, and balancing period. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.
- B. Complete all tests specified herein to the satisfaction of the Architect/Engineer before final acceptance.
- C. The Architect/Engineer, or his representative, is the sole judge of the acceptability of the tests. The Architect/Engineer may direct the performance of any such additional tests, as he deems necessary in order to determine the acceptability of the systems, equipment, material and workmanship. No additional payment will be made for any test required by the Architect/Engineer.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Obtain design drawings and specifications and become thoroughly acquainted with the design intent.
- B. Obtain copies of approved shop drawings of all air handling equipment, air outlets (supply, return and exhaust), and the temperature control diagrams, including intended sequence of operations.
- C. Existing Systems: Where existing systems are to be added to or modified perform operational tests prior to modifications including but not limited to existing fan curves, pressure readings and flow measurements.
 - 1. Obtain copies of the equipment and motor nameplate data along with equipment performance curves indicating operating points prior to any modifications. Where terminal units are to be adjusted or modified obtain performance data for these units.
- D. Examine installed work and conditions under which testing is to be done to ensure that work has been completed, cleaned, and is operable. Do not proceed with testing, adjusting and balancing until unsatisfactory conditions have been corrected in a manner approved by the testing and balancing specialist.

- E. Examine the air systems to see that they are free from obstructions. Determine that all dampers and registers are open, moving equipment is lubricated, clean filters are installed, and automatic controls are functioning; and perform other inspections and maintenance activities necessary for proper operation of the systems.
- F. Where existing systems are to be modified or added to ensure that all filters are clean and any operational problems that will prevent system balance have been brought to the attention of the Owner and repaired.

3.02 TESTING, ADJUSTING AND BALANCING

- A. Notify the Owner 48 hours in advance of starting any tests. Do not perform any tests until acknowledgment of notification and approval has been received from the Owner.
- B. Provide all necessary instruments and personnel for the tests. If, in the opinion of the Architect/Engineer, the results of such tests show that the Work has not complied with the requirements of the Contract Documents, make all additions or changes necessary to put the system in proper working condition and pay all expenses for all subsequent tests which are necessary to determine whether the Work is satisfactory. Any additional work or subsequent tests shall be carried out at the convenience of the Architect/Engineer.
- C. Test all packaged equipment in strict accordance with the equipment manufacturer's requirements.
- D. Perform any and all other tests that may be required by the local municipality or other governing body, board or agency having jurisdiction.
- E. Perform testing, adjusting, and balancing after leakage and pressure tests on air distribution systems have been satisfactorily completed.
- F. Actuate all safety devices in a manner that clearly demonstrates their workability and operation.
- G. Cut insulation and ductwork for installation of test probes to the minimum extent necessary to allow adequate performance of test procedure.
- H. Perform tests and compile test data for all air systems.
- I. Include a schematic diagram locating the air inlets, outlets, fans, equipment, dampers and regulating devices for air systems.
- J. All instruments used shall be provided by the entity performing the Work of this Section, and shall be accurately calibrated and maintained in good working order.
- K. Air Systems
 - 1. Perform the testing, adjusting and balancing of air systems in accordance with the detailed procedures outlined in the referenced standards; including but not be limited to the following:
 - 2. Test, record and adjust fan rpm to meet design CFM requirements.
 - 3. Test and record motor full load amperes.
 - 4. Make a pitot tube traverse of main ducts and obtain design flow rate at fans.
 - 5. Test and record system static pressure, velocity pressure and total pressure.
 - 6. Test and adjust system for design air flow rate.
 - 7. Test and adjust system for minimum and maximum design flow rates.
 - 8. Adjust all ducts to proper design flow rate.
 - 9. Test and adjust each diffuser, grille and register.
 - 10. Identify each grille, diffuser and register as to location and area on the schematic diagram.

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11. Identify and list in the final report size, type and manufacturer of diffusers, grilles and registers and all tested equipment. Use manufacturer's data on all equipment to make required calculations for testing, adjusting and balancing. Include design required velocity and test resultant velocity, required flow rate and test resultant flow rate after adjustment as part of readings and tests of diffusers, grilles and registers.
12. Permanently mark all dampers after air balance is complete so that they can be restored to their correct position, if disturbed later.
13. Seal openings in ductwork for pitot tube insertion with snap-in plugs after air balance is complete.

END OF SECTION

SECTION 16010 – GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. General electrical requirements shall be provided in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.
- B. Provide all labor, materials and equipment required to perform the work as specified in the Specifications and as shown on the Contract Drawings. The work shall also include the following:
 - 1. Inserts and other electrical items which shall be installed embedded in concrete, or built into walls, partitions, ceilings or panels.
 - 2. Installation procedures and schedules under other contracts shall be reviewed and coordinated with other Subcontractors regarding the installation of electrical items that must be installed.
 - 3. Keep informed of the construction so the electrical work shall be installed within such time periods as will not delay the work of the other Subcontractors.

1.02 NOTIFY OTHER SUBCONTRACTORS IN ADVANCE OF THE INSTALLATION OF THE WORK INCLUDED, SO THEY SHALL HAVE SUFFICIENT TIME FOR COORDINATION AND INSTALLATION OF INTERRELATED ITEMS THAT ARE INCLUDED IN THEIR CONTRACTS AND THAT MUST BE INSTALLED IN CONJUNCTION WITH THE WORK INCLUDED UNDER THIS CONTRACT.

- A. The existing facility will be maintained in continuous operation during the entire construction period of all contracts. Work shall be so scheduled and conducted to not impede any operation or cause odor or other nuisance. In performing the work shown and specified, plan and schedule work to meet the facility operating requirements.
- B. The Contractor has the option of providing additional temporary facilities that can eliminate a constraint, provided it is done at no additional cost and provided that all requirements of these specifications are fulfilled. The Owner will be available to supervise, operate or maintain any temporary facilities. Work not specifically covered in the following paragraphs may, in general, be done at any time during the contract period, subject to the operating requirements outlined hereinafter. All references to days in this section are to consecutive calendar days, except where noted. All references to schedule completion dates shall mean the date noted in the latest revision of the CPM schedule.

1.03 RELATED SECTIONS

- A. Specification 01711 – Maintenance of Facility Operation
- B. Specification 09900 – Painting.
- C. Specification 16036 – Testing

1.04 PAYMENT

- A. Payment for general electrical requirements shall be made as provided for in the Specifications.

1.05 REFERENCES

- A. General electrical requirements shall comply with the latest applicable provisions and recommendations of the following:
 - 1. NFPA 70, National Electrical Code.
 - 2. NEMA, National Electrical Manufacturers Association.
 - 3. UL, Underwriters Laboratories Incorporated.

1.06 SUBMITTALS

- A. Submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions and as specified under Division 1 of the Specifications.
- B. Working Drawings:
 - 1. Point-to-point field wiring diagrams.

SECTION 16010 – GENERAL ELECTRICAL REQUIREMENTS

2. Qualifications of proposed wiring coordinator who shall prepare the point-to-point field wiring diagrams.

C. Reports: Demonstration of equipment report shall be submitted.

1.07 QUALITY ASSURANCE

A. General:

1. All equipment and devices shall be properly connected and interconnected with other equipment and devices so as to render the installations complete for successful operation, regardless of whether all the connections and interconnections are specifically mentioned in the Specifications or shown on the Contract Drawings.
2. Similar products shall be by the same manufacturer for uniformity on the Contract.
3. Electrical material and equipment shall be new and shall bear the label of UL, or other nationally recognized, independent testing laboratory, wherever standards have been established and label service regularly applies.
4. Where execution of the work under this Contract requires certain systems and equipment to be modified, perform the work with due regard to construction staging in accordance with the Specifications.
5. The modification work shall be coordinated in advance with the Owner and existing conditions. Field determine and make such investigations as required to determine the functionality of each circuit and identify circuit terminations as required for the modifications intended to ensure the proper interface of all components for a complete functional system.
6. Retain the services of a wiring coordinator, to prepare the point-to-point field wiring diagrams. The wiring coordinator shall have experience in the development of the diagrams of the type specified and shall have served in a similar role on a project of similar size and complexity.

B. Area Classifications:

1. Materials and equipment for all indoor areas shall conform to the area classifications shown on the Contract Drawings or stated in the Specifications. Where not specified on the Contract Drawings or stated in the specifications, minimum enclosure rating for all indoor areas shall be NEMA 12.
2. Materials and equipment for all outdoor areas shall conform to corrosive requirements, unless shown otherwise on the Contract Drawings or stated in the Specifications.
3. The locations and requirements shall be in accordance with the following:
 - a. Materials, equipment and incidentals installed in corrosive areas shall meet NEC and NEMA requirements for corrosive locations. Enclosures installed in corrosive locations shall meet NEMA 4X requirements. All exterior areas for this Contract, as well as all areas within the wet well, are noted as NEMA 4X.
 - b. Materials, equipment and incidentals installed in hazardous locations shall meet NEC requirements for the Class and Division designated. Enclosures installed in hazardous locations such as the wet well shall be provided with stainless steel hardware and watertight gasketing.
 - c. Materials, equipment and incidentals installed in dusty locations shall meet NEC and NEMA 12 requirements. The interiors of the control and generator buildings are noted as NEMA 12.

1.08 GENERAL CONSTRAINTS

- A. General: Under Paragraph 1.9, Sequence of Construction and Operation, herein, the sequence for units which are to be taken out of service for renovation and remedial work is outlined for each area. The operational status of completed or existing units other than the designated units shall not be interrupted by the Contractor. New units may only be used after the specified testing and acceptance of the units.
- B. Accidental Shutdown: In the event of accidental shutdown of facility equipment notify facility personnel immediately to allow for an orderly restart of affected equipment.

SECTION 16010 – GENERAL ELECTRICAL REQUIREMENTS

- C. Power, Light and Communication Systems: Maintain electric power, lighting service and communications in uninterrupted operation in all areas which remain in operation. Individual units may be disconnected as required for replacement.

1.09 PRIOR, CURRENT AND FUTURE CONSTRUCTION CONTRACTS

- A. Refer to Specification 01000- Summary of Work

1.10 SEQUENCE OF CONSTRUCTION AND OPERATION

- A. Refer to Specification 01711, Maintenance of Facility Operations for work phasing and sequencing requirements.

1.11 TEMPORARY FACILITIES

- A. Temporary facilities shall be provided in accordance with the requirements of Division 1, Maintenance of Facility Operations.
- B. Temporary facilities shall be any equipment, materials, controls, services and accessories temporarily needed for access to and for protection of all existing structures and equipment, and to maintain an operating system, all in accordance with the provisions of these Specifications.
- C. The size or capacity of the temporary facility shall generally be equal to the size or capacity of the facility replaced, unless otherwise directed by the Engineer.

1.12 INTERIM AND TEMPORARY MATERIAL AND EQUIPMENT

- A. Furnish, install, and remove the interim material and equipment in accordance with the Contract Documents.
- B. The Contractor is responsible for the removal from the site of all interim material and equipment and disposal thereof in accordance with the Specifications.
- C. Temporary material and equipment is material and equipment which must be furnished by the Contractor based on his method of construction, or the utility or service systems during the installation or connection of new equipment or material.

1.13 ADDITIONAL PROVISIONS

- A. Site Visit: The Contractor, before submitting his proposal, shall visit the site and shall be responsible for having ascertained local conditions, such as location, accessibility and general character of the site, the character and extent of any existing work within or adjacent to the site, and any other work being performed on the site at the time of submitting his proposal. Fully examine all the drawings relating to the work and shall become completely informed as to the extent and character of the work required and prevailing existing condition. No allowances will be made for the Contractor's failure to avail himself of such information.

PART 2 - PRODUCTS

2.01 POINT-TO-POINT FIELD WIRING DIAGRAMS

- A. Provide point-to-point field wiring diagrams for all equipment, including equipment provided by other Contractors and Owner.
- B. Develop diagrams for performance of the work and to document terminations. Prepare diagrams based upon approved shop drawings of related Contracts, working drawings and inspections as necessary to complete the diagrams. The diagrams shall include:
 - 1. External wiring for each piece of equipment, panel, instrument and other devices to control stations, lighting panels and motor controllers. The diagrams shall include control, status, signal and power wiring. Power diagrams shall include connections to switchgear, motor control centers, panelboards, panels and field devices.
 - 2. Numbered terminal block identification for each wire termination.
 - 3. Identification of the assigned wire numbers and color coding for all interconnections.
 - 4. Identification of all wiring by the conduit tag in which the wire is installed.
 - 5. Terminal, junction, and pull boxes through which wiring is routed.

SECTION 16010 – GENERAL ELECTRICAL REQUIREMENTS

6. Identification of equipment with functional name and number to which wiring is to be connected.

2.02 SHOP FINISHES

- A. Electrical equipment shall be shop painted in accordance with the requirements of Specification 09900.
- B. Exposed ferrous metal surfaces except aluminum, bronze, brass and stainless steel components shall be cleaned with a commercial blast and primed with one coat of rust inhibitive primer.
- C. Manufactured assemblies such as switchgear, substations, motor control centers, panelboards, control panels, and motor controllers shall be shop painted in accordance with the requirements of Specification 09900.
- D. Other equipment shall be painted with the manufacturer's best grade finish paint system compatible with the finish coatings specified in Specification 09900.

PART 3 - EXECUTION

3.01 DEMONSTRATION OF EQUIPMENT

- A. Demonstrate, in the presence of the Engineer that all electrical systems and electrically operated equipment operates as specified, designed and as required.
- B. Coordinate the demonstration of the electrical systems which are part of other Contracts with the other Subcontractors.
- C. The demonstration of equipment shall include the following:
 1. All power circuits shall be operated to verify proper connection to equipment. Power shall be removed and reapplied to automatic transfer switches to verify their operation.
 2. Emergency power systems shall be activated to verify their automatic start-up, proper operation while running and proper de-energization and cool down upon availability of normal power.
 3. All pushbuttons, indicating lights and similar devices shall be operated to verify proper connection and function. All devices, such as pressure and flow switches and similar devices shall be operated to verify that shut-downs and control sequences operate as required.
 4. The Contractor, with coordination of the other Subcontractors, shall operate the systems to verify wiring and adjust the controls, as required, to achieve proper operation. This shall include wiring, timing and switching functions.
 5. Lighting and Receptacle Systems
 - a. All lighting systems shall be operated to verify proper switching and proper circuit wiring. Emergency lighting systems shall be operated to verify proper switching, circuit wiring and response to loss of primary power. Replace all lamps that have failed during construction.
 - b. Receptacle circuit wiring shall be verified to agree with panelboard schedules.
 - c. All instrumentation systems shall be operated to verify that wiring and data transmission is correct.
 - d. Coordinate the demonstration of the electrical systems which are part of other systems (HVAC, plumbing, mechanical, and instrumentation) with the other Subcontractors. Operate the systems to verify that the wiring is correct and that all controls operate as required.

3.02 RESTORATION

- A. Field paint after installation marred or scratched surfaces. All scratches, abrasions and other damage to equipment shall be touch-up painted in accordance with the requirements of Specification 09900.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Requirements for providing demolition work. This section also includes equipment relocation. The demolition and relocation work shall be performed in accordance with the requirements specified under this Section, the Specifications and the Contract Drawings.
- B. Remove and dispose of all electrical equipment and items as a result of the demolition Work. Where demolished equipment is so identified, it shall become the property of the Owner and disposal shall not occur.
- C. The Contractor shall also relocate electrical equipment. The extent of the demolition and relocation work is shown on the Contract Drawings.

1.02 PAYMENT

- A. Payment for demolition work shall be made as provided for in the Specifications.

1.03 REFERENCES

- A. Demolition work shall comply with the latest applicable provisions and recommendations of the following:
 - 1. NFPA 70, National Electrical Code.
 - 2. Local Codes and Ordinances

1.04 SUBMITTALS

- A. Submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions, Article GC-14 – Contractor Submissions; and as specified under Division 1 of the Specifications.
- B. Working Drawings: Techniques and details proposed to accomplish the demolition work.

1.05 QUALITY ASSURANCE

- A. All demolition and removal work shall be in accordance with the Nassau County Building Code and NFPA 70 National Electrical Code.
- B. In performance of the demolition work, provide protection of adjacent facility areas, existing equipment and on-going construction. No electrical equipment shall be disposed off-site without the written approval of the Owner and Engineer.
- C. Execute the work in a careful and safe manner with the least possible disturbance to the public. All work shall be performed with due regard to construction staging in accordance with the Specifications.
- D. Demolition and removal work shall be executed with care and performed by competent experienced workers for the various types of demolition and removal work. All patching, replacing and refinishing of work shall be done by skilled workers. The work shall be carried out through to completion with due regard to the safety of Owner employees, workers on site and the public.
- E. Make such investigations, explorations and probes necessary to ascertain any required protective measures before proceeding with demolition and removal. The Contractor shall give particular attention to shoring, bracing and shielding requirements so as to prevent any damage to new or existing construction. The Contractor shall be responsible for any damage which may be caused by demolition and removal work to any part or parts of existing structures or equipment designated for reuse or to remain.
- F. All demolished equipment becomes the property of the Contractor, except where identified by the Owner. All equipment marked by the Owner to remain shall be carefully removed by the Contractor, so as not to be damaged, cleaned and stored on or adjacent to the site in a protected place or loaded onto trucks provided by the Owner.
- G. Coordinate the disconnection and removal of sources of power to equipment being removed or relocated under the Contract.

1.06 SITE CONDITIONS

- A. The Owner assumes no responsibility for the actual condition of structures to be demolished and removed. Conditions existing at the time of inspection for bidding purposes shall be noted by the Contractor and shall be used by him in preparing his bid.
- B. Perform the work with due regard that certain equipment, tanks, and piping contain gases which are potentially hazardous and may be toxic, contain insufficient oxygen for human survival and are combustible in the presence of oxygen. All work regarding hazardous materials shall be performed in accordance with the Specifications.

1.07 SCHEDULING

- A. Notify the Engineer 48 hours before proceeding with demolition and removal of any equipment and meet with facility personnel to review removals and demolition work. Work shall begin only after approval of the Owner and Engineer.
- B. Equipment and appurtenances removed without proper authorization, which are necessary for the operation of the existing facility, shall be replaced to the satisfaction of the Engineer at no cost to the Owner.
- C. The Contractor shall familiarize himself with the work and coordinate and schedule demolition activities for proper sequencing of the work and the removal of equipment.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 PREPARATION

- A. Provide protection and restoration of structures in accordance with the Specifications. Provide catch platforms, lights, barriers, weather protection, warning signs and other items as required for proper protection of the public, occupants of the building, workers engaged in demolition operations, and adjacent construction.
- B. Provide weather protection at exterior openings so as to fully protect the interior premises against damage from the elements until such openings are closed by new construction.
- C. Provide temporary protection of the existing structure designated to remain where demolition, removal and new work is being done, connections made, materials handled or equipment moved.
- D. Provide dustproof partitions to prevent dust from rising by wetting demolished masonry, concrete, plaster and similar debris. Unaltered portions of the existing equipment affected by the demolition shall be protected. Such enclosures will be required in areas of major demolition work and for protection of existing equipment and personnel. Insulating barriers shall also be provided where necessary for protection.
 - 1. Construct dust proof partitions of wood or metal studs with plywood on both sides. Partitions shall extend from floor to ceiling with a closure plate at the floor and ceiling and a dust- tight door in each enclosure complete with hardware, attached and keyed.
 - 2. Insulation barriers shall be provided to cover exposed, energized terminals, wires and busses.
 - 3. Provide adequate ventilation for a safe working environment.
 - 4. Provide adequate fire protection during demolition in accordance with requirements of the Fire Department with jurisdiction.
 - 5. Do not close or obstruct roadways, walkways, passageways, or stairways and do not store or place materials in passageways, stairs or other means of egress. Conduct operations with minimum traffic interference.
 - 6. Repair damage to the existing structure or contents by reason of the insufficiency of protection provided.

3.02 REMOVALS

- A. Demolish or relocate electrical equipment as shown on the Contract Drawings. All motors shall be disconnected by the Contractor and removed with the driven equipment.

SECTION 16035 – DEMOLITION ELECTRICAL

- B. All wiring shall be removed, salvaged and stored. Direct burial cable shall be abandoned, but disconnected at both ends, insulated and identified. Where cable enters a structure, cut back cable to the point of entrance.
- C. Remove and dispose of exposed conduits. Conduits underground or concealed shall be abandoned. Cut abandoned conduits flush with the slab or wall at the point of entrance and plugged.
- D. Wherever cable and conduit are to be removed for disposition, de-energize the circuit. Adjacent circuits that are to remain in service shall be blanked off and then isolated.
- E. All supports, pedestals and anchors for conduits, lighting fixtures and other equipment shall be removed in their entirety with the equipment unless otherwise noted on the Contract Drawings.
- F. Dispose of all demolition equipment, debris and other items, not marked by the Owner to remain, off the site and in conformance with all applicable codes and regulations.
- G. Superstructure wall and roof openings shall be closed, and damaged surfaces shall be restored to match the adjacent areas. Wall sleeves and castings shall be plugged or blanked-off, all conduit openings in equipment shall be closed.
- H. Where equipment is indicated to be removed, relocated and reused, the equipment shall be operated in the presence of representatives of the Contractor, and the Engineer. Such items shall be removed or relocated with care to prevent unnecessary damage, under the supervision of the trade responsible for reinstallation and protected and stored until required. Material or items damaged during removal shall be replaced with similar new material or items.

3.03 CLEANING AND MAINTENANCE

- A. Maintain all protection facilities installed in preparation of the demolition work.
- B. Provide on-site dump containers for collection of waste materials, debris and rubbish.
- C. Clean the site and properties of dust, dirt and debris caused by the demolition and removal work in accordance with the Specifications. Waste materials, debris and rubbish shall be disposed of and the areas shall be returned to conditions prior to start of the work.

END OF SECTION

SECTION 16035 – DEMOLITION ELECTRICAL

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PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Perform all tests as specified in these specifications, and as required.
- B. Individual testing requirements are detailed in the individual equipment specifications.

1.02 REFERENCES

- A. NETA - International Electrical Testing Association.
- B. IEEE - Institute of Electrical and Electronics Engineers.
- C. ANSI - American National Standards Institute.

1.03 DESIGN REQUIREMENTS

- A. General
 - 1. Furnish all instruments and qualified personnel for all tests.
 - 2. Submit written notice of all tests to the Engineer at least two (2) weeks in advance.
 - 3. Unless waived in writing by the Engineer, conduct all tests in the presence of a duly authorized representative of the Engineer. When the presence of such representative is so waived, submit sworn statements, in duplicate, of the tests made and the results thereof, to the Engineer.
 - 4. Necessary adjustments and testing shall be made in cooperation with the respective manufacturers and other Contractors when necessary.
 - 5. Make available the electrical system and personnel when required to test equipment.
 - 6. Factory and witness shop testing requirements shall be as detailed in the individual equipment specifications.
 - 7. Field Testing: All electrical equipment furnished, installed or modified under this Contract shall be field tested as detailed in the individual equipment specifications.
 - 8. Schedules and Facility Operations
 - a. When testing requires that certain pieces of equipment be taken out of service, all testing procedures and schedules must be submitted to the Owner's engineer for review and approval one month prior to any work beginning. When testing has been scheduled as above, the facility must be notified 48 hours prior to any work to allow time for load switching and/or alternation of equipment. In addition, all testing that requires temporary shutdown of facility equipment must be coordinated with facility personnel so as not to affect proper facility operations.
 - b. At the end of the workday, all equipment shall be back in place and ready for immediate use should a facility emergency arise. In addition, should an emergency condition occur during testing, at the request of the facility engineer, the equipment shall be placed back in service immediately and turned over to facility personnel.
 - c. In the event of accidental shutdown of facility equipment the Contractor shall notify facility personnel immediately to allow for an orderly restart of affected equipment.
 - 9. Independent Testing: In addition to the independent testing for the short circuit and relay coordination studies and relay setting and protective device settings as described in Specification 16292 - Power Distribution System Coordination, all medium voltage equipment testing, including medium voltage cable tests, shall be performed by a qualified testing company using NETA certified technicians.
 - 10. Final Field Testing
 - a. Complete the installation and testing of the electrical installation at least two (2) months prior to the start-up and testing of all other work. During the period between the completion of electrical installation and the start-up and testing of all other work, make all electrical components available as it is completed for use in performing Preliminary and Final Field Tests.
 - b. Before each test commences, submit a detailed test procedure with manpower and scheduling for the approval of the Engineer. In addition, identify detailed test procedures for all equipment required as part of the field tests of systems.

SECTION 16036 – TESTING

1.04 SUBMITTALS

- A. Submit the following in accordance with the General Conditions and Division 1.
- B. Certificate of Compliance
 - 1. Qualifications of independent testing firm and technicians.
 - 2. Reports
 - a. Proposed testing methods and schedules.
 - b. All field test reports.

1.05 QUALITY ASSURANCE AND QUALIFICATIONS

- A. As detailed above, the independent testing firm shall be a qualified firm employing NETA certified technicians.

END OF SECTION

SECTION 16061 – GROUNDING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Requirements for providing grounding and bonding. Provide grounding in accordance with the requirements specified under this section, the Specifications and the working drawings.
- B. The grounding and bonding work shall be a complete system for the electrical and instrumentation systems, structures and equipment. The work shall include grounding of all electrical equipment, transformer neutrals, equipment enclosures, grounding electrodes, fences and gates.

1.02 PAYMENT

- A. Payment for grounding and bonding shall be made as provided for in the Specifications.

1.03 REFERENCES

- A. Grounding and bonding shall comply with the latest applicable provisions and recommendations of the following:
 - 1. NFPA 70 - National Electrical Code.
 - 2. Electric Utility.
 - 3. UL Standard No. 467 - Electrical Grounding and Bonding Equipment.

1.04 SUBMITTALS

- A. Submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions and as specified under Division 1 of the Specifications.
- B. Working Drawings:
 - 1. Prior to equipment submission, submit a list of proposed manufacturers with the products they produce proposed for the Contract.
 - 2. Manufacturer's catalog cuts for the grounding and bonding materials proposed for use.
 - 3. Scaled working drawings showing proposed routing and layout of the grounding and bonding system.
 - 4. Submit Field test reports.

1.05 QUALITY ASSURANCE

- A. The grounding system maximum resistance shall not exceed 5 ohms under normally dry conditions. All structures and metal equipment containing electrical apparatus shall be connected to ground.
- B. All grounding and bonding associated with the electric utility service feeders shall be in accordance with the requirements of electric utility.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle grounding and bonding equipment in accordance with the Specifications and the manufacturer's recommendations.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. The ground cable: Soft drawn bare stranded copper conforming to ASTM B8 and B189.
- B. The insulated cable for equipment grounding shall conform to the requirements of Specification 16121 - Electric Wires and Cables.
- C. Ground cable: General Cable Corporation, Okonite Cable Company or equal to be approved by the Engineer.
- D. Ground rods: copper-clad steel, 5/8-inch diameter and 10 feet long. Ground rods shall have a drive point at the lower ends. The upper end of each rod shall be equipped with bronze, clamp type connectors with not less than four bolts.
- E. Ground rods shall be Heary Brothers Lightning Protection Company, Fushi Copperweld, or equal to be approved by the Engineer.

SECTION 16061 – GROUNDING

- F. Compression connectors shall be heavy duty copper. Bolted connectors shall be copper alloy castings, designed specifically for the items to be connected, and assembled with Durium or silicone bronze bolts, nuts and washers.
- G. Welded connections shall be by exothermic process utilizing molds, cartridges and hardware designed specifically for the connection to be made.
- H. Bolted or compression grounding connectors: Burndy, Thomas and Betts or equal to be approved by the Engineer. Welded grounding connections shall be Cadwell or equal to be approved by the Engineer.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install a complete ground grid system as shown on the working drawings.
- B. Install ground cable around perimeter of structures at a minimum of 2 feet-6-inches below grade.
- C. Ground rods shall be installed 2 feet below grade, 2 feet from foundation walls and shall extend 10 feet vertically into the earth.
- D. Install test points at locations and in accordance with the details shown on the working drawings.
- E. Equipment shall be connected in accordance with the details shown on the working drawings. All steel column and underground connections shall be welded except for test points.
- F. Ground metal casings or supporting frames of electrical equipment, such as transformers, panel boards, control panels, unit substations, and individual motor controllers. The equipment shall be thoroughly grounded to the facility grounding system. All metal conduits leaving all electrical equipment shall be grounded. Grounding type fittings shall be installed on flexible conduits.
- G. Install an insulated cable for equipment grounding with the phase conductors within the conduit for the nominal 120 volt and higher power, lighting and control circuits.

3.02 FIELD TESTING

- A. After installation, field test the completed ground system for operation and conformance. The field tests shall be witnessed by the Engineer and certified by the Contractor. Provide testing consisting of the following:
 - 1. Resistance testing shall be made using a Biddle, Null Balance Earth Tester or Associated Research Vibro-ground, not less than 48 hours after rainfall. Resistance shall be no more than 5 ohms. If resistance is greater than 5 ohms, continue to drive ground rods up to a maximum of three to reduce the resistance to 5 ohms. Resistance values above 5 ohms after three ground rods have been driven in the same area shall be brought to the Engineer's attention.
 - 2. Grounded cables and metal parts shall be continuity tested. The conduit system shall be ground tested in accordance with the requirements of Specification 16131 - Electric Conduit System.
- B. Submit a Field Test Report that identifies the testing performed and the results obtained.

END OF SECTION

SECTION 16071 – SUPPORTING DEVICES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Requirements for providing supporting devices. Supporting devices shall be provided in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.
- B. The supporting devices shall be a complete system for the equipment. The work shall include providing all required support devices to properly mount and secure all equipment furnished under this Contract.
- C. This section also includes equipment anchorage and restraints suitable to meet the specified seismic requirements.

1.02 RELATED SPECIFICATIONS

- A. Specification 16131 - Electric Conduit System

1.03 PAYMENT

- A. Payment for supporting devices shall be made as provided for in the Specifications.

1.04 REFERENCES

- A. Supporting devices shall comply with the latest applicable provisions and recommendations of the following:
 - 1. ASTM A240 - Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and General Applications.
 - 2. ASTM A1011 - Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength, Low-Alloy, High-Strength, Low-Alloy with Improved Formability, and Ultra-High Strength.
 - 3. ASTM B633 - Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
 - 4. AISI, Standard for Stainless Steel.
 - 5. MFMA-1, Standard Publication for Metal Framing.

1.05 SUBMITTALS

- A. Submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions and as specified under Division 1 of the Specifications.
- B. Working Drawings:
 - 1. Manufacturer's catalog cuts for the supporting devices proposed for use with specifications and other data required to demonstrate compliance with the specified requirements.
 - 2. Scaled working drawings showing dimensions and locations of all items and clearance requirements.
 - 3. Support design details and equipment seismic anchorage and restraint details, stamped by a licensed Engineer as required.

1.06 QUALITY ASSURANCE

- A. General:
 - 1. All channels, fittings and hardware used in the supporting system shall be in accordance with MFMA-1, Standard Publication.
 - 2. The design of the support system shall be the responsibility of the Contractor. Provide the proper sized rods, channels, fittings, brackets and appurtenances necessary to adequately support the equipment.
 - 3. Retain the services of a Licensed Engineer, registered in the State of New York, to prepare support details for equipment exceeding 50 pounds in weight. The Engineer shall stamp the support system design details.
- B. Seismic Requirements:

SECTION 16071 – SUPPORTING DEVICES

1. Equipment assemblies such as secondary unit substations, switchgear, motor control centers and panelboards shall be certified to meet seismic requirements in accordance with the requirements specified in the applicable sections of the Specifications.
2. Provide equipment anchorage details for all equipment certified to meet seismic requirements. The details shall be coordinated with the manufacturer's equipment mounting provisions.
3. Electric conduit shall include seismic restraints in accordance with the requirements of Specification 16131 - Electric Conduit System.
4. Retain the services of a Licensed Engineer, registered in the State of New York, to prepare the seismic anchorage and restraint details. The Engineer shall stamp the seismic anchorage and restraint details.

1.07 DELIVERY, STORAGE AND HANDLING

- A. The supporting devices shall be delivered, stored and handled in accordance with the Specifications and the manufacturer's recommendations.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Supporting devices shall be by B-Line (Eaton), Kindorf (Thomas & Betts/ ABB Group) or equal to be approved by the Engineer.

2.02 CHANNELS, FITTINGS AND BRACKETS

- A. Provide channels, fittings, brackets and related hardware for mounting and supporting the electrical equipment. Anchor bolts, concrete inserts and related hardware for proper support of equipment shall also be provided. All equipment necessary to meet the seismic requirements specified shall be provided.
- B. Channels shall be Type 316 stainless steel conforming to ASTM A240. Channels shall have a minimum thickness of 12 gauge. The cross-sectional width dimension shall be 1-1/2 inch minimum. The depth shall be as required to satisfy load requirements.
- C. Attachment holes, when required, shall be factory punched on hole centers approximately equal to the cross-sectional width and shall be 9/16 inch diameter.
- D. Fittings and brackets shall have 9/16 inch diameter holes on centers identical to the channel or as required to align with the channel holes. Fittings and brackets shall have the same width as the channel and shall be 1/4 inch thick minimum. Fittings and brackets shall mate properly with the channel.
- E. Channels, fittings, brackets and related hardware shall be type 316 stainless steel or PVC coated.

2.03 CONDUIT HANGERS, SUPPORTS AND INSERTS

- A. Provide Type 316 Stainless Steel channels, rods, straps, anchors and related hardware for support of the exposed electric conduit system.
- B. Provide anchor bolts, concrete inserts and related hardware for proper support of equipment. All equipment necessary to meet the seismic requirements specified shall be provided.
- C. Conduit hangers, supports and inserts shall be in accordance with Specification 16131 - Electric Conduit System.

2.04 2.4 - HARDWARE AND THREADED COMPONENTS

- A. Hardware and threaded components shall include all miscellaneous items to complete the assembly of the support system. This includes nuts, bolts, springs, washers, etc.
- B. All hardware and threaded components, regardless of the location, shall be type 316 stainless steel.
- C. Hardware used to anchor supports to concrete or masonry shall be stainless steel.
- D. Minimum size of threaded rod shall be 1/4-inch diameter.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. All supporting devices shall be installed level, parallel and perpendicular to building walls and floors, such that the support system is installed in a neat and professional manner.
- B. All holes in hung ceilings for support rods and other equipment shall be made adjacent to bars where possible, to facilitate removal of ceiling panels.
- C. The channels, fittings and brackets shall be rigidly bolted together and braced to make a substantial supporting framework support system.
- D. Where motor control centers, switchgear, unit substations and other electrical equipment is being installed on concrete pads, furnish leveling channels. Install the leveling channel in the concrete pads. Seismic certified equipment shall be anchored in accordance with the seismic anchorage details.
- E. All equipment fastenings to steel columns, beams and trusses shall be by beam clamps. In lieu of beam clamps, equipment may be welded to steel structures, subject to Engineer approval.
- F. No holes shall be drilled in any steel columns, beams and trusses.
- G. Hanger rod supports shall be installed such that threaded rod is parallel and perpendicular to building walls and floors.
- H. Mounting of electrical devices to handrail shall not be permitted. All local disconnect switches, pull boxes, transmitters, panels, and junction boxes shall be frame mounted.

END OF SECTION

SECTION 16071 – SUPPORTING DEVICES

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PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Requirements for providing labeling and identification. Labeling and identification shall be provided in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.
- B. The labelling and identification shall be provided for the identification of equipment. The work shall include providing all high voltage signs, equipment nameplates, markers and tags for all equipment furnished under this Contract.
- C. The Contractor is advised that the equipment identification shown on the Contract Drawings is preliminary and will be finalized during construction.
- D. Temporary identification will be required as to information specified, but only final identification needs to conform to materials and mounting methods specified herein.
- E. All motor control center and control panel nameplates shall have both the equipment name and tag identification number.
- F. All pullboxes, junction boxes, terminal boxes, etc. shall be tagged with its own unique system related tag number.
- G. All conduits shall be tagged with its own unique system related tag number. The conduit systems include, but are not limited to, power, lighting, telephone, instrumentation, process/mechanical, fire alarm, low voltage power, security, CCTV, and Fiber Optic Network.
- H. In addition to tagging and labeling the pullbox exterior, the pullbox interior shall also be tagged and labeled. All conduit bushings on the pullbox interior shall be tagged and labeled.

1.02 PAYMENT

- A. Payment for labeling and identification shall be made as provided for in Division 1 of the Specifications.

1.03 REFERENCES

- A. Labeling and identification shall comply with the latest applicable provisions and recommendations of the following:
 - 1. NFPA 70 - National Electrical Code.
 - 2. OSHA - Occupational Safety and Health Act.

1.04 SUBMITTALS

- A. Submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions and as specified under Division 1 of the Specifications.
- B. Working Drawings:
 - 1. Prior to equipment submission, submit a list of proposed manufacturers with the products they produce proposed for the contract.
 - 2. Submit signs, nameplates and other labeling and identification devices proposed for use with specifications and other data required to demonstrate compliance with the specified requirements.

1.05 QUALITY ASSURANCE

- A. All labeling and identification signs and nameplates shall be provided in accordance with the NFPA 70 and OSHA.

1.06 DELIVERY, STORAGE AND HANDLING

- A. The labeling and identification devices shall be delivered, stored and handled in accordance with the Specifications and the manufacturer's recommendations.

PART 2 - PRODUCTS

2.01 HIGH VOLTAGE SIGNS

- A. High voltage signs shall be provided for equipment operating over 600 volts.
- B. High voltage signs shall be fiberglass reinforced polyester, rigid acrylic or aluminum plate 1/16-inch thick. Finish shall be industry standard of red, white and black graphics. Signs shall be 10 inches by 14 inches with the following exceptions:
 - 1. Use 7-inch by 10-inch signs where this is the largest size that can be applied.
 - 2. Use 14-inch by 20-inch signs where needed for adequate vision.
 - 3. High voltage signs shall read; "DANGER - HIGH VOLTAGE KEEP OUT".
 - 4. High voltage sign mounting screws shall be 3/16 inch diameter, round head, stainless steel, self-tapping type.

2.02 EQUIPMENT NAMEPLATES

- A. Equipment nameplates shall be provided in addition to the manufacturer's nameplate, to identify the equipment number and the item's function and the equipment to which it serves.
- B. Equipment nameplates shall be provided in accordance with the requirements specified under Article 2.02 and Specification 15076 - Piping and Equipment Identification.
- C. Equipment nameplates shall be laminated plastic with black letters on a white background. Nameplates for equipment identification shall have 1/2-inch high letter engravings. Nameplates for pilot device identification shall have 1/4-inch high letter engravings.
- D. Nameplates for distribution equipment shall have the following information:
 - 1. Equipment name and number.
 - 2. Voltage.
 - 3. Phases and number of wires.
 - 4. Pullboxes, junction boxes and control stations shall have a nameplate identifying the equipment's name and number.
 - 5. All feeders and branch circuit devices shall have nameplates identifying the served equipment name and number. Where execution of the work under this Contract requires certain feeders and branch circuit devices to be modified, the Contractor shall provide new nameplates reflecting the modifications. The nameplates shall identify the served equipment name and number.
 - 6. All control and indicating devices shall have individual nameplates identifying device function.
 - 7. Nameplate mounting screws shall be 3/16 inch diameter, round-head, stainless steel self-tapping type. Adhesives shall not be used.

2.03 CONDUIT MARKERS AND TAGS

- A. Conduit markers and tags shall be provided for the identification of the electric conduit system.
- B. Conduit markers and tags shall be in accordance with Specification 16131 - Electric Conduit System.

2.04 CABLE AND WIRE MARKERS

- A. Cable and wire markers shall be provided for the identification of the electric wire and cable.
- B. Cable and wire markers shall be fiberglass based. Teflon coated stainless steel line/wire shall be used to attach the markers to the cables.
- C. Cable and wire markers shall be in accordance with Specification 16121 - Electric Wire and Cable.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. All signs, nameplates and tags shall be installed neatly, properly and in accordance with the manufacturer's installation instructions.

SECTION 16076 – LABELING AND IDENTIFICATION

- B. Signs and nameplates shall be mounted with screws. Where mounting of signs or nameplates with screws is impractical, notify the Engineer.
- C. Install high voltage signs on equipment operating at over 600 volts and on sides of fences or walls which enclose outdoor equipment operating at over 600 volts.
- D. Control, signal and status wire and cable shall be identified by a unique number. The numbering system shall reflect the actual identification used in the work and shall be documented on the point-to-point wiring diagrams.

END OF SECTION

SECTION 16076 – LABELING AND IDENTIFICATION

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ROSLYN POWER CONDUIT AND WIRE SCHEDULE									
Conduit ID	Conduit Type	Conduit Size	Wire Type	No. Of Wires	Wire Size	Ground Size	Description	From	To
MCCA-MCCB-001	RGS	2"	THWN	4	#2/0	#6	MCCB POWER	MCC-A-4	MCC-B
TS1-MTS-001	RGS	4"	THWN	4	#350	#1	GENERATOR POWER	TS1	MTS
TS1-GDS-001	RGS	3/4"	XHHW-2	3	#14	N/A	PORTABLE GENERATOR START/STOP	TS1	MTS
TS1-BR-001	RGS	3/4"	THWN	2	#10	#10	BATTERY CHARGER	TS1	BATTERY CHARGER
MTS-GEN-001	RGS	4"	THWN	4	#350	#1	Generator	MTS	GEN
TS1-GEN-001	RGS	3/4"	THWN	20	#14	N/A	Generator	TS1	GEN
TS1-GEN-002	RGS	3/4"	BELDEN 9729	N/A	BELDEN 9729	N/A	Generator	TS1	GEN
MCCA-MCCC-001	RGS	2-1/2"	THWN	3	#3/0	3	MCCC Power	MCC-A-5	MCC-C
MCCA-MCCC-002	RGS	2-1/2"	THWN	3	#3/0	3	MCCC Power	MCC-A-5	MCC-C
MCCB-HGCP-001	RGS	3/4"	THWN	3	#12	12	Hydraulic Grinder Control Panel	MCC-B	HG
MCCB-EMCP-001	RGS	3/4"	THWN	3	#12	12	Existing Emergency Storage Control Panel	MCC-B	EMCP
MCCB-MVJB-001	RGS	3/4"	THWN	3	#12	12	Existing MV-1 and MV-2 JB	MCC-B	MVJB
MCCB-SPCP-001	RGS	3/4"	THWN	3	#12	12	Ex. Sump Pump Control Panel	MCC-B	SPCP
MCCB-OC-001	RGS	3/4"	THWN	3	#12	12	Ex. Overhead Crane	MCC-B	OC
MCCA-EUH6-001	RGS	3/4"	THWN	3	#12	#12	ELECTRIC UNIT HEATER MID	MCC-A-5	EUH-6
MCCA-EUH7-001	RGS	3/4"	THWN	3	#12	#12	ELECTRIC UNIT HEATER LOWER	MCC-A-5	EUH-7
MCCA-EUH3-001	RGS	3/4"	THWN	3	#12	#12	ELECTRIC UNIT HEATER GEN RM	MCC-A-57.5 KW	EUH-3
MCCB-EUH4-001	RGS	3/4"	THWN	3	#12	#12	ELECTRIC UNIT HEATER UPPER	MCC-B-2	EUH-4
MCCB-EUH5-001	RGS	3/4"	THWN	3	#12	#12	ELECTRIC UNIT HEATER UPPER	MCC-B-2	EUH-5
RLP-ACC1-001	RGS	3/4"	THWN	2	#12	12	Generator Accesory 1	RLP	ACC1
RLP-ACC2-001	RGS	3/4"	THWN	2	#12	12	Generator Accesory 2	RLP	ACC2
RLP-SP-001	RGS	3/4"	XHHW-2	2	#10	10	Gen. Shore Power	RLP	SP
MCCC-SP1JB-001	RGS	2"	THWN	3	#2/0	6	Sewage Pump No. 1	MCC-C-2	SP1JB
MCCC-SP2JB-001	RGS	2"	THWN	3	#2/0	6	Sewage Pump No. 2	MCC-C-3	SP2JB
MCCC-SP3JB-001	RGS	2"	THWN	3	#2/0	6	Sewage Pump No. 3	MCC-C-4	SP3JB
EF3MS-EF3-001	RGS	3/4"	THWN	2	#12	12	GENERATOR EXHAUST FAN	MCC-A-3	EF-3
UTLY-MAIN-001	RGS	4"	XHHW-2	4	#300	#1/0	MAIN POWER	UTILITY/METER	MCC-A
UTLY-MAIN-002	RGS	4"	XHHW-2	4	#300	#1/0	MAIN POWER	UTILITY/METER	MCC-A
MCCB-WWCP-001	RGS	3/4"	THWN	3	#12	#12	WET WELL FAN CONTROL PANEL	MCC-B-2	WWCP
MCCB-DWCP-001	RGS	3/4"	THWN	3	#12	#12	DRY WELL FAN CONTROL PANEL	MCC-B-2	DWCP
DWCP-EF1-001	RGS	3/4"	THWN	3	#12	#12	DRY WELL EXHAUST FAN	DWCP	EF-1
DWCP-SF1-001	RGS	3/4"	THWN	3	#12	#12	DRY WELL SUPPLY FAN	DWCP	SF-1
RP-SS-001	N/A	N/A	MICRO Z, LOW INDUCTANCE CABLE	N/A	N/A	N/A	SURGE SUPPRESSION	MCC-A-3	SS
RP-T1-001	N/A	N/A	THWN	3	#8	#10	STEP DOWN TRANSFORMER	MCC-A-3	T1
RP-RLP-001	N/A	N/A	THWN	4	#3	#8	PANEL RLP	MCC-A-4	RLP
WWCP-SF2-001	N/A	N/A	THWN	3	#12	#12	WET WELL SUPPLY FAN	MCC-A-3	WWCP
WWCP-EF2-002	RGS	3/4"	THWN	3	#12	#12	WET WELL EXHAUST FAN	EF2MS	WWCP
RP-EF3MS-001	N/A	N/A	THWN	2	#12	#12	EF-3 MOTOR STARTER	RLP	EF3MS

MORGAN PARK POWER CONDUIT AND WIRE SCHEDULE									
Conduit ID	Conduit Type	Conduit Size	Wire Type	No. Of Wires	Wire Size	Ground Size	Description	From	To
MP-MAIN-001	RGS	4"	XHHW-2	4	350	#1	Main	UTILITY	MAIN
MP-MAIN-002	RGS	4"	XHHW-2	4	350	#6	Main	UTILITY	MAIN
MP-SP1MS-001	N/A	N/A	THWN	3	#1	#6	SEWAGE PUMP NO. 1 MS	MP-MCC	SP1MS
MP-SP1MS-002	N/A	N/A	THWN	3	#1	#6	SEWAGE PUMP NO. 2 MS	MP-MCC	SP2MS
SP1MS-SP1DS-001	RGS	1-1/2"	XHHW-2	3	#1	#6	Sewage Pump No. 1 Disconnect Switch	MP-MCC	SP1DS
SP2MS-SP2DS-001	RGS	1-1/2"	XHHW-2	3	#1	#6	Sewage Pump No. 2 Disconnect Switch	MP-MCC	SP2DS
SP1DS-SP1JB-001	RGS	1-1/2"	XHHW-2	3	#1	#6	Sewage Pump No. 1	SP1DS	SP1JB
SP2DS-SP2JB-001	RGS	1-1/2"	XHHW-2	3	#1	#6	Sewage Pump No. 2	SP2DS	SP2JB
SP1JB-SP1-001	RGS	1-1/2"	XHHW-2	3	#1	#6	Sewage Pump No. 1	SP1DS	SP1
SP2JB-SP2-001	RGS	1-1/2"	XHHW-2	3	#1	#12	Sewage Pump No. 2	SP2DS	SP2
MLP-WWEFMS-001	RGS	3/4"	XHHW-2	3	#12	#12	Wet Well EF Motor starter	MLP	WWEFMS
WWEFMS-WWJB-001	RGS	3/4"	XHHW-2	3	#12	#12	Wet Well JB	WWEFMS	WWJB
WWJB-WWEF-001	RGS	3/4"	XHHW-2	3	#12	#12	Wet Well fan	WWJB	WW FAN
MP-SGCP-001	RGS	3/4"	THWN	3	#12	#12	Hydraulic Grinder Control Panel	MP-MCC	SGCP
SGCP-SGJB-001	RGS	3/4"	XHHW-2	3	#12	#12	SEWAGE GRINDER JB	SGCP	SGJB
SGJB-SG-001	RGS	3/4"	MANUFACTURER'S RECOMMENDED CABLE	N/A	N/A	#12	SEWAGE GRINDER	SGJB	SG
MLP-ACC1-001	RGS	3/4"	XHHW-2	2	#12	#12	Generator Accessory 1	MLP	ACC1
MLP-ACC2-001	RGS	3/4"	XHHW-2	2	#12	#12	Generator Accessory 2	MLP	ACC2
MLP-ACC3-001	RGS	3/4"	XHHW-2	2	#12	#12	Generator Accessory 3	MLP	ACC3
TS2-MTS-001	RGS	4"	XHHW-2	4	#350	#1	MTS	TS2	MTS
TS2-MTS-002	RGS	4"	XHHW-2	4	#350	#1	MTS	TS2	MTS
MTS-GEN-001	RGS	4"	XHHW-2	4	#350	#1	GEN	MTS	GEN
MTS-GEN-002	RGS	4"	XHHW-2	4	#350	N/A	GEN	MTS	GEN
TS2-GEN-003	RGS	3/4"	XHHW-2	20	#14	N/A	GEN CONTROL	TS2	GEN
TS2-GEN-004	RGS	2"	9729 BELDEN + CAT 6	N/A	N/A	N/A	GEN COMMUNICATION	TS2	GEN
MP-SS-001	N/A	N/A	MICRO Z, LOW INDUCTANCE CABLE	N/A	N/A	N/A	SURGE SUPPRESSION	MCC	SS
MP-MLP-001	N/A	N/A	THWN	4	#1/0	#6	PANEL MLP	MCC	MLP
MP-PLP-001	N/A	N/A	THWN	4	#3/0	#6	PANEL PLP	MCC	PLP
MP-CS-001	RGS	1-1/4"	XHHW-2	3	#3	#12	CONSESSION STAND	MCC	CS
MLP-EF4MS-001	N/A	N/A	THWN	2	#12	#12	EF-4 MOTOR STARTER	MLP	EF4MS
EF4MS-EF4-001	RGS	3/4"	THWN	2	#12	#12	EF-4	EF4MS	EF4
MLP-EUH1-001	RGS	3/4"	THWN	3	#12	#14	EUH1	MLP	EUH1
MLP-EUH2-001	RGS	3/4"	THWN	3	#12	#12	EUH2	MLP	EUH2
VCCL-MLP-001	RGS	3/4"	XHHW-2	2	#12	#12	VALVE CHAMBER LIGHTING	MLP	VALVE CHAMBER
MLP-FM-001	RGS	3/4"	XHHW-2	2	#12	#12	FLOW METER POWER	MLP	FM POWER

VIOLA POWER CONDUIT AND WIRE SCHEDULE									
Conduit ID	Conduit Type	Conduit Size	Wire Type	No. Of Wires	Wire Size	Ground Size	Description	From	To
VLP-SP-001	RGS	3/4"	THWN	2	#12	#12	SHORE POWER	VLP	SP
VLP-TGLP-001	RGS	3/4"	THWN	3	#12	#12	TANK MONITORING AND LEAK DETECTION PANEL	VDP	TGLP
VDP-SGCP-001	RGS	3/4"	THWN	3	#12	#12	Hydraulic Grinder Control Panel	VDP	SGCP
SGCP-SGJB-001	RGS	3/4"	THWN	3	#12	#12	Hydraulic Grinder JB	SGCP	SGJB
SGJB-SG-001	RGS	3/4"	MANUFACTURER'S RECOMMENDED CABLE	N/A	N/A	N/A	Hydraulic Grinder	SGJB	SG
VLP-ACC1-001	RGS	3/4"	THWN	2	#12	#12	Generator Accessory 1	VLP	ACC1
VLP-ACC2-001	RGS	3/4"	THWN	2	#12	#12	Generator Accessory 2	VLP	ACC2
VLP-BR-001	RGS	3/4"	THWN	2	#10	#12	Generator Battery	VLP	BR
MTS3-GEN-001	RGS	2-1/2"	THWN	4	#3	#8	Generator	MTS3	GEN
TS3-GEN-002	RGS	3/4"	THWN	20	#14	#12	0	TS3	0
TS3-GEN-003	RGS	2"	9729 BELDEN + CAT 6	N/A	N/A	N/A	0	TS3	0
TS3-MTS3-001	RGS	2-1/2"	XHHW-2	4	#3	#8	MANUAL TRANSFER SWITCH/DOCKING STATION	TS3	MTS3
VDP-EUH9-001	RGS	3/4"	THWN	3	#12	#12	EUH-9	VDP	EUH-9
VDP-EUH8-001	RGS	3/4"	THWN	3	#12	#12	EUH-8	VDP	EUH-8
TS3-VDP-001	RGS	1-1/2"	THWN	4	#3	#8	DISTRIBUTION PANEL	MAIN	VDP
VDP-SG-001	RGS	3/4"	MICRO-Z, LOW CONDUCTANCE CABLE	N/A	N/A	N/A	SURGE SUPPRESSION	VDP	SG
MAIN-TS3-001	RGS	2-1/2"	XHHW-2	4	#3/0	#6	TS3	MAIN	TS3
VP-MAIN-001	PVC SCH 80	N/A	XHHW-2	4	#3/0	#6	MAIN	UTILITY	MAIN
VDP-T2-001	RGS	1"	THWN	3	#8	#10	TRANFORMER T2	VDP	T2
T2-VLP-001	RGS	1-1/2"	THWN	4	#3	#8	LIGHTING PANEL	T2	VLP
VDP-SP1DS-001	RGS	3/4"	XHHW-2	3	#10	#10	Sewage Pump no. 1	VDP	SP1DS
VDP-SP2DS-001	RGS	3/4"	XHHW-2	3	#10	#10	Sewage Pump no. 2	VDP	SP2DS
SP1DS-WWJB-001	RGS	3/4"	XHHW-2	3	#10	#10	Sewage Pump NO. 1	SP1DS	WWJB
SP2DS-WWJB-001	RGS	3/4"	XHHW-2	3	#10	#10	Sewage Pump NO. 2	SP2DS	WWJB
WWJB-SP1-001	RGS	3/4"	XHHW-2	3	#10	#10	Sewage Pump WW no. 1	WWJB	SP1
WWJB-SP2-001	RGS	3/4"	XHHW-2	3	#10	#10	Sewage Pump WW no. 2	WWJB	SP2
VLP-WWEFMS-001	RGS	3/4"	XHHW-2	2	#12	#12	WET WELL EFMS	VLP	WWEFMS
WWEFMS-WWJB-001	RGS	3/4"	XHHW-2	2	#12	#12	WWJB	WWEFMS	WWJB
WWJB-WWEF-001	RGS	3/4"	XHHW-2	2	#12	#12	WWEF	WWJB	WWEF
MPLC-MLP-001	RGS	3/4"	XHHW-2	2	#12	#12	METERING PIT LIGHTING CIRCUIT	VLP	MLC
VCLC-MLP-001	RGS	3/4"	XHHW-2	2	#12	#12	VALVE CHAMBER LIGHTING CIRCUIT	VLP	VCLC
WWLC-MLP-001	RGS	3/4"	XHHW-2	2	#12	#12	WET WELL LIGHTING CIRCUIT	VLP	WWLC

KNOTT DRIVE POWER CONDUIT AND WIRE SCHEDULE									
Conduit ID	Conduit Type	Conduit Size	Wire Type	No. Of Wires	Wire Size	Ground Size	Description	From	To
K-MAIN-001	RGS	1-1/2"	XHHW-2	4	#3	N/A	MAIN DISCONNECT	UTILITY	MAIN
TS4-KDP-001	RGS	1-1/2"	XHHW-2	4	#3	#8	DISTRIBUTION PANEL	TS4	KDP
KDP-PC-001	RGS	1"	XHHW-2	2	#6	#10	PHASE CONVERTER	KDP	PHASE CONVERTER
MAIN-TS4-001	RGS	1-1/2"	XHHW-2	4	#3	#8	ATS	UTILITY/GEN	TS4
KDP-SS-001	RGS	3/4"	MICRO-Z, LOW CONDUCTANCE CABLE	N/A	N/A	N/A	SURGE SUPPR.	KDP	SS
MTS2-GEN-001	RGS	1"	XHHW-2	4	#6	#10	GENERATOR	MTS2	GEN
TS4-GEN-002	RGS	3/4"	XHHW-2	20	#14	N/A	GENERATOR	TS4	GEN
TS4-GEN-003	RGS	2"	9729 BELDEN CABLE + CAT 6	N/A	N/A	N/A	GENERATOR	TS4	GEN
TS4-MTS2-001	RGS	1"	XHHW-2	4	#6	#10	MANUAL TRANSFER SWITCH	TS4	MTS2
TS4-MTS2-001	RGS	3/4"	XHHW-2	3	#14	N/A	MANUAL TRANSFER SWITCH	TS4	MTS3
MAIN-KDP-001	RGS	1-1/2"	XHHW-2	4	#3	#8	DISTRIBUTION PANEL	MAIN	KDP
PC-SP1DS-001	RGS	3/4"	XHHW-2	3	#12	#12	SEWAGE PUMPS	PHASE CONVERTER	SP1DS
PC-SP2DS-001	RGS	3/4"	XHHW-2	3	#12	#12	SEWAGE PUMPS	PHASE CONVERTER	SP2DS
SP1DS-WWJB-001	RGS	3/4"	XHHW-2	3	#12	#12	SEWAGE PUMPS	SP1DS	WWJB
SP2DS-WWJB-001	RGS	3/4"	XHHW-2	3	#12	#12	SEWAGE PUMPS	SP2DS	WWJB
WWJB-SP1PC-001	RGS	3/4"	XHHW-2	3	#12	#12	SEWAGE PUMPS	WWJB	SP1PC
WWJB-SP2PC-001	RGS	3/4"	XHHW-2	3	#12	#12	SEWAGE PUMPS	WWJB	SP2PC
SP1PC-SP1-001	RGS	3/4"	XHHW-2	3	#12	#12	SEWAGE PUMPS	PHASE CONVERTER	SP1
SP2PC-SP2-001	RGS	3/4"	XHHW-2	3	#12	#12	SEWAGE PUMPS	PHASE CONVERTER	SP2
KDP-WWEFMS-001	RGS	3/4"	XHHW-2	2	#12	#12	WET WELL FAN MS	KDP	WWEFMS
WWEFMS-WWJB-001	RGS	3/4"	XHHW-2	2	#12	#12	WET WELL FAN	WWEFMS	WWEF
WWJB-WWEF-001	RGS	3/4"	XHHW-2	2	#12	#12	WET WELL FAN	WWJB	WWEF
KDP-LG-001	RGS	3/4"	XHHW-2	2	#12	#12	LIGHTING AND RECEPTACLE	KDP	LIGHTING AND RECEPT.
KDP-KCP-001	RGS	3/4"	XHHW-2	2	#12	#12	SCADA PANEL	KDP	KCP
KDP-ACC-001	RGS	3/4"	XHHW-2	2	#12	#12	GENERATOR ACCESSORIES	KDP	GEN ACCESSORY 1
KDP-ACC-002	RGS	3/4"	XHHW-2	2	#12	#12	GENERATOR ACCESSORIES	KDP	GEN ACCESSORY 2
KDP-SP-001	RGS	3/4"	XHHW-2	2	#12	#12	SHORE POWER RECEPTACLE	KDP	SP
MPLC-KDP-001	RGS	3/4"	XHHW-2	2	#12	#12	METERING PIT LIGHTING	KDP	METERING PIT
VCCLC-KDP-001	RGS	3/4"	XHHW-2	2	#12	#12	VALVE CHAMBER LIGHTING	KDP	VALVE CHAMBER
WWLC-KDP-001	RGS	3/4"	XHHW-2	2	#12	#12	WET WELL LIGHTING	KDP	WET WELL
KDP-FM-001	RGS	3/4"	XHHW-2	2	#12	#12	FLOW METER POWER	KDP	FLOW METER

CONTROL CONDUIT AND WIRE SCHEDULE										
MORGAN PARK										
Conduit ID	Conduit Type	Conduit Size	No. of Conduit	Wire Type	Wire Size	No. Of Wires	Ground Size	Description	From	To
TS2-MCP-001	RGS	3/4"	1	XHHW-2	#14	20	N/A	ATS TO PLC	TS2	MCP
MTS-MCP-001	RGS	3/4"	1	XHHW-2	#14	4	N/A	MTS TO PLC	MTS	MCP
TP1-MCP-001	RGS	3/4"	1	XHHW-2	#14	10	N/A	FUEL OIL TRANSFER PUMP MONITORING PANEL	TP1	MCP
WWHL-MCP-001	RGS	3/4"	1	XHHW-2	#14	4	N/A	HIGH-HIGH LEVEL FLOAT	WWHL	MCP
WWLL-MCP-001	RGS	3/4"	1	XHHW-2	#14	4	N/A	LOW-LOW LEVEL FLOAT	WWLL	MCP
SP1MS-MCP-001	RGS	3/4"	1	XHHW-2	#14	30	N/A	SEWAGE PUMP 1 MS IN MCC	SP1MS	MCP
SP2MS-MCP-001	RGS	3/4"	1	XHHW-2	#14	30	N/A	SEWAGE PUMP 2 MS IN MCC	SP2MS	MCP
BUB-MCP-001	RGS	3/4"	1	XHHW-2	#14	20	N/A	WET WELL BUBBLER SIGNALS	BUB	MCP
GEN-MCP-001	RGS	3/4"	1	XHHW-2	#14	10	N/A	GENERATOR CP	GENCP	MCP
PT-MCP-001	RGS	3/4"	1	SHIELED TWISTED PAIR CABLE	N/A	1	N/A	DISCHARGE PRESSURE TRANSMITTER	VALVE CH	MCP
FM-MCP-001	RGS	3/4"	1	SHIELED TWISTED PAIR CABLE	N/A	1	N/A	FLOW TRANSMITTER	MPFM	MCP
SP1MS-MCP-002	RGS	3/4"	1	CAT 6 CABLE	N/A	N/A	N/A	SEWAGE PUMP 1 MS IN MCC	SP1MS	MCP
SP2MS-MCP-002	RGS	3/4"	1	CAT 6 CABLE	N/A	N/A	N/A	SEWAGE PUMP 2 MS IN MCC	SP2MS	MCP
TS2-GEN-001	RGS	3/4"	1	XHHW-2	#14	20	N/A	GENERATOR CONTROL	TS2	GEN
TS2-GEN-002	RGS	3/4"	1	BELDEN 9729 CABLE	N/A	N/A	N/A	GENERATOR COMMUNICATION	TS2	GEN
TLS-TP1-001	RGS	3/4"	1	MANUFACTURER'S RECOMMENED CABLE	N/A	N/A	N/A	GENERATOR TANK LEVEL SENSOR	TLS	TP1
TLD-TP1-001	RGS	3/4"	1	MANUFACTURER'S RECOMMENED CABLE	N/A	N/A	N/A	GENERATOR TANK LEAK DETECTION	TLD	TP1

VIOLA										
SPCP-VIO-001	RGS	3/4"	1	THWN	#14	30	N/A	SEWAGE GRINDER CONTROL PANEL	SPCP	PLC-VIO
TS3-VIO-001	RGS	3/4"	1	XHHW-2	#14	20	N/A	TRANSFER SWITCH	TS3	PLC-VIO
WWHL-VIO-001	RGS	3/4"	1	XHHW-2	#14	4	N/A	HIGH-HIGH LEVEL FLOAT	WWHL	PLC-VIO
WWLL-VIO-001	RGS	3/4"	1	XHHW-2	#14	4	N/A	LOW-LOW LEVEL FLOAT	WWLL	PLC-VIO
TGLP-VIO-001	RGS	3/4"	1	XHHW-2	#12	2	N/A	OMTEC FUEL TANK (LEAK DETECTION)	RA	PLC-VIO
MTS3-VIO-001	RGS	3/4"	1	XHHW-2	#14	10	N/A	MTS TO PLC	MTS3	PLC-VIO
WWJB-VIO-001	RGS	3/4"	1	XHHW-2	#14	4	N/A	SEWAGE PUMP SIGNALS	WWJB	PLC-VIO
FM-VIO-001	RGS	3/4"	1	SHIELED TWISTED PAIR CABLE	N/A	1	N/A	FLOW TRANSMITTER	FM	MCP
PT-VIO-001	RGS	3/4"	1	SHIELED TWISTED PAIR CABLE	N/A	1	N/A	DISCHARGE PRESSURE TRANSMITTER	VALVE CH	MCP
SP1-CJB-001	RGS	3/4"	1	XHHW-2	#14	20	N/A	SEWAGE PUMP NO. 1 DIGITAL SIGNALS	SP1	CJB
SP1-CJB-002	RGS	3/4"	1	SHIELED TWISTED PAIR CABLE CAT 6 CABLE	N/A	2 / 1	N/A	SEWAGE PUMP NO. 1 ANALOG SIGNALS AND COMM. SIGNALS	SP1	CJB
SP2-CJB-001	RGS	3/4"	1	XHHW-2	#14	20	N/A	SEWAGE PUMP NO. 2 DIGITAL SIGNALS	SP2	CJB
SP2-CJB-002	RGS	3/4"	0	SHIELED TWISTED PAIR CABLE CAT 6 CABLE	N/A	2 / 1	N/A	SEWAGE PUMP NO. 2 ANALOG SIGNALS AND COMM. SIGNALS	SP2	CJB

KNOTT DRIVE										
WWHL-CJB-001	RGS	3/4"	1	XHHW-2	#14	4	N/A	WET WELL HIGH LEVEL FLOAT	WWHL	CJB
WWLL-CJB-001	RGS	3/4"	1	XHHW-2	#14	4	N/A	WET WELL LOW LEVEL FLOAT	WWLL	CJB
WWPT-CJB-001	RGS	3/4"	1	SHIELED TWISTED PAIR	N/A	N/A	N/A	WET WELL PRESSURE TRANSDUCER	WWPT	CJB
TS4-KCP-001	RGS	3/4"	1	XHHW-2	#14	20	N/A	ATS SIGNALS	TS4	PLC-KCP
FM-CJB-001	RGS	3/4"	1	SHIELED TWISTED PAIR	N/A	1	N/A	MAGNETIC FLOW METER	FM	CJB
VCPT-CJB-001	RGS	3/4"	1	SHIELED TWISTED PAIR	N/A	1	N/A	VALVE CHAMBER PRESSURE TRANSDUCER	VCPT	CJB
WWEFMS-KCP-001	RGS	3/4"	1	XHHW-2	#14	4	N/A	WET WELL EXHAUST FAN RUN STATUS	WWEF	CJB
CJB-KCP-001	RGS	3"	1	SHIELED TWISTED PAIR/ CAT 6 CABLE	N/A	4 / 2	N/A	CONTROL JUNCTION BOX	CJB	PLC-KCP
CJB-KCP-002	RGS	3"	1	XHHW-2	#14	60	N/A	CONTROL JUNCTION BOX	CJB	PLC-KCP
RA-KCP-001	RGS	3/4"	1	XHHW-2	#12	10	N/A	OMTEC FUEL TANK (leak detection)	RA	PLC-KCP
MTS2-KCP-001	RGS	3/4"	1	XHHW-2	#14	4	N/A	MTS SIGNALS	MTS2	PLC-KCP
TS4-GDS-001	RGS	3/4"	1	XHHW-2	#14	2	N/A	PORTABLE GENERATOR START/STOP	TS4	GDS
SP1-CJB-001	RGS	3/4"	1	XHHW-2	#14	20	N/A	SEWAGE PUMP NO. 1 DIGITAL SIGNALS	SP1	CJB
SP1-CJB-002	RGS	2	1	SHIELED TWISTED PAIR / CAT 6 CABLE	N/A	2 / 1	N/A	SEWAGE PUMP NO. 1 ANALOG SIGNALS AND COMM. SIGNALS	SP1	CJB
SP2-CJB-001	RGS	3/4"	1	XHHW-2	#14	20	N/A	SEWAGE PUMP NO. 2 DIGITAL SIGNALS	SP2	CJB
SP2-CJB-002	RGS	2	1	SHIELED TWISTED PAIR / CAT 6 CABLE	N/A	2 / 1	N/A	SEWAGE PUMP NO. 2 ANALOG SIGNALS AND COMM. SIGNALS	SP2	CJB
TS4-GEN-001	RGS	3/4"	1	XHHW-2	#14	20	N/A	GENERATOR CONTROL	TS4	GEN
TS4-GEN-002	RGS	2	1	BELDEN 9729 CABLE / CAT 6 CABLE	N/A	1 / 1	N/A	GENERATOR COMMUNICATION	TS4	GEN
GEN-MCP-001	RGS	3/4"	1	XHHW-2	#14	2	N/A	PORTABLE GENERATOR START/STOP	GEN	MCP

ROSLYN										
SP1MS-RCP-001	RGS	3/4"	1	THWN	#14	12	N/A	SEWAGE PUMP NO. 1 COMMUNICATION DIGITAL SIGNALS	SP1MS	RCP
SP1MS-RCP-002	RGS	3/4"	1	SHIELED TWISTED PAIR CABLE	N/A	2	N/A	SEWAGE PUMP NO. 1 COMMUNICATION ANALOG SIGNALS	SP2MS	RCP
SP2MS-RCP-001	RGS	3/4"	1	THWN	#14	12	N/A	SEWAGE PUMP NO. 2 COMMUNICATION DIGITAL SIGNALS	SP3MS	RCP
SP2MS-RCP-002	RGS	3/4"	1	SHIELED TWISTED PAIR CABLE	N/A	2	N/A	SEWAGE PUMP NO. 2 COMMUNICATION ANALOG SIGNALS	SP1MS	RCP
SP3MS-RCP-001	RGS	3/4"	1	THWN	#14	12	N/A	SEWAGE PUMP NO. 3 COMMUNICATION DIGITAL SIGNALS	SP2MS	RCP
SP3MS-RCP-002	RGS	3/4"	1	SHIELED TWISTED PAIR CABLE	N/A	2	N/A	SEWAGE PUMP NO. 3 COMMUNICATION ANALOG SIGNALS	SP3MS	RCP
TS1-RCP-001	RGS	3/4"	1	THWN	#14	20	N/A	ATS	TS2	RCP
MV1-RCP-001	RGS	3/4"	1	SHIELED TWISTED PAIR CABLE	N/A	N/A	N/A	MOTORIZED BUTTERFLY VALVE	MV-2	RCP
WWLT-RCP-001	RGS	3/4"	1	SHIELED TWISTED PAIR CABLE	N/A	N/A	N/A	WET WELL LEVEL 1	WWLT	RCP
RVP-RCP-001	RGS	3/4"	1	SHIELED TWISTED PAIR CABLE	N/A	N/A	N/A	VALVE PIT DISCHARGE PRESSURE	RVP	RCP
DWHW-RCP-001	RGS	3/4"	1	SHIELED TWISTED PAIR CABLE	#14	2	N/A	DRY WELL HIGH WATER	DDHW	RCP
MCCC-SP1-002	RGS	3/4"	1	THWN	#14	6	N/A	SEWAGE PUMP NO. 1 SEAL AND THERMAL SIGNALS	SP1JB	SP1MS
MCCC-SP2-002	RGS	3/4"	1	THWN	#14	6	N/A	SEWAGE PUMP NO. 1 SEAL AND THERMAL SIGNALS	SP2JB	SP2MS
MCCC-SP3-002	RGS	3/4"	1	THWN	#14	6	N/A	SEWAGE PUMP NO. 1 SEAL AND THERMAL SIGNALS	SP3JB	SP3MS

SECTION 16121 – ELECTRIC WIRES AND CABLES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Requirements for providing electric wires and cables. Electric wires and cables shall be provided in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.
- B. The electric wires and cables to be provided shall include all accessories.
- C. The cables and wires proposed for all instrumentation cables and wires shall be approved by the Contractor before Engineer approval can be given. Submit Contractor approvals along with the cable and wire shop drawings for Engineer approval. The cable and wires shall include those used for all equipment and devices specified in Division 15.

1.02 PAYMENT

- A. Payment for electric wires and cables shall be made as provided for in Division 1 of the Specifications.

1.03 REFERENCES

- A. Electric wires and cables shall comply with the latest applicable provisions and recommendations of the following:
 - 1. NFPA 70 - National Electrical Code.
 - 2. National Electrical Safety Code.
 - 3. ASTM B5 - High Conductivity Tough-Pitch Copper Refinery Shapes.
 - 4. ASTM B8 - Concentric-Lay-Stranded Copper Conductors, Hard, Medium-hard or Soft.
 - 5. ASTM B33 - Tin Coated Conductors.
 - 6. ASTM D69 - Test Methods for Friction Tape
 - 7. ICEA S-66-524 - Cross-linked-thermosetting - polyethylene-insulated Wire and Cable for the Transmission and Distribution of Electrical energy.
 - 8. ICEA S-68-516 - Ethylene-Propylene-Rubber-Insulated Wire and Cable for Transmission and Distribution of Electrical Energy.
 - 9. UL Standard No. 44 - Wires and Cables, Rubber-Insulated.
 - 10. UL Standard No. 83 - Wires and Cables, Thermoplastic-Insulated.
 - 11. UL Standard 486A - Wire Connectors and Soldering Lugs for Use With Copper Conductors.
 - 12. UL 1072 - Medium Voltage Power Cables.
 - 13. AEIC CS6-87 - Ethylene-Propylene-Rubber-Insulated Shielded Power Cable.
 - 14. NETA - International Electrical Testing Association.
 - 15. IEEE 48 - Test Procedures and Requirements for High Voltage Alternating-Current Cable Terminations.

1.04 SUBMITTALS

- A. Submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions and as specified under Division 1 of the Specifications.
 - 1. Working Drawings:
 - a. Prior to equipment submission, submit a list of proposed manufacturers with the products they produce proposed for the Contract.
 - b. Manufacturer's Literature, specifications and engineering data for the electric wires and cables and accessories.
 - c. For medium voltage wires and cables the following information shall be submitted:
 - 1) Manufacturer and type of cable.
 - 2) Minimum insulation resistance in megohms per 1,000 feet at 15.5 degrees C.
 - 3) Material, number and size of strands composing each conductor.
 - 4) Conductor insulation in thickness inches or 64th of an inch with material and voltage rating.
 - 5) Sheath thickness in inches or 64th of an inch.

SECTION 16121 – ELECTRIC WIRES AND CABLES

- 6) Average outside diameter of bare conductor.
- 7) Average outside diameter of finished cable and jacket material.
- 8) Weight per 1,000 ft. of finished cable.
- 9) Material and thickness in inches or 64th of an inch of each shield system.
- 10) Minimum bending radius, in inches.
- 11) Minimum pulling temperatures at which cable may be pulled without damage.
- 12) Maximum pulling tensions which may be applied to the cable without damage.
- 13) Literature identifying the methods and materials which Contractor proposes to use to make splices and terminations. Submittal shall consist of manufacturer's literature evidencing compatibility of the conductor insulation, shield and jacket of the cable with the splicing or terminating materials and methods which Contractor proposes to use.
- 14) Manufacturer's recommended pulling lubricants.
- 15) Qualifications of splicing and termination personnel.
- d. Description of shop and field-testing methods, procedures and apparatus with calibration dates shall be submitted. Testing methods and procedures shall be submitted at least 45 days in advance prior to conformation of witness testing dates and actual testing.
- e. Qualifications of proposed testing firm to perform acceptance testing shall be submitted. Submit firm experience records at least 45 days in advance to actual testing, five recent references with phone numbers shall be submitted.
- f. Qualifications of proposed mineral-insulated metal sheath cable installer shall be submitted. Submit installer experience records with five recent completed installations with names and phone numbers.
- g. Certification from the mineral-insulated metal sheath cable manufacturer's representative that the cable installation is in accordance with the manufacturer's requirements.
2. Reports:
 - a. Shop and field test reports shall be submitted.
 - b. Acceptance testing report shall be submitted.
3. SAFETY DATA SHEETS
 - a. Safety and Data Sheets (SDS) shall be submitted for all cables and wires supplied. SDS shall be submitted with the equipment shop drawings.

1.05 QUALITY ASSURANCE

- A. General:
 1. All cables and wires shall be made by an approved manufacturer, and in their construction shall be employed the most improved commercial materials and processes of manufacture.
 2. Only electrical wiring manufactured under high standards of production and meeting the approval of the Engineer shall be used. Friction tape shall be in accordance with ASTM D69.
 3. The wire and cable manufacturer shall use a shop test facility that has recently calibrated testing apparatus and qualified, experienced technicians, for all shop tests. Calibration of testing apparatus shall be within one year.
 4. All test equipment and instrument calibration shall be in accordance with the latest edition of the accuracy standard of the U.S. National Institute of Standards and Technology and the NETA acceptance testing specification.
 5. Retain the services of the mineral-insulated metal sheath cable manufacturer's representative to certify the cable installation is in accordance with the manufacturer's requirements.
- B. Field Tests:
 1. Electric wires and cables shall be field tested. Field testing for 600 volt and below wires and cables shall be in accordance with the requirements specified under Article 3.4.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Electric wires and cables shall be delivered, stored and handled in accordance with the Specifications and the manufacturer's instructions.

PART 2 - PRODUCTS

2.01 600 VOLT INSULATED WIRE AND CABLE

- A. 600 volt insulated wire and cable shall be used for all 600 volt and below power, lighting, control and alarm circuits. The size and quantity of 600 volt insulated wire and cable shall be as indicated in the conduit and cable schedule. The conductor jacket shall be in accordance with color identification requirements specified under Article 3.3.
- B. 600 volt single conductor wire and cable for installation in conduit shall be in accordance with the following:
 - 1. Conductors shall be stranded, tinned coated copper, single conductor cable conforming to ASTM B8 and B33, No. 12 AWG minimum size.
 - 2. Insulation shall be flame-retardant EPR (FREP), moisture and heat resistant thermoset rated 90 degrees C in dry locations and 90 degrees C in wet locations and listed by UL as type XHHW-2 or RHW-2.
 - 3. XHHW-2 shall be used for all indoor circuits and RHW-2 for all underground and outdoor circuits.
 - 4. 600 volt insulated wire and cable for installation in conduit shall be by Okonite Company, General Cable Corporation or equal to be approved by the Engineer.
- C. When identified in the conduit and cable schedule 600 volt multiple conductor cable shall be used for control and alarm circuits in the quantities indicated. 600 volt multiple conductor control cable for installation in conduit shall be in accordance with the following:
 - 1. Conductors shall be stranded, tinned coated copper conforming to ASTM B8 and B33, No. 12 AWG minimum size.
 - 2. Insulation shall be moisture and flame resistant cross-linked polyethylene rated 90 degrees C in wet and dry locations and listed by UL as type XHHW-2.
 - 3. Cable conductors shall be assembled together with flame and moisture resistant filters and tape to make round.
 - 4. Cable shall include an overall protective jacket of polyethylene compound, 45 mils minimum thickness.
 - 5. 600 volt multiple conductor control cable shall be Okonite Company, General Cable Corporation or equal to be approved by the Engineer.
- D. Instrumentation cable shall be in accordance with the following:
 - 1. Conductors shall be stranded, tinned coated copper, No. 16 AWG minimum size. All conductors shall be polyethylene insulated and twisted in pairs with an aluminum-mylar shield overlapped.
 - 2. The cable shall include an outer jacket. Jacketing shall be neoprene, chlorosulfonated polyethylene (hypalon), chlorinated polyethylene or flame retardant 105 degree C polyvinyl chloride.
 - 3. Instrumentation cable shall be by Okonite Company, General Cable Corporation, Belden Company or equal to be approved by the Engineer.
- E. Communication and Fire Alarm Cable shall be in accordance with the following:
 - 1. Conductors shall be stranded, tinned coated copper, No. 18 AWG minimum size for fire alarm cable and No. 24 AWG for communication cable. Insulation shall be polyethylene. Where specifically shown on the Contract Drawings or stated in the Specifications, communication system conductors shall be twisted shielded cable.
 - 2. The cable shall include an outer jacket. Jacketing shall be neoprene, chlorosulfonated polyethylene (hypalon), chlorinated polyethylene or flame retardant 105 degree C or polyvinyl chloride.
 - 3. Communication and Fire Alarm Cable shall be by General Cable Corporation, Belden Company with Beldfoil shielding or equal to be approved by the Engineer.

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- F. Security system cables shall be 600 Volt insulated. Minimum size conductors for the security system shall be No. 22 AWG. Where specifically shown on the Contract Drawings or stated in the Specifications, security system shall use twisted shielded cable or coaxial type cable.

2.02 600 VOLT AND BELOW WIRE AND CABLE ACCESSORIES

- A. Cable connectors shall be provided for terminating 600 volt and lower voltage wire and cable. Connectors for wire and cable up to 600 volt shall be solder less type and properly sized to fit fastening device and wire size. Connectors shall be in accordance with the following:
1. For wire sizes up to and including No. 6 AWG, compression type with UL 486A listing shall be used. All cable terminations for conductors No. 10 AWG and smaller shall be terminated using UL listed ring tongue type, nylon insulated connectors, at each terminal board.
 2. For wire sizes No. 4 AWG and above, either compression type or bolted type with tin-plated contact faces shall be used.
 3. For wire sizes No. 250 kcmil and larger, connectors with at least 2 cable clamping elements or compression indents and provision for at least 2 bolts for joining to apparatus terminal shall be used.
 4. Compression connectors shall be Power-Connect, ring tongue shall be Series 83 as manufactured by Ideal Industries. Connectors shall also be by Thomas and Betts, Burndy or equal approved by the Engineer.
- B. Cable splicing for 600 volt and below wire and cable shall be performed when terminals are not provided. Splicing shall be in accordance with the following:
1. For wire sizes No. 8 AWG and larger, splices shall be made up with compression type copper splice fittings with UL 486A listing. Splices shall be taped and covered with materials recommended by the cable manufacturers, to provide insulation equal to that on the conductors.
 2. For wire sizes No. 10 AWG and smaller, splices shall be made up with pre-insulated spring connectors. Connectors shall be flame retardant with UL listing.
 3. For wet locations, splices shall be submersible rated for underwater use. Underwater splices shall be rated for 10,000 psig. The splices shall be precision precast polyurethane compression dams, waterblock solder pins and an amber polyurethane overmold to prevent all water from entering the cable and keeping seawater outside the cable from passing through the splice to the electrical connection. Underwater splices shall be UL listed. All underwater splices shall be manufactured by PMI Industries or approved equal.
 4. Compression splices shall be by Ideal Industries, Thomas and Betts, Burndy, or equal to be approved by the Engineer. Waterproof compression splices shall be thermo-shrink as manufactured by Ideal Industries. Waterproof compression splices shall also be by Thomas and Betts, Burndy, Buchanan or equal approved by the Engineer.
 5. Spring connector splices shall be Twister type and Twister DB type for waterproof, as manufactured by Ideal Industries. Spring connectors shall also be by Thomas and Betts, Burndy, or equal approved by the Engineer.
- C. Cable markers shall be provided for the identification of 600 volt and below wire and cable. Markers for 600 volt and below wire and cable shall be in accordance with the following:
1. Markers shall be vinyl type, moisture, heat and abrasion resistant with adhesive back. Cable identification shall be clearly marked.
 2. Markers shall be by Ideal Industries, Thomas and Betts or equal to be approved by the Engineer.
- D. Pulling compound shall be provided to facilitate wire pulling. Pulling compound shall be in accordance with the following:
1. Pulling compound shall be waxed based, with a .17 average coefficient of friction and a temperature range of 30 to 190 degrees F. The compound shall be compatible with all cable types.
 2. Pulling compound shall be Ideal Industries, Greenlee or equal to be approved by the Engineer.

2.03 SHOP TESTS

- A. Certified Shop Tests:
 - 1. Shop testing shall be performed on the wire and cable at the manufacturer's plant prior to shipment. Shop test shall be in accordance with the latest revisions of ICEA and UL and shall demonstrate that the wire and cable tested conforms to the requirements specified.
 - 2. Provide a shop test report that identifies the tests performed and the results obtained.
 - 3. All low voltage wire and cable shall be shop tested in accordance with the requirements of Underwriters' Laboratories.
- B. Witnessed Shop Tests:
 - 1. Perform witnessed shop tests in accordance with the Specifications.
 - 2. The Engineer shall have access during working hours for inspection purposes to all parts of the works where material and cable are being manufactured, and all reasonable inspection and testing facilities shall be provided to him without increase in price. The Engineer may request that dielectric strength tests and measurements be made to verify the cable data furnished by the Contractor. For this purpose furnish without increase in price, a length of cable, not to exceed 3 feet for each size to be cut from one or more reels as directed by the Engineer. Each sample shall be marked with a tag bearing full description of cable insulation and number of reel from which it is cut.

2.04 PROCESS NETWORK CABLE

- A. Process network cable shall be utilized for interior data highway systems and circuits where shown on the Contract Drawings or in Section 16900, Cable and Conduit Schedule.
- B. All process network cable provided under this Contract shall be furnished by a single manufacturer.
- C. The process network cable shall have the following specifications:
 - 1. Category 6 plenum cable.
 - 2. 4 Pair - AWG 24 solid copper conductors.
 - 3. FEP insulation with PVC overall jacket.
 - 4. Meets ANSI/TIA/EIA-568-A performance specifications.
 - 5. Characteristic impedance: 100+/-15 ohms.
 - 6. DC resistance: 7 ohms (maximum).
 - 7. DC resistance unbalance: 2.5% (maximum).
 - 8. Mutual capacitance: 5.6 nF/100 meters (maximum).
 - 9. Pair-to-pair capacitance unbalance: 100 pF/100 meters (maximum).
 - 10. Manufactured to UL444 and flame tested to UL910.
 - 11. UL rated Type CMP and MMP.
- D. Cable shall be equal to Southwire Cyber Technologies, "Cyber LAN Category 6 plenum."

PART 3 - EXECUTION

3.01 GENERAL

- A. Install cables and wires within the raceways as indicated on the Contract Drawings. Carefully handle cables and wires so as to avoid twists or kinks in the conductors or damage to the insulation.
- B. Ensure that the manufacturer's recommended cable bending radii and pulling are not exceeded and that the number of conductors permitted in a conduit are in accordance with the applicable section of NFPA 70 National Electrical Code.
- C. No splices shall be permitted between terminals except at approved junction or terminal boxes. Boxes shall be provided as shown on the Contract Drawings or as required by Code for the pull lengths. No more than two terminations shall be made at each terminal point. Cable and wire runs shall be looped through pull boxes without cutting and splicing where possible. All splices below grade, in manholes, hand holes and wet locations shall be waterproofed.

SECTION 16121 – ELECTRIC WIRES AND CABLES

- D. No splicing of instrument wiring shall be permitted. Instrument wiring shall be extended by use of field termination boxes employing labeled terminal strips. Shield continuity shall be maintained. Ultimate shield termination (ground) shall be at one end only.
- E. The mineral-insulated metal sheath cable manufacturer's representative shall review the cable installation to certify that the cables are installed in accordance with the manufacturer's requirements.

3.02 INSTALLATION OF WIRING

- A. Cables shall be installed complete with proper terminations at both ends. For each motor circuit, Contractor shall ensure proper phase sequence and motor rotation.
- B. Wire and cable contained within a single conduit shall be pulled simultaneously using insulating pulling compounds containing no mineral oil.
- C. Pulling tension on medium voltage cables shall be continuously monitored using a calibrated Dynamometer type device, having a calibration label within six months of its use.
- D. Cables shall be installed with maximum slack at all terminal points, boxes, handholes and manholes.
- E. Medium voltage cables located within manholes, handholes and boxes shall be wrapped with fireproofing tape for their entire length on an individual cable basis. Tape shall be 30 mils thick of self-extinguishing material which will not support combustion. Tape shall not deteriorate when subjected to water, salt, sewage or fungus and shall be secured with glass cloth tape. Medium voltage cables shall be fireproofed in accordance with the cable manufacturer's recommendations and then covered with tape extending at least one inch into any duct.

3.03 CONDUCTOR IDENTIFICATION

- A. Label each wire at each termination point and all splice locations. Carry individual conductor or circuit identification throughout, with circuit numbers or other identification stamped on terminal boards when provided or the cable so it is visible around the cable's circumference.
- B. Identify each wire in junction boxes, cabinets, and terminal boxes. Where no termination is made, use a plastic-coated, self-adhesive, wire marker. Where termination is made, use a plastic, pre-printed sleeve wire marker. Paper, self-adhesive wire markers shall not be used.
- C. In manholes and handholes, identify each power wire by a laminated plastic tag located so that it can be seen from center of manhole without moving adjoining wires. Bundle and mark control wires as listed in conduit and cable schedule.
- D. Multi-conductor control cables shall be color coded in accordance with ICEA S-61-402, Method 1, Table K.
- E. The following identification scheme shall be used for all 600 volt and below power circuits:

<u>SYSTEM VOLTAGE</u>	<u>NEUTRAL</u>	<u>PHASE A</u>	<u>PHASE B</u>	<u>PHASE C</u>	<u>GROUND</u>
208/120V	WHITE	BLACK	RED	LIGHT BLUE	GREEN
240/120V	WHITE-GRAY STRIP	BLACK-BLUE STRIP	RED-BLUE STRIP	NONE	GREEN
480/277V	GRAY	BROWN	ORANGE	YELLOW	GREEN

3.04 600 VOLT AND BELOW WIRE AND CABLE FIELD TESTING

- A. After installation, all 600 volt and below wire and cable shall be field tested. The field tests shall be performed by the Contractor who shall furnish all testing equipment. The field tests shall be

SECTION 16121 – ELECTRIC WIRES AND CABLES

witnessed by the Engineer and certified by the Contractor. Provide a report identifying the tests performed and the results obtained.

- B. Test each electrical circuit after permanent cables are in place to demonstrate that the circuit and equipment are connected properly and will perform satisfactorily and that they are free from improper grounds and short circuits. The tests shall consist of the following:
1. 600 volt wire and cable mechanical connections shall be individually tested after installation and before they are put in service with a calibrated torque wrench. Values shall be in accordance with manufacturer's recommendations.
 2. 600 volt and below wire and cables shall be individually tested for insulation resistance between phase and from each phase to ground. Test after cables are installed and before they are put in service with a Megger for one minute at a voltage rating recommended by the cable manufacturer or in accordance with NEMA and ICEA standards.
 3. The insulation resistance for any given conductor shall not be less than the value recommended by the cable manufacturer or in accordance with NEMA and ICEA standards. Any cable not meeting the recommended value or which fails when tested under full load conditions shall be replaced with a new cable for the full length.
 4. Shielded instrumentation cable shields shall be tested with an ohmmeter for continuity along the full length of the cable and for shield continuity to ground.
 5. Connect Shielded instrumentation cables shall be connected to a calibrated 4-20 milliamp DC signal transmitter and receiver. Test at 4, 12, and 20 milliamp transmitter settings.

END OF SECTION

SECTION 16121 – ELECTRIC WIRES AND CABLES

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SECTION 16131 – ELECTRIC CONDUIT SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Requirements for providing conduit system. The conduit system shall be provided in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.
- B. The conduit system required shall be provided with all rigid and flexible conduits, boxes, fittings, supports, hangers and inserts and other conduit accessories as required for the installation of the electric wire and cable.
- C. The conduit system proposed for all instrumentation circuits shall be approved by the Contractor before Engineer approval can be given. Submit Contractor approvals along with the conduit layout submittals for Engineer approval. The circuits shall include all equipment and devices specified in other divisions and their associated conduit runs.
- D. The conduit system proposed for all of the HVAC instrumentation circuits shall be approved by the Contractor before Engineer approval can be given. Submit approvals along with the conduit layout submittals for Engineer approval. The circuits shall include all instrumentation equipment and devices specified in other divisions, such as transmitters, analyzers, monitors, PLC's, CPU's, workstations. Fans, air conditioners, heaters and other mechanical equipment circuits.
- E. All PVC coated conduit installed shall be the same uniform gray color. No other color variations will be accepted. All RGS conduit shall be painted to match the same uniform gray color of the PVC coated conduit delivered to the site.
- F. Conduits shall be tagged to define its system served: power, process/mechanical, instrumentation, telephone, fire alarm, communications and lighting.
- G. Where conduit enters and exits pull boxes, junction boxes, terminal boxes, etc. the labels for conduit tags shall be placed on the interior of the box on the conduit bushings.

1.02 RELATED SECTIONS

- A. Specification 05050 - Metal Fastening.
- B. Specification 09900 - Painting.
- C. Specification 16071 – Supporting Devices.

1.03 PAYMENT

- A. Payment for Electric Conduit System shall be made as provided in Division 1 of the Specifications.

1.04 REFERENCES

- A. Electric conduit system shall comply with the latest applicable provisions and recommendations of the following:
 - 1. NFPA 70 - National Electrical Code.
 - 2. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 - 3. UL Standard No. 6 - Rigid Metal Electrical Conduit.
 - 4. UL Standard No. 50 - Electrical Cabinets and Boxes.
 - 5. UL Standard No. 360 - Liquid-Tight Flexible Steel Conduit.
 - 6. UL Standard No. 514A - Metallic Outlet Boxes.
 - 7. UL Standard No. 514B - Fittings for Conduit and Outlet Boxes.
 - 8. UL Standard No. 886 - Electrical Outlet Boxes and Fittings for Use in Hazardous Locations.
 - 9. ANSI C80.1 - Specification for Zinc Coated Rigid Steel Conduit.
 - 10. ANSI C80.4 - Specification for Fittings for Rigid Metal Conduit and Electrical Metallic Tubing.
 - 11. NEMA Standard No. RN-1 - PVC Externally Coated Galvanized Rigid Steel Conduit.

SECTION 16131 – ELECTRIC CONDUIT SYSTEM

1.05 SUBMITTALS

- A. Submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions and as specified under Division 1 of the Specifications.
- B. Working Drawings:
 - 1. Prior to equipment submission, submit a list of proposed manufacturers with the products they produce proposed for the contract.
 - 2. Manufacturer's catalog cuts for the conduit, boxes, fittings and supports proposed for use.
 - 3. Construction details of conduit racks and other conduit support systems with seismic restraint details and calculations signed by a licensed Engineer.
 - 4. Scaled working drawings showing proposed routing of all conduits, inclusive of conduits routed above grade on exterior support structures, embedded in structural concrete and conduits directly buried in earth. Drawings shall show locations of pull and junction boxes and all penetrations in walls and floor slabs.
- C. Field test report shall be submitted.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Electric conduit system shall be delivered, stored and handled in accordance with the Specifications, the manufacturer's instructions and the following:
 - 1. Conduit shall be delivered to the work in standard bundles having each length suitably marked with the manufacturer's name or trademark and bearing the label of the Underwriters' Laboratories, Incorporated, inspection service.

PART 2 - PRODUCTS

2.01 RIGID STEEL CONDUIT

- A. Provide rigid steel conduit for all exterior buried locations only. All steel conduit shall comply with the requirements of ANSI C80.1, and the Underwriters' Laboratories, Incorporated, Standard for No. 6.
- B. Both the inside and outside surfaces of the rigid steel conduit shall be protected against corrosion by a coating of zinc applied by the hot-dip galvanizing process.
- C. Conduits, elbows and couplings shall be rigid, heavy wall, mild steel, hot dip galvanized. Conduits, elbows and couplings shall have a smooth interior with tapered threads and carefully reamed ends. Conduit size shall be 3/4-inch minimum and shall conform to UL-6.
- D. Rigid steel conduit shall be by Allied Tube and Conduit Corporation, Wheatland Tube Company or approved equal.

2.02 PVC COATED RIGID STEEL CONDUIT

- A. Conduits, elbows and couplings shall include a PVC coating for all areas except for exterior buried conduit.
- B. PVC coated conduit shall be factory applied and shall include a smooth 2 mil thick urethane interior coating and 40 mil thick polyvinyl chloride exterior coating. The exterior PVC coating color shall be gray. The threads of conduits that have been cut to size shall have the same PVC coating applied in the field. PVC coated conduit shall conform to NEMA Standard RN-1.
- C. PVC coated rigid steel conduit shall be by Perma-Cote Industries, OCAL Incorporated, Robroy Industries or equal to be approved by the Engineer.

2.03 HANGERS, SUPPORTS AND INSERTS

- A. Provide hangers, supports and inserts for support of the electric conduit system. The supports shall securely attach the electric conduit system to the channel and structure.
- B. Design, construct and install electric conduit system suitable for earthquake regulations in accordance with the seismic requirements of the Nassau County Building Code and the Uniform Building Code for Zone 2A application.

SECTION 16131 – ELECTRIC CONDUIT SYSTEM

- C. Transverse and longitudinal bracing shall be provided as required to brace the electric conduit for the seismic requirements specified.
- D. All drilled in type concrete inserts shall be expansion shields or anchors conforming to Specification 05050 - Metal Fastening. In corrosive locations, concrete inserts shall be 316 stainless steel.
- E. Hangers and supports shall be in accordance with the requirements of Specification 16071 – Supporting Devices.
- F. In corrosive and NEMA 4X locations, hangers and support hardware shall be type 316 stainless steel or factory applied 40 mil thick PVC coated.
- G. Hangers, Supports and Inserts shall be by B-Line, Kindorf or equal to be approved by the Engineer.

2.04 FLEXIBLE LIQUID-TIGHT METALLIC CONDUIT

- A. Provide flexible liquid-tight metallic conduit where required to permit movement of connected devices and where it is impractical to complete runs with rigid conduit.
- B. For hazardous areas flexible conduit shall include a brass inner core with a bronze outer braid and protective neoprene plastic coating. End fittings shall be steel, brass or bronze.
- C. Flexible conduit shall be by Anaconda American Brass Company, Electric-Flex Company or approved equal. Hazardous area flexible conduit shall be by Crouse Hinds Company, Appleton Electric Company or equal to be approved by the Engineer.

2.05 OUTLET BOXES AND FITTINGS

- A. Provide outlet boxes and fittings for rigid and flexible conduit. The outlet boxes and fittings required for the work which constitutes a part of the conduit system, shall be of approved types.
- B. For outdoor, wet and corrosive areas, conduit fittings and outlet bodies shall be cast gray iron alloy, cast malleable iron bodies and covers. All units shall be gasketed, watertight, and threaded with five full threads and shall have rust-proofing in accordance with the requirements of Article 2.6. Fittings and bodies installed on PVC coated conduits shall also include interior and exterior coatings equivalent to the conduit.
- C. Threaded cast ferrous metal, hub type outlet boxes shall be used throughout. Cast iron or alloy outlet boxes of the proper size and depths for the application, complete with watertight gaskets and covers secured by brass screws, shall be furnished and installed as indicated on the Contract Drawings or as required by the conduit run. Outlet boxes, furnished and installed for the installation of lighting fixtures, switches and receptacles in a future contract, shall be furnished with watertight gaskets and blank covers.
- D. All outlet boxes intended for fixtures shall be provided with approved fixture studs.
- E. For concealed conduit runs in outside walls and all exposed conduit work, connections to boxes and fittings shall be made through threaded holes, unless otherwise approved by the Engineer. Where necessary unions may be used. Unions in hazardous locations shall be Crouse Hinds type UNF, UNL, UNY conduit fittings or equal to be approved by the Engineer. Unions in non-hazardous areas shall be Universal or Erickson conduit couplings or equal to be approved by the Engineer.
- F. All boxes installed for concealed conduit, shall be provided with extension rings or plaster rings and covers as required. For non-hazardous, dry indoor areas stainless 302/304, satin beveled steel cover and device plates for surface mounted boxes shall be used. For corrosive locations, galvanized ferrous and galvanized cast ferrous metal cover and device plates with neoprene gaskets shall be used.
- G. Outlet boxes and fittings installed on PVC coated conduit shall also include interior and exterior coatings equivalent to the conduit.

2.06 CONDUIT ACCESSORIES

- A. Provide conduit accessories for use with the conduit system. The conduit accessories shall be of approved types.

SECTION 16131 – ELECTRIC CONDUIT SYSTEM

B. Expansion and Deflection Fittings:

1. Expansion and deflection fittings shall be made up of non-corrodible parts and shall provide for ample longitudinal and lateral movement. A suitable bond shall provide a low resistance, continuous longitudinal path for ground currents.
2. Expansion and deflection fittings shall be watertight cast iron, malleable iron or hot dipped galvanized. Fittings shall be corrosion-resistant, UL listed and compatible with the conduit system.
3. Expansion /deflection fittings shall provide both expansion and deflection in a single fitting in accordance with the following:
 - a. Axial expansion or contraction up to 3/4-inch.
 - b. Angular misalignment up to 30 degrees.
 - c. Parallel misalignment up to 3/4-inch.
4. Expansion fittings shall provide expansion /contraction with eight inch total movement.
5. Expansion and deflection fittings shall be by Crouse Hinds, Appleton Electric or equal to be approved by the Engineer.

C. Sealing Fittings:

1. Sealing fittings shall be cast gray iron alloy or cast malleable iron or copper free aluminum with zinc electroplate and lacquer or enamel finish.
2. Sealing fittings shall have an ample opening with threaded closure for access to conduit hub for making dam. Sealing fiber and compound shall be suitable for use with the fitting and shall be the products of the fitting manufacturer.
3. For corrosive locations, seal fittings shall include interior and exterior coatings equivalent to the PVC conduit coating specified under Article 2.01.
4. Sealing fittings shall be by Crouse Hinds, Appleton Electric or equal to be approved by the Engineer.
5. Hazardous Location Sealing Hub
 - a. Hazardous location sealing hubs shall be O-Z/GEDNEY EYH, EYH-SG or approved equal.
 - b. Contractor shall provide hazardous sealing fittings of different types and configurations to facilitate the installation as manufactured by O-Z/GEDNEY or approved equal.
 - c. Sealing compound and fiber shall be O-Z/GEDNEY type EYC and EYF.

D. Drain Fittings:

1. Drain fittings shall be a combination device designed to provide ventilation to minimize condensation and drains accumulated condensate.
2. The combination drain/breather fitting shall be 3/8 inch male thread size with stainless steel body.
3. Drain fittings shall be by Crouse Hinds, Appleton Electric or equal to be approved by the Engineer.

E. Conduit Hubs:

1. Conduit hubs shall be threaded, insulated throat type with bonding screw locknut.
2. The conduit hub and locknut shall be malleable iron or zinc and shall include a 90 degree C insulating surface and a sealing ring for a water tight and dust tight connection.
3. Conduit hubs shall be by O-Z Gedney, Thomas and Betts or equal to be approved by Engineer.

F. Conduit Bushings:

1. Conduit bushings shall be insulated, grounding type with lay-in-lug connection. Two locknuts shall be provided for each bushing.
2. The conduit bushing and locknuts shall be steel, malleable iron or zinc. The bushing shall include a 90 degree C insulating surface.
3. Conduit bushings and locknuts shall be by O-Z Gedney, Thomas and Betts or equal to be approved by the Engineer.

G. Duct Seal:

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1. Duct seal shall be a soft, fibrous non-hardening sealing compound for sealing between cables and conduits.
 2. Duct seal shall be by O-Z Gedney, Ideal Industries or equal to be approved by the Engineer.
- H. Thruwall Seals and Bushings:
1. Thruwall seals and bushings shall be in accordance with the following:
 - a. For conduits and cables in new construction and passing through exterior subsurface walls and exterior concrete walls, thruwall seals shall be used. Thruwall seals shall be Type WSK and WSCS manufactured by O-Z/Gedney or equal to be approved by the Engineer.
 - b. For conduits and cables in new construction and passing through concrete floors and floor slabs, floor seals shall be used. Floor seals shall be type SK and FSCS manufactured by O-Z/Gedney or equal to be approved by the Engineer.
 - c. For conduits passing through exterior block walls or installed in existing construction passing through exterior subsurface walls, exterior concrete walls, floor slabs and roof slabs for use in core bit-drilled holes sealing bushings shall be used. Sealing bushings shall be Type CSMI at the inside of the structure and Type CSMC at the outside of the structure, within the same core drilled hole. Sealing bushings shall be manufactured by O-Z/Gedney or equal to be approved by the Engineer.
 - d. For conduits passing through existing interior concrete walls or floors and interior block walls sealing bushings shall also be used. Sealing bushings shall be CSMC or CSMI type as manufactured by O-Z/Gedney or equal to be approved by the Engineer.
 - e. For conduits passing through fire rated floors and walls fire stop fittings shall be used. Fire stop fittings shall be CFS and/or CFSI type as manufactured by O-Z/ Gedney or equal to be approved by the Engineer.
 - f. For multiple conduit runs passing through interior or exterior and fire rated walls thru-wall barriers shall be used. Thru-wall barriers shall be TW series by Crouse-Hinds or equal to be approved by the Engineer.
- I. Conduit Tags:
1. Conduit tags shall be Setmark snap around conduit markers which shall be secured to the conduit with annealed brass wire.
 2. Conduit tags shall be clearly stamped with the conduit number in conformity with the cable and conduit schedule or as directed by the Engineer.
 3. Conduit tags shall be by Seton Nameplate Corporation or equal to be approved by the Engineer.
- J. Conduit Markers:
1. Conduit identification markers shall be self-sticking color-coded tape. Identification tape shall be two inches wide and colored in accordance with the color banding specified under this section.
 2. Conduit markers shall be by Thomas and Betts or equal to be approved by the Engineer.

2.07 TERMINAL, JUNCTION AND PULL BOXES

- A. Provide terminal, junction and pull boxes as shown on the Contract Drawings and where otherwise required, or as directed by the Engineer.
- B. Boxes located indoor in dry, dustless areas shall be NEMA Type 12, constructed of welded and galvanized sheet steel. Boxes 24 inches and less shall be 14 USS standard gauge metal. 12 USS standard gauge metal on boxes greater than 24 inches, except 10 USS standard gauge shall be used for boxes with any dimension of 36 inches or more.
- C. Boxes located in other areas shall conform to the following area classifications:
 1. For wet locations boxes shall be watertight NEMA Type 4. Boxes shall be constructed of galvanized cast iron and shall include gasketed, bolt on covers, with tapped holes in bosses or hubs for conduit entrance. Boxes shall be provided with cast mounting lugs for installation in concrete.

SECTION 16131 – ELECTRIC CONDUIT SYSTEM

2. For hazardous locations boxes shall be explosion proof NEMA Type 7. Boxes shall be constructed of cast iron and shall include threaded connections and ground joint surfaces.
3. For corrosive locations boxes shall be corrosion resistant, NEMA Type 4X. Boxes shall be constructed of 316 stainless steel material with sealed seams.
- D. Pull and junction boxes shall be provided with covers held in place by brass screws. Terminal boxes shall be provided with terminal block supports and approved hinged covers fitted tightly against a gasket and secured by lug bolts and wing nuts. Hinges, lug bolts, wing nuts and other fittings shall be made of an approved, non-ferrous, non-corrodible metal. All boxes shall be provided with rabbeted gaskets or flange gaskets securely held in place.
- E. Tapping for threaded connections to outlet boxes, junction boxes, pull boxes and conduit fittings in non-explosion proof construction shall conform to the following:
 1. All threads shall be tapered.
 2. If threads for connection of conduit are tapped all the way through a hole in an enclosure, or if an equivalent construction is employed, there shall be not less than 3-1/2 threads in the metal and the construction of the enclosure shall be such that a suitable conduit bushing can be properly attached.
 3. If threads for connections of conduit are not all the way through a hole in a boxwall, conduit hub or the like, there shall be not less than five full threads in the metal and there shall be a smooth, well rounded inlet hole for the conductors, which shall afford protection to the conductors equivalent to that provided by a standard conduit bushing and which shall have an internal diameter approximately the same as that of the corresponding trade size of rigid conduit. The threaded hole shall be provided with a conduit end stop.
 4. Tapping for threaded connections for explosion proof construction shall conform to the requirements of the National Electrical Code for construction in Class I, Division 1, hazardous locations.
- F. Cast iron or cast ferrous alloy outlet boxes, junction boxes, pull boxes, conduit fittings and conduit accessories such as box covers shall be rust-proofed by zinc coating applied by the "hot-dip" process or shall be given a rust protective coating applied by either of the following methods:
 1. Method A:
 - a. Castings shall be given a mechanical and chemical cleaning.
 - b. Castings shall be given a phosphoric acid type dip.
 - c. Then a coating of zinc chromate primer shall be applied, and finally
 - d. A coating of baked enamel finish shall be applied over the outside and inside surfaces of the castings.
 2. Method B:
 - a. Castings shall be given a mechanical and chemical cleaning.
 - b. Then a coating of cadmium shall be deposited electrolytic ally.
 - c. Then a coating of zinc shall be applied by electroplating.
 - d. Then a vinyl resin base aluminum lacquer shall be applied.
- G. Stamped steel junction boxes and box covers shall be rust-proofed by a zinc coating applied by an electro-galvanizing or sherardizing process. Fabricated sheet steel boxes shall be formed from galvanized sheet steel. Welded joints shall be touched up with aluminum lacquer and boxes and covers shall be given a shop priming coat of zinc chromate rust inhibiting paint.
- H. Terminal blocks shall be used within terminal boxes for termination of prepared conductors No. 10 AWG and smaller. Terminal blocks shall be in accordance with the following:
 1. Terminal blocks shall be high density, screw terminal type suitable for rail mounting with quantities sufficient for the conductors to be terminated plus 20 percent spare.
 2. Terminal blocks shall be NEMA rated, 600 volt, 35 ampere suitable for 85 degrees C.
 3. Terminal block components shall have stainless steel and tin plated copper alloy components, backed out captive screws and marking surface.
 4. Terminal blocks shall be Allen-Bradley Company, General Electric Company or equal to be approved by the Engineer.

PART 3 - EXECUTION

3.01 GENERAL

- A. Install conduits in accordance with the requirements specified under this section and in conformity with the sizes stated in the Specifications or shown on the Contract Drawings. Install conduits complete with all accessories, fittings and boxes, in an approved and workmanlike manner so as to provide proper raceways for electrical conductors.
- B. The Contractor's attention is called to the fact that all conduit runs indicated on the Contract Drawings are shown diagrammatically for the purpose of outlining the general method of routing the conduits to avoid interference. Where conduit runs are not shown, it shall be the responsibility of the Contractor to establish the runs required based upon the various systems shown on the Contract Drawings. Run conduits parallel and perpendicular to building construction.
- C. Should any structural difficulties prevent the setting of cabinets, boxes, conduits, etc., at points shown on the plans, deviations therefrom as determined by the Engineer will be permitted and shall be made without additional cost.
- D. All exposed steel conduits, fittings, boxes, straps, racks and hangers shall be painted in conformity with Specifications 09900 - Painting. PVC coated conduit systems shall not be painted. Paint shall match the gray color of the PVC coated conduits.
- E. Identify conduits using conduit tags. Install conduit tags where conduits terminate in equipment and enclosures.
- F. Exposed conduits shall be color banded using conduit markers. Markers shall also include operating voltage when over 600 volts. Conduit markers shall be installed 360 degrees, double wrap around conduit exterior. Install conduit markers where conduits enter equipment, boxes, within each room, at wall penetrations and 50 feet on centers in each area. When exposed conduits are to be painted, markers shall be installed after the conduits are painted. Color banding shall be in accordance with the following:
 - 1. 120/208 volt AC: Gray.
 - 2. 277/480 volt or 480 volt AC: Sand.
 - 3. 2400 volt or 4160 volt AC: Silver.
 - 4. 13800 volt AC: Brown.
 - 5. Fire Detection and Alarm: Red.
 - 6. Telephone: Blue.
 - 7. Intercommunication: Yellow.
 - 8. Security System: Rust.
 - 9. Low Voltage Switching, Instrumentation and Controls System: Black.

3.02 INSTALLATION OF RACEWAYS

- A. Install all exposed raceways parallel or at right angles to walls and ceiling beams. Changes in directions shall be made with bends, elbows and pull boxes. All parallel runs shall be spaced uniformly throughout and secured in place with hangers and fasteners. Brace raceways to satisfy the specified seismic requirements in accordance with the restraint details.
- B. Conduits, where exposed, shall in all cases be substantially supported in an approved manner, but they shall not be fastened to or come in contact with any other pipes, ducts or other work of a similar nature. In all exposed work, approved channel or angle iron hangers, racks, one-hole straps or a combination thereof shall be provided to support the conduits. Where conduits are supported with one-hole straps, spacers shall be used to provide 1/4-inch minimum clearance between the conduits and walls or ceilings.
- C. Hanger rods for trapeze type hangers shall not be less than 5/8 inch diameter. Conduit supports shall be located at intervals not exceeding 8 feet. Securely fasten conduits to each support with U-bolts, straps or clamps. All hanger types (trapeze and others) shall be furnished and installed in accordance with Specification 15060, Hangers and Supports. All items that are hung and supported shall be submitted as a separate shop drawing complete with licensed structural engineer P.E. seal.

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- D. All concealed conduits shall be placed in walls, floors, ceilings, or slabs at the proper time in accordance with the progress of the structural work. The Contractor shall cooperate in every respect in meeting schedules and shall not delay the structural work unnecessarily.
- E. Conduits embedded in concrete shall be blocked and braced in place by use of adequate conduit separators to prevent displacement during the pouring of concrete. The Contractor will be held responsible for proper position of conduits and shall rearrange any conduit that may be displaced while concrete is poured, without additional cost.
- F. Where conduit runs are to be concealed and the Contractor fails to place such conduit in sufficient time to be included in the structures and the structures are completed without such conduit, the Contractor shall install such runs either concealed or exposed as directed by the Engineer, with no extra payment for additional work or for more conduit than the original lengths.
- G. Embedded conduit shall be run in structural concrete in the center of slabs and walls and above water-stops. Conduit connections shall be made watertight. Confirm that concrete thickness is sufficient for embedding the quantity of conduits intended. Unless specifically shown otherwise on the Contract Drawings or stated in the Specifications, embedded conduits shall be in accordance with the following criteria:
 - 1. Minimum concrete thickness shall be as follows:
 - a. For concrete 16 inches thick and less, the minimum concrete thickness shall be 11.5 inches plus the depth of the largest conduit assembly. The conduit assembly depth shall be from the top of the uppermost conduit to the bottom of the lowest conduit.
 - b. For concrete greater than 16 inches thick, the minimum concrete thickness shall be 13.5 inches plus the depth of the largest conduit assembly.
 - c. For concrete at foundation slabs, an additional inch shall be added to the minimum concrete thicknesses previously stated.
 - 2. Conduit spacing shall be as follows:
 - a. Conduits shall be separated three times outer diameter of larger conduit center to center.
 - b. For multiple conduit layer assemblies, conduits shall be separated vertically three times outer diameter of larger conduit center to center.
 - c. When conduits cross at a given point, the conduits may be in direct contact and the angle of cross shall be 45 degrees or greater. Conduits may also cross within the vertical spacing of a multi-conduit layer assembly.
 - d. When conduits cross a structural expansion joint, conduits shall be separated three times outer diameter of larger conduit fitting center to center.
- H. A run of conduit between outlet and outlet, between fitting and fitting or between outlet and fitting shall not contain more than the equivalent of three quarter bends, including those bends located immediately at the outlet or fitting. The equivalent number of 90° bends in a single conduit run are limited to the following:
 - 1. Runs in excess of 300 feet 0
 - 2. Runs of 300 feet to 201 feet 1
 - 3. Runs of 200 feet to 101 feet 2
 - 4. Runs of 100 feet and less 3
- I. Factory bent elbows or field bent elbows with approved tools may be used. Heating of conduit to facilitate bending is prohibited.
- J. Factory-made conduit bends or elbows shall be used wherever possible in making necessary changes in direction. Field bends shall be carefully made so as to prevent conduit damage or reduction in the internal areas. The radius shall not be less than six times the nominal diameters for the conduit with carefully matched bends on parallel runs so as to present a neat appearance.
- K. All conduits, where cut, shall be carefully reamed to remove burrs. No running threads will be permitted. All screw joints shall be watertight. Conduits shall be fitted in an approved manner to all devices and boxes. The ends of all conduits shall be equipped with suitable approved

SECTION 16131 – ELECTRIC CONDUIT SYSTEM

conduit fittings. The ends of all empty conduits shall stub up six inches above the slab and shall be capped.

- L. All conduits shall be carefully cleaned before and after installation and all inside surfaces shall be free from all imperfections likely to injure the cable. Conduits shall be cleaned in accordance with the following:
 - 1. After erection of complete conduit runs, conduits shall be snaked with a suitable swap to which shall be attached an approved tube cleaner equipped with an approved cylindrical mandrel of a diameter not less than 85 percent of the nominal diameter of the conduit.
 - 2. All conduits through which the mandrel will not pass shall be removed and replaced by the Contractor at his own expense. After snaking, the ends of the dead-ended conduits shall be protected with standard malleable iron caps to prevent the entrance of water or other foreign matter.
 - 3. Conduit ends shall be protected after cleaning with caps to prevent entrance of water, concrete, debris or other foreign substance.
- M. As far as practicable, conduits shall be pitched to drain to outlet boxes or otherwise so installed as to avoid trapping moisture. Trapped conduits in concealed construction shall be provided with outlet boxes for drainage. Where necessary drainage in outlet boxes or where dips are unavoidable in exposed conduits, a drain fitting shall be installed at the low point.
- N. Thruwall type seals and conduit sealing bushings shall be installed for all conduits passing through concrete slabs, floors, walls or block walls.
- O. Conduit runs shall be installed so as to avoid flues, heat sources, steam or hot water pipes. A minimum separation of 12 inches shall be maintained where conduit crosses or parallels hot water, steam pipes or heat sources.
- P. Where conduit enter or leave equipment located within electrical and control rooms the conduit shall be sealed and packed with duct seal compound.
- Q. A 250 pound tested polyethylene pull tape shall be provided in all empty conduits, with a minimum 8 inch of slack, double backed into the conduit. Protect conduit immediately after installation by installing flat non-corrosive metallic discs and steel bushings designed for this purpose at each end. Discs shall not be removed until it is necessary to clean the conduit.
- R. All conduit that is cut on the job shall be cut square and taper reamed to remove burrs before installation. Where steel conduit is cut and threaded on the site, it shall be coated before and after making connections.
- S. Conduits embedded in concrete shall stub up 6 inches above the slab. A three-inch high curb extending three inches from the outer surface of the conduit penetrating the floor shall be provided to prevent corrosion. Conduit stub-ups shall be terminated in couplings, slightly above the finished concrete curb.

3.03 CONDUIT CONNECTIONS TO EQUIPMENT

- A. At each motor, limit switch, solenoid valve, electrical control device or other electrically controlled or operated equipment, install a complete conduit connection between the conduit system and the terminal box of the motor or the conduit connection point of the equipment.
- B. Conduits installed in the conduit system shall be terminated in such locations as to permit direct connections to motors, devices or equipment.
- C. Connections shall be made with rigid conduit if equipment is fixed and not subject to adjustment, mechanical movement or vibration. Rigid connections shall be provided with union fittings to permit removal of equipment without cutting, breaking or burning conduit.
- D. Motors, transformers and equipment subject to adjustment, mechanical movement or vibration shall be connected with flexible metallic conduit.
- E. Devices such as solenoid valves, small limit switches, etc., shall be connected with flexible metallic conduit arranged to prevent strain and distortion.
- F. Flexible conduit connections shall be watertight unless the area of installation requires explosion-proof construction.

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- G. Refer to the end of section 16076 for Cable and Conduit Schedules.

3.04 INSTALLATION OF BOXES AND FITTINGS

- A. All concealed outlet boxes shall be set in such a manner that they will be plumb and flush with the finished surface.
- B. Boxes shall be installed rigidly and securely to the structure. Independent supports shall be provided where no walls or other structural surface exists.
- C. Expansion and expansion/deflection fittings shall be installed where conduits cross structural expansion joints and at locations shown on the Contract Drawings. Fittings shall be installed on each conduit and incorporated into the expansion joints of structures, at right angles to the joint, to insure their proper functioning and preservation.
- D. Expansion fittings shall be installed on exposed conduit runs exceeding 200 feet. Unless specifically shown otherwise on the Contract Drawings or stated in the Specifications, when crossing structural expansion joints larger than one inch, an expansion fitting shall also be installed together with an expansion/deflection fitting. The fittings shall be installed on each conduit run in accordance with manufacture's recommendations to provide the additional movement necessary.
- E. All conduit connections in wet and corrosive locations shall be made up watertight and shall terminate at enclosures with an approved conduit hubs.
- F. All conduit connections in dry and dustless locations shall terminate at enclosures with bushings and lock nuts. Terminations shall include one bushing and two lock nuts at each location. Lock nuts shall be installed one inside and one lock nut outside the enclosure. All conduit shall be bonded to the safety ground.
- G. At pull and junction boxes having any box dimension in excess of 18 inches, jumper type grounding bushings shall be installed on conduit ends and jumper wires shall be installed to bond all conduits and to bond conduits to boxes.
- H. All insulated grounding bushings shall be bonded together and to the structure of the enclosure by a continuous, copper bonding wire.
- I. Removable, flame-retardant, insulating cable supports shall be provided in all boxes with any dimension exceeding 3 feet.
- J. Scratched PVC boxes damaged as a result of installation shall be touched up by field applying PVC. All touch up work shall be in strict conformance with manufacturer's recommendations.

3.05 INSTALLATION WITHIN HAZARDOUS AREAS

- A. Explosion-proof boxes and fittings shall be of a type approved by the Engineer. Boxes and fittings shall be of cast iron with finish as specified hereinbefore or of an aluminum alloy specially developed for use in hazardous areas.
- B. Explosion-proof boxes shall be suitable for the installation of explosion-proof switches, receptacles, lighting fixtures or other devices as indicated. All conduit connections to such boxes shall be made with threaded fittings. Bushings and locknut connections shall not be used.
- C. Conduits terminating at explosion-proof boxes, enclosing circuit opening equipment, shall be sealed at the entrance to the box with an approved compound-filled sealing fitting to prevent passage of explosive or combustible gases through the conduit. Where construction prevents the use of sealing fittings, the ends of the conduits shall be properly sealed with sealing compound.
- D. Sealing fittings shall be installed to seal each conduit leading from or entering into hazardous locations. Exposed conduits passing through hazardous locations shall be sealed at point of exit and entrance.

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- E. The installation of explosion-proof boxes, fittings and all conduits in connection therewith shall conform to the requirements of the National Electrical Code for Class I, Division 1 Group D hazardous location unless specifically noted otherwise.

3.06 FIELD TESTS

- A. After installation, field test the electric conduit system. The field tests shall be witnessed by the Engineer and certified by the Contractor. Provide testing consisting of the following:
 - 1. Test each conduit by pulling through a cylindrical mandrel as specified under paragraph 3.2 K. Maintain a record of all conduits testing clear.
 - 2. Conduit systems shall be ground tested in the presence of the Engineer, who will inspect all enclosures, pull and junction boxes for bonding to the safety green conductor pulled with the nominal 120 volt and higher power and control circuits, and for bonding of the conduit grounding bushing to this safety ground.
 - 3. The separation of above safety grounding system from the instrumentation signal grounding shall be verified.
- B. Provide a Field Test Report. The Report shall identify the testing performed and the results obtained.

END OF SECTION

SECTION 16131 – ELECTRIC CONDUIT SYSTEM

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SECTION 16140 – WIRING DEVICES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provide all labor, equipment and material necessary to furnish, install and test wiring devices, complete, in place, as shown on the Contract Drawings, specified herein and approved by the Engineer.
- B. In general, the wiring devices included under this Section shall include, but not be limited to receptacles and lighting switches.

1.02 REFERENCES

- A. ANSI/NFPA 70 - National Electric Code.
- B. NEMA WD1 - General Purpose Wiring Devices.

1.03 SUBMITTALS

- A. Submit product data under provisions of Section 01300.
- B. Provide manufacturer's catalog information showing dimensions, colors and configuration.

PART 2 - PRODUCTS

2.01 SWITCHES

- A. Due to the large number of possible combinations of devices available, only the most frequently used devices are detailed in the following sections. Where devices are required which are not specified here, the device shall be specified on the Contract Drawings.
- B. Furnish devices with all necessary auxiliary items, as required, for a proper installation and operation such as screws, gaskets, protective boots, explosion proof seals, etc.

2.02 RECEPTACLES – GENERAL PURPOSE

- A. Receptacles: heavy duty, specification grade, duplex type, 125V, 20A, NEMA WD-1, 2 poles and 3 wires grounding type, unless shown otherwise on the Contract Drawings.
- B. Receptacles shall be back and side wired, have a green ground screw terminal, automatic ground clip, fully enclosed in composition case and nylon face. Receptacles shall also have a wrap around bridge with integral ground contacts and heat resistant base for dimensional stability.
- C. Receptacles shall be brown unless shown otherwise on the Contract Drawings. Where brown receptacles are not available for a particular type, receive Engineer's approval for alternate color.
- D. All receptacles shall be corrosion resistant, have an isolated ground, and ground fault interrupter.
- E. The receptacles shall be equal to Hubbell, "5362 Series", or approved equal.
- F. Receptacles for winches shall be equal to Hubbell "9530 Series" 30A, 250V.
- G. Specialty receptacles that have either high amperage or voltage rating, or other configuration, shall be as identified on the Contract Drawings.

2.03 SWITCHES

- A. Switches: heavy duty, specification grade, toggle type, 120/277V, NEMA WD-1, 20A, single pole, unless shown otherwise on the Contract Drawings.
- B. Switches shall be back and side wired, fully enclosed in composition case and shall have rivetless spring contact arm to eliminate stress and weak points. Contacts shall be silver cadmium oxide to eliminate welding. Switches shall have a #8 brass, green ground screw and stainless-steel automatic grounding clip.
- C. Switches shall be brown unless shown otherwise on the Contract Drawings. Where brown switches are not available for a particular type, receive Engineer approval for alternate color.

SECTION 16140 – WIRING DEVICES

- D. Where indicated on the Contract Drawings, provide switches that are double pole, 3-way, 4-way, key operated, illuminated, etc.
- E. The switches shall be equal to Hubbell, "HBL 1220 Series".
- F. Where 15A and 30A switches are shown, they shall be equal to Hubbell, "HBL 1200 Series" and Hubbell, "HBL 3030 Series".
- G. Specialty switches with other configurations shall be as identified on the Contract Drawings.
- H. Switches - Explosion Proof:
 - 1. Switches shall be 125V, 20A, 120/277V, single pole unless shown otherwise on the Contract Drawings.
 - 2. Switches shall be installed in an aluminum-sealing chamber (when factory sealed) and shall have a malleable iron cover with a front operated handle. The handle shall be lockable in either the "on" or "off" position. The cover shall be compatible with the back box finish, such as epoxy powder coated, as specified in Section 16132.
 - 3. The switch housing shall mount onto an appropriate black box with four (4) stainless steel screws.
 - 4. Where indicated on the Contract Drawings, provide switches that are 2-pole, 3-way or 4-way.
 - 5. The switches shall be equal to Appleton Electric Co., "Types EDS and EFS".

2.04 DEVICE PLATES - FLUSH MOUNTED

- A. Device plates for flush mounted devices shall be smooth metal, 302 stainless steel type. Edges shall be contoured with satin finish. Device plates shall be 0.040 inches thick. Screws shall be stainless steel.
- B. Device plate manufacturers and their particular products shall be as follows: General Electric, "93000 Series", Hubbell, "97000 Series".
- C. Device plates for surface mounted devices shall be sheet steel, aluminum, or malleable iron for non-corrosive/weatherproof devices, and shall be die cast aluminum or malleable iron, with gasketed covers for corrosive/weatherproof devices.
- D. All screws shall be stainless steel.
- E. Corrosive/weatherproof device plates shall match the finish of the device box, such as epoxy powder coated, etc., as specified in Section 16131.
- F. The device plates shall be as manufactured by the following: Appleton Electric Co., "Type FSK", Crouse-Hinds, "Types DS and WLR".
- G. Device plates for explosion proof devices are an integral part of the device. The device plate shall be as described in the explosion-proof receptacle and switch paragraphs above.

2.05 HAZARDOUS LOCATION LIMIT SWITCHES

- A. Acceptable Manufacturers: Square D
- B. Contact Form: 1NC/1NO
- C. Actuator Style: Plunger
- D. NEMA Rating: 7,9
- E. Contact Rating: 10A @ 600V AC/DC

2.06 HAZARDOUS LOCATION RECEPTACLES

- A. Acceptable Manufacturers: Crouse-Hinds by Eaton
- B. Protected Class: 1
- C. Degree of protection accd. to EN 60529: IP66
- D. Amperage Rating: 16A
- E. Rated Voltage: 415V

2.07 HAZARDOUS LOCATION LIGHT SWITCHES

- A. Acceptable Manufacturer: Hubbell Killark
- B. Switch type: 1-Pole
- C. Rated Amps: 20 A
- D. Voltage: 120V
- E. Safety Rating: Class 1, Div 1

PART 3 - EXECUTION

3.01 INSTALLATION

- A. All wiring device locations are approximate. Determine the proper location of wiring devices based on field conditions and equipment requirements. Review wiring device locations with Engineer.
- B. General-purpose receptacles shall be mounted 1.5 feet above finished floors (to centerline of receptacle) unless shown otherwise.
- C. Lighting switches shall be mounted 4.5 feet above finished floor (to centerline of switch) unless shown otherwise.
- D. Receptacles and switches shall be mounted at different heights, where necessary, due to field conditions or where required by specific equipment (such as a kitchen stove, water cooler, etc.).
- E. Polarity: Properly wire all receptacles so that the hot wire, the neutral wire and the ground wire connect to the proper terminal on all receptacles.
- F. Grounding: Install all receptacles in boxes specified under Section 16061 and install a No. 12 green ground wire from device grounding terminal to the outlet box in accordance with the National Electric Code.

3.02 BOXES

- A. Boxes used for the wiring devices shall conform to the requirements of Section 16131.

3.03 CIRCUITING

- A. Wiring devices shall be circuited as shown on the Contract Drawings and shall comply with the requirements of the NEC.
- B. All receptacles shall be pigtailed to the supply circuit with #12 AWG wires. Pigtails shall be stranded copper. Pigtail wire colors shall match supply circuit colors. Connection to the supply circuit shall be with properly sized wire nuts.

3.04 DEVICE PLATES

- A. Device plates shall be installed wherever a wiring device is installed. All device plates shall be set true and plumb and shall fit tightly against the finished wall surfaces and device boxes.
- B. Where multiple devices are mounted in a box, gang plates shall be used. Gang plates shall be one (1) piece. Assembled gang plates shall not be allowed.
- C. Where plugs are being furnished with receptacles, connect the plugs to the flexible cords of equipment as directed by the Engineer. Provide all necessary devices for proper connection of plug to flexible cord.

3.05 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects. Operate each wall switch with circuit energized and verify proper operation. Verify that each receptacle device is energized. Test each receptacle device for proper polarity. Test each GFCI receptacle device for proper operation.

END OF SECTION

SECTION 16140 – WIRING DEVICES

SECTION 16140 – WIRING DEVICES

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PART 1 - GENERAL

1.01 - SCOPE

- A. The contractor shall furnish short-circuit and protective device coordination studies as prepared by the equipment manufacturer being furnished on the project. **Third Party Studies Shall Not Be Acceptable.**
- B. The contractor shall furnish an Arc Flash Hazard Analysis Study per the requirements set forth in the current version of NFPA 70E - *Standard for Electrical Safety in the Workplace*. The arc flash hazard analysis shall be performed according to the IEEE Standard 1584-2002, the *IEEE Guide for Performing Arc-Flash Calculations*.
- C. The scope of the studies shall include new distribution equipment supplied under this contract.

1.0 - REFERENCES

- A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 1. IEEE 141 - Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
 - 2. IEEE 242 -Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
 - 3. IEEE 399 - Recommended Practice for Industrial and Commercial Power System Analysis
 - 4. IEEE 241 -Recommended Practice for Electric Power Systems in Commercial Buildings
 - 5. IEEE 1015 - Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
 - 6. IEEE 1584 -Guide for Performing Arc-Flash Hazard Calculations
- B. American National Standards Institute (ANSI):
 - 1. ANSI C57.12.00- Standard General Requirements for Liquid-Immersed Distribution, Power, and .Regulating Transformers
 - 2. ANSI C37.13- Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures

3. ANSI C37.010- Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
 4. ANSI C 37.41- Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.
- C. The National Fire Protection Association (NFPA)
1. NFPA 70 -National Electrical Code, latest edition
 2. NFPA 70E- Standard for Electrical Safety in the Workplace

1.04 - SUBMITTALS FOR REVIEW/APPROVAL

- A. The studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the study may cause delays in equipment shipments, approval from the Engineer may be obtained for a preliminary submittal of data to ensure that the selection of device ratings and characteristics will be satisfactory to properly select the distribution equipment. The formal study will be provided to verify preliminary findings.

1.05 - SUBMITTALS FOR CONSTRUCTION

- A. The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. A minimum of five (5) bound copies of the complete final report shall be submitted. For large system studies, submittals requiring more than five (5) copies of the report will be provided without the section containing the computer printout of the short- circuit input and output data. Electronic PDF copies of the report shall be provided upon request.
- B. The report shall include the following sections:
1. Executive Summary including Introduction, Scope of Work and Results/Recommendations.
 2. Short-Circuit Methodology Analysis Results and Recommendations
 3. Short-Circuit Device Evaluation Table
 4. Protective Device Coordination Methodology Analysis Results and Recommendations
 5. Protective Device Settings Table

6. Time-Current Coordination Graphs and Recommendations
7. Arc Flash Hazard Methodology Analysis Results and Recommendations including the details of the incident energy and flash protection boundary calculations, along with Arc Flash boundary distances, working distances, Incident Energy levels and Personal Protection Equipment levels.
8. Arc Flash Labeling section showing types of labels to be provided. Section will contain descriptive information as well as typical label images.
9. One-line system diagram that shall be computer generated and will clearly identify individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location, device numbers used in the time-current coordination analysis, and other information pertinent to the computer analysis.

1.06 - QUALIFICATIONS

- A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the responsible charge and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.
- B. The Registered Professional Electrical Engineer shall be an employee of the equipment manufacturer or an approved engineering firm.
- C. The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.
- D. The approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analyses it has performed in the past year.
- E. The engineering firm shall have a minimum of twenty-five (25) years of experience in performing power system studies.

1.07 - COMPUTER ANALYSIS SOFTWARE

- A. The studies shall be performed using SKM Systems Analysis Power*Tools for Windows (PTW) software program.

PART 2 - PRODUCT

2.01 - STUDIES

- A. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E -Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D. This study shall also include short-circuit and protective device coordination studies. All studies to be prepared by Square D Engineering Services.

2.02 - DATA

- A. Contractor shall furnish all data as required for the power system studies. The Engineer performing the short circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.
- B. Source combination may include present and future motors and generators.
- C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner, or Contractor.
- D. If applicable, include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.03 - SHORT-CIRCUIT ANALYSIS

- A. Transformer design impedances shall be used when test impedances are not available.
- B. Provide the following:
 - 1. Calculation methods and assumptions
 - 2. Selected base per unit quantities
 - 3. One-line diagram of the system being evaluated that clearly identifies individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location and other information pertinent to the computer analysis
 - 4. The study shall include input circuit data including electric utility system characteristics, source impedance data, conductor lengths, number of conductors per phase,

conductor impedance values, insulation types, transformer impedances and X/R ratios, motor contributions, and other circuit information as related to the short-circuit calculations.

5. Tabulations of calculated quantities including short-circuit currents, X/R ratios, equipment short-circuit interrupting or withstand current ratings and notes regarding adequacy or inadequacy of the equipment rating.
 6. Results, conclusions, and recommendations. A comprehensive discussion section evaluating the adequacy or inadequacy of the equipment must be provided and include recommendations as appropriate for improvements to the system.
- C. For solidly-grounded systems, provide a bolted line-to-ground fault current study for applicable buses as determined by the engineer performing the study.
- D. Protective Device Evaluation:
1. Evaluate equipment and protective devices and compare to short circuit ratings
 2. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short circuit stresses
 3. Square D shall notify Owner in writing, of any circuit protective devices improperly rated for the calculated available fault current.

2.04 - PROTECTIVE DEVICE TIME-CURRENT COORDINATION ANALYSIS

- A. Protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.
- B. Include on each TCC graph, a complete title with descriptive device names.
- C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
- D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
- E. Plot the following characteristics on the TCC graphs, where applicable:
 1. Electric utility's overcurrent protective device

2. Medium voltage equipment overcurrent relays
 3. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands
 4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands
 5. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves
 6. Medium voltage conductor damage curves
 7. Ground fault protective devices, as applicable
 8. Pertinent motor starting characteristics and motor damage points, where applicable
 9. Pertinent generator short-circuit decrement curve and generator damage point
 10. The largest feeder circuit breaker in each motor control center and applicable panelboard.
- F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.
- G. Provide the following:
1. A One-line diagram shall be provided which clearly identifies individual equipment buses, bus numbers, device identification numbers and the maximum available short-circuit current at each bus when known.
 2. A sufficient number of log-log plots shall be provided to indicate the degree of system protection and coordination by displaying the time-current characteristics of series connected overcurrent devices and other pertinent system parameters.
 3. Computer printouts shall accompany the log-log plots and will contain descriptions for each of the devices shown, settings of the adjustable devices, and device identification numbers to aid in locating the devices on the log-log plots and the system one-line diagram.
 4. The study shall include a separate, tabular printout containing the recommended settings of all adjustable overcurrent protective devices, the equipment designation where the

device is located, and the device number corresponding to the device on the system one-line diagram

5. A discussion section which evaluates the degree of system protection and service continuity with overcurrent devices, along with recommendations as required for addressing system protection or device coordination deficiencies.
6. Square D shall notify Owner in writing of any significant deficiencies in protection and/or coordination. Provide recommendations for improvements.

2.05 - ARC FLASH HAZARD ANALYSIS

- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2009, Annex D. The arc flash hazard analysis shall be performed in conjunction with the short-circuit analysis (Section 2.03) and the protective device time-current coordination analysis (Section 2.04)
- B. The flash protection boundary and the incident energy shall be calculated at significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.
- C. Circuits 240V or less fed by single transformer rated less than 125 kVA may be omitted from the computer model and will be assumed to have a hazard risk category 0 per NFPA 70E.
- D. Working distances shall be based on IEEE 1584. The calculated arc flash protection boundary shall be determined using those working distances.
- E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations
- F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location in a single table. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum. Conversely, the maximum calculation will assume a maximum contribution from the utility. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable as well as any stand-by generator applications.

The Arc-Flash Hazard Analysis shall be performed utilizing mutually agreed upon facility operational conditions, and the final report shall describe, when applicable, how these conditions differ from worst-case bolted fault conditions.

- G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors should be decremented as follows:
 - 1. Fault contribution from induction motors should not be considered beyond 5 cycles.
- H. For each piece of ANSI rated equipment with an enclosed main device, two calculations shall be made. A calculation shall be made for the main cubicle, sides, or rear; and shall be based on a device located upstream of the equipment to clear the arcing fault. A second calculation shall be made for the front cubicles and shall be based on the equipment's main device to clear the arcing fault. For all other non-ANSI rated equipment, only one calculation shall be required and it shall be based on a device located upstream of the equipment to clear the arcing fault.
- I. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
- J. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- K. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. A maximum clearing time of 2 seconds will be used based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.
- L. Provide the following:
 - 1. Results of the Arc-Flash Hazard Analysis shall be submitted in tabular form, and shall include device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, working distances, personal-protective equipment classes and AFIE (Arc Flash Incident Energy) levels.
 - 2. The Arc-Flash Hazard Analysis shall report incident energy values based on recommended device settings for equipment within the scope of the study.

3. The Arc-Flash Hazard Analysis may include recommendations to reduce AFIE levels and enhance worker safety.

PART 3 - EXECUTION

3.01 - FIELD ADJUSTMENT

- A. Contractor shall adjust relay and protective device settings according to the recommended settings table provided by the coordination study.

<OPTION>

Field adjustments to be completed by Square D Services under the separate Startup and Acceptance Testing contract portion of project specifications.

- B. Contractor shall make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- C. Square D shall notify Owner in writing of any required major equipment modifications.

3.02 - ARC FLASH LABELS <OPTION>

- A. Square D Engineering Services shall provide a 4.0 in. x 4.0 in. Brady thermal transfer type label of high adhesion polyester for each work location analyzed.
- B. The labels shall be designed according to the following standards:
 1. UL969 – Standard for Marking and Labeling Systems
 2. ANSI Z535.4-Product Safety Signs and Labels
 3. NFPA 70 (National Electric Code)-Article 110.16
- C. The label shall include the following information:
 1. System Voltage
 2. Flash protection boundary
 3. Personal Protective Equipment category
 4. Arc Flash Incident energy value (cal/cm²)

5. Limited, restricted, and prohibited Approach Boundaries
 6. Study report number and issue date
- D. Labels shall be printed by a thermal transfer type printer, with no field markings.
- E. Arc flash labels shall be provided for equipment as identified in the study and the respective equipment access areas per the following:
1. Floor Standing Equipment - Labels shall be provided on the front of each individual section. Equipment requiring rear and/or side access shall have labels provided on each individual section access area. Equipment line-ups containing sections with multiple incident energy and flash protection boundaries shall be labeled as identified in the Arc Flash Analysis table.
 2. Wall Mounted Equipment- Labels shall be provided on the front cover or a nearby adjacent surface, depending upon equipment configuration.
 3. General Use Safety labels shall be installed on equipment in coordination with the Arc Flash labels. The General Use Safety labels shall warn of general electrical hazards associated with shock, arc flash, and explosions, and instruct workers to turn off power prior to work.

Label Installation <OPTION>

- F. Labels shall be field installed by Square D Services. The technician providing the installation shall have completed an 8-Hour instructor led Electrical Safety Training Course with includes NFPA 70E material including the selection of personal protective equipment.

3.03 - ARC FLASH TRAINING <OPTION>

- A. The vendor supplying the Arc Flash Hazard Analysis shall train the owner's qualified electrical personnel of the potential arc flash hazards, associated with working on energized equipment (minimum of 4 hours). The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET) or equivalent. The trainer shall be an authorized OSHA Outreach instructor.
- B. The vendor supplying the Arc Flash Hazard Analysis shall offer instructor led and online NFPA 70E training classes.

+ + END OF SECTION + +

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PART 1 - GENERAL

1.01 - SECTION INCLUDES

- A. The Contractor shall provide all labor, equipment, and material necessary to furnish, install, and test variable frequency drives complete, in place, as shown on the Contract Drawings, as specified herein and approved by the Engineer.
- B. The following equipment shall be provided with variable frequency drives and shall function as specified herein:
 - 1. Three (3) Dry Submersible Pumps (RSP-1, RSP-2, and RSP-3). Speed control at existing SCASA Control Panel (remote) and at the VFD enclosure (local position). The existing SCADA control panel will be provided with a PLC program that will the operator to vary the speed based on the Influent flow. The control panel will generator a proportional 4-20mA signal that shall be used to set the Dry Submersible Pump speed.
- C. Existing SCADA Control panel shall be updated as required by the Electrical Contractor to communicate, monitor, and control the new Dry Submersible Pump VFDs. The Electrical Contractor shall prepare point-to-point interconnection wiring diagrams as specified in Section 16010 and shall otherwise coordinate and manage the VFD manufacturer so as to form unified, properly functioning variable speed systems.

1.02 - REFERENCES

- A. National Electrical Manufacturers Association (NEMA) - No. ICS-1, General Standards for Industrial Control and Systems; No. ICS-2, Industrial Control Devices, Controllers and Assemblies; No. ICS-6, Enclosures for Industrial Control and Systems.
- B. ANSI/NFPA 70 - National Electrical Code.
- C. Underwriters Laboratories, Inc. (UL) - No. 845, Motor Control Centers, Electric.

1.03 – QUALITY ASSURANCE

- A. The Contractor shall comply with ANSI, IEEE, NEMA, UL, and all applicable Federal, State and municipal codes including revisions to date of Contract.
- B. In all cases where a device or part of the equipment is referred to in this Section in the singular (such as motor starter), it is intended that such references shall apply to as may such devices as are required to complete the installation.

SECTION 16260 - VARIABLE FREQUENCY CONTROLLERS

C. Qualifications of Manufacturers:

1. Products used in the work of this Section shall be produced by manufacturers regularly engaged in the manufacturing, installing and servicing of similar items with a history of successful production acceptable to the Engineer as specified herein.
2. Contractor shall submit the following information pertaining to the manufacturer(s):
 - a. Certification that manufacturer has been producing the product for a minimum of five (5) years.
 - b. Complete literature, performance and technical data describing the proposed equipment and listing of items made by the manufacturer.
 - c. Location of closest service office from which this equipment shall be serviced.
 - d. Location of closest parts inventory for item installation.

1.04 – COORDINATION

- A. The Contractor shall coordinate the work of this Section with the General Contractor as it relates to supplying a complete variable frequency drive system for aeration blowers and submersible pumps as shown on the Drawings and noted on Drawing PD-1.
- B. Comply with the requirements contained in Section 013100 and Section 16010.
- C. The Contractor shall review installation procedures under other Sections and contracts and coordinate them with the work specified herein.
- D. The Contractor shall notify other prime contractors in advance of the installation of the work included to provide them with sufficient time for installation and coordination of interrelated items that are included in their contracts and that must be installed in conjunction with the work included in this Section.
- E. The manufacturer will be provided with shop drawings of the Modified SCADA Control panel as work of the General Construction contract for the purposes of providing a complete and functional system. The manufacturer shall be responsible for the design, fabrication and supply of VFD's compatible with equipment and controls furnished under Contract G. The Engineer will supply the Electrical Contractor with the necessary shop drawings submitted as work of other contracts.
- F. The MCC supplier shall furnish point-to-point interconnection wiring diagrams for approval by the Engineer prior to fabrication.

1.05 - FACTORY TESTS

- A. The Contractor shall perform all factory testing (shop tests) as specified herein.
- B. Before shipment, perform factory testing at the manufacturer's facility to verify that system components are functioning properly and that they meet the functional and performance requirements of the Contract Documents. All necessary personnel, equipment, facilities, temporary wiring, and incidentals required for testing shall be provided by the Contractor.
- C. The Contractor shall submit information on factory testing procedures to verify that testing will fulfill the requirements as specified herein. Submittal shall be made at least two (2) months in advance of any scheduled testing and shall include dates of scheduled tests.
- D. The Contractor shall notify Engineer in writing at least four (4) weeks before expected initiation of tests. Factory testing of all VFD panels, enclosures, disconnects, VFD software, and communications shall be witnessed by Owner and Engineer, if desired. Cost of lodging, meals, and travel for the Owner and Engineer are not to be included in the bid price. However, if factory tests are not performed satisfactorily on the agreed date as a result of Contractor's or manufacturer's action, those costs will be borne by the Contractor. The presence of Owner and Engineer during testing does not relieve the Contractor from conforming to the requirements of the Contract Documents and shall in no way imply acceptance of the equipment. The Owner and Engineer reserve the right not to attend factory tests.
- E. The factory test shall not begin until all related VFD Shop Drawings have been submitted and approved.
- F. All system hardware components shall be tested to verify proper operation of the equipment as stand-alone units. Test shall include, but not be limited to, the following:
 - 1. System Checks:
 - a. Input / Output current test.
 - b. Input voltage test.
 - c. Ground fault test.
 - d. Short circuit test.
 - 2. Verify Operator interface communication properties.
 - 3. Verify automatic operation of process trip circuits.

SECTION 16260 - VARIABLE FREQUENCY CONTROLLERS

4. Dynamic System Testing:
 - a. Test drive at 110% full load for one (1) hour at ambient temperature.
 - b. Input / Output current unbalance test.
5. VFD's shall not be shipped from the factory until two copies of certified factory test reports indicating satisfactory performance have been submitted to and approved by Engineer. Factory test reports shall include the following information:
 - a. List of tests performed.
 - b. Certified check lists or documentation verifying all sub-systems has been tested, as specified above.
 - c. Documentation verifying all VFD panel wiring has been checked.
 - d. List of required modifications or corrections identified during the Factory Test and corrective action taken.
 - e. Factory test reports shall be signed and dated by an authorized representative of the VFD drive and the Contractor.

1.06 – SUBMITTALS

- A. Comply with the requirements contained in Section 01300. Submit the following:
 1. Product Data: Manufacturer's specifications and other data demonstrating compliance with these specifications.
 2. Schematic wiring diagrams for drive units.
 3. Point-to-point interconnection wiring diagrams.
 4. Complete shop drawings of all work of this Section, showing dimensions and locations of all items including supporting structures and clearance requirements.
 5. Samples and Test Reports: The Contractor shall submit for review and approval samples of materials, supporting data, and testing methods and results for all materials and tests specified in this Section in accordance with Articles 4 and 5 of the General Conditions.

SECTION 16260 - VARIABLE FREQUENCY CONTROLLERS

6. Operation and Maintenance Manuals: Within thirty (30) days after receiving approved shop drawings, and on a condition of its acceptance, the Contractor shall deliver to the Engineer the materials compiled in accordance with the provisions of Section 01730.
7. Drive submittal shall include any derating required for the selected carrier frequency and the recommended default frequency. Submittal shall be rejected and returned for revision and resubmittal if this information is not provided.

1.08 – MANUFACTURER SUPPLIED FIELD SERVICES

- A. The Supplier shall supply and credit to the Owner the costs for field services as specified in Section 01660 - Quality Control.
- B. The following field services shall be provided as a minimum in accordance with the requirements contained in Section 017500 - Starting and Adjusting:
 1. Five (5) days totaling five (5) trips once the system has been installed to check the completed installation, make all necessary adjustments, startup the system, provide operations and maintenance instruction to the Owner, and otherwise place the system into permanent, fault free operation as specified in Section 01700 - Starting and Adjusting.
- C. Manufacturer's representative, after initial field startup, shall remove all logic PC boards and install, and adjust, a spare set of PC boards. These boards shall remain in the drives and the initial boards shall be provided as spares to the Owner.

1.09 - WARRANTY

- A. The Supplier shall provide a Warranty Certificate typed on company letterhead and signed by an authorized officer of the Supplier. The certificate shall be witnessed by a notary public in the state in which the company headquarters is located. The Warranty Certificate shall be submitted, verbatim and without exception, as follows:

"We, (SUPPLIER) guarantee all components of the system specified in Section 16260 for the Glen Cove Wastewater Treatment Facility specifications to be free from defects in design, materials and workmanship for a period of one (1) year commencing on the date the system was permanently placed on-line.

During the guarantee period, if any part or equipment component is defective or fails to perform when operating at design conditions and if the equipment has been installed and is being operated and maintained in accordance with the written instructions we provided, then we shall repair or exchange such defective part (s).

The replacement or repair of parts normally consumed in service shall include pilot light bulbs and lubrication. These parts only shall be considered as part of routine

SECTION 16260 - VARIABLE FREQUENCY CONTROLLERS

maintenance and upkeep and shall not be considered eligible for exchange free of charge under this Warranty.

Agreed upon this _____ day
(DATE)

by _____ of
(NAME OF AUTHORIZED AGENT)

_____, who,
(NAME OF SUPPLIER)

by signing this document, affirms that he/she is legally authorized to submit this warranty on behalf of the manufacturer.

AUTHORIZED SIGNATURE

DATE

NOTARY

1.10 - DELIVERY, STORAGE AND HANDLING

- A. The system supplier and the Contractor shall comply with the requirements contained in Section 01610 – Product Storage and Handling Requirements.

1.11 - EXTRA MATERIALS

- A. Provide three of each fuse size and type.
- B. Provide one complete set of spare logic boards for each system provided.

PART 2 - PRODUCTS

2.01 - MANUFACTURERS

- A. Variable frequency drives shall be Yaskawa IQPump.
- B. Variable frequency drives shown on drawings are based on Yaskawa IQPump
- C. Substitute Manufacturer shall be responsible to fit drive to dimension of MCC detailed on the drawings.

SECTION 16260 - VARIABLE FREQUENCY CONTROLLERS

2.02 - DESCRIPTION

- A. Provide enclosed variable frequency controllers suitable for operating the indicated loads. Conform to requirements of NEMA ICS 3.1.
- B. Minimum efficiency at full load: 98 percent.

2.03 - ENVIRONMENT RATINGS

- A. Operating Ambient: -10 degrees C to 50 degrees C.
- B. Relative Humidity: 5 to 95% non-condensing, all power ratings.
- C. Altitude: 3,300 feet maximum without derating.
- D. Vibration: 0.006 inches (0.152 mm) displacement, 1G peak.
- E. Shock: 15G peak for 11ms duration (+-1.0 ms).

2.04 - VARIABLE SPEED DRIVE RATINGS

- A. Voltage: 460V AC +/-10%
- B. Frequency: 57 to 63 Hz
- C. Phase: 3-phase
- D. Motor Horsepower: Provide minimum HP for all drives as indicated on Drawings.
- E. Minimum Efficiency: 98% at Full Load
- F. Line Transient Protection: Line transients up to 5,000 volts peak. 320 Joules phase-to-phase 380 Joules phase-to-ground
- G. Logic Power Ride-Thru: 2 seconds or longer
- H. Drive Characteristics: Drive shall use isolated gate bi-polar technology
- I. Control Logic Noise Immunity: Showering arc transients from 350 to 2,000 volts peak
- J. Voltage: 0 to applied input voltage, 480V AC, maximum output voltage shall not exceed applied input voltage.
- K. Frequency Range: 0.1 to 400 Hz with local programmable minimum and maximum limits

SECTION 16260 - VARIABLE FREQUENCY CONTROLLERS

- L. Frequency Output Resolution: 0.01 Hz
- M. Volts-per-Hertz: Fully programmable minimum 1 to 14.3 V/Hz through local programming
- N. Intermittent Overload Capability: Programmable MOPC from 50 to 150% of rated output current for up to 1 minute maximum
- O. Carrier Frequency: Carrier frequency shall be adjustable from 1KHZ up to 15 KHZ.
- P. Employ switching power supply operating off DC link. Design for ability to operate controller with motor disconnected from output.
- Q. Design to attempt ten automatic restarts following a non-volatile fault condition before locking out and requiring manual restart.
- R. Overtorque protection and multi-Speed operation. Acceleration/Deceleration operation shall have capabilities for linear or s-curve ramp operations.
- S. In case of sustained power loss, the control shall shut down safely without component failure. In the event of momentary power loss, the control shall shut down safely without component failure. Upon return to power the system shall automatically return to normal operation, being able to restart into a rotating motor, regaining positive speed control without power failure.
- T. Drive shall have two and three wire control capability. Drive shall have Energy Saving Voltage reduction during lightly loaded motor condition. Drive shall have PID control capability or accept external PID control capability. Drive shall have full range automatic torque boost.
- U. Analog Inputs: 4-20 mA DC or 0-10V DC.
- V. Drive shall have five (5) programmable output control contacts for external interface with remote control panels as confirmation that the motor was called to start. Show this on the point-to-point interconnection diagram.
- W. Drive shall have nine (9) input preset speed inputs.
- X. Keypad shall be English with 2-line by 16-character LCD display.
- Y. Drive shall have built-in overload relay.

2.05 - VARIABLE SPEED DRIVE SYSTEM

- A. The variable speed drive system shall include a diode bridge converter, filter network and a transistorized inverter section. Base driver signals used to control firing of the power transistors shall be designed with optically coupled isolators for optimum drive protection. The output shall be sinusoidal wave, pulse width modulated, voltage waveform for reduced harmonic heating in the motor. The systems shall include all the necessary control circuits, synchronizing the equipment and protective devices as required by design. The drive unit shall be able to withstand a phase-to-phase and a phase-to-ground short without damage to the drive unit.
- B. The systems protection as a minimum shall provide the following:
 - 1. Current Limit: 115% of rated current
 - 2. Overcurrent: 180% of rated output current IET (trip fault)
 - 3. Short-circuit: Phase-to-phase (trip fault)
 - 4. Overvoltage: High D.C. bus voltage (trip fault)
 - 5. Undervoltage: 20% below line voltage (trip fault)
 - 6. Momentary Power Failure: 30 to 500 milliseconds
 - 7. Burn-out: D.C. bus fuse protection or 3 phase input fusing
 - 8. Alarms: Fault contact (Form C)
 - 9. Digital Indication
 - 10. Individual Fault Condition: Overcurrent of a transistor. Output overcurrent or short-circuit. Overcurrent while running. Thermal overload. Overvoltage of the D.C. bus due to regeneration. Overvoltage of the D.C. bus due to high line voltage. Overtemperature of the enclosure and ground fault shall also be provided.
 - 11. LED Indication: D.C. bus capacitor charge
 - 12. Stall Protection: Prevents current limit activation during overload condition to prevent stall
 - 13. Ground Fault: Detects output short-circuit due to a ground (trip fault)
 - 14. Voltage Limit: Prevents the overvoltage of the D.C. bus during deceleration.

SECTION 16260 - VARIABLE FREQUENCY CONTROLLERS

15. Acceleration & Deceleration Time: Fully programmable.
- C. The system parameters shall be shown on the digital display meter before, during, and after the adjustment. The digital display shall indicate the actual setting of the adjustment, not percentage of setting. The following adjustment shall be provided:
1. Acceleration: 0.1 to 60 seconds
 2. Deceleration: 0.1 to 60 seconds
 3. Upper Frequency Limit: 0 to 80 Hz
 4. Lower Frequency Limit: 0 to 80 Hz
 5. Auto Reference Bias: 0 to 80 Hz
 6. Auto Reference Gain: 0 to 80 Hz
- D. The unit shall be self-protecting to prevent any misadjustments by the operator. The upper limit cannot be set below the lower limit, and will signal the operator of this misadjustment.

2.06 – DRIVE AND MCC FEATURES

- A. Operator Interface with Display: Each VFD shall be provided with an operator interface with digital display to set VFD parameters and motor speed and to indicate output voltage, output frequency, and output current. Display shall be flush mounted on the MCC section enclosure door containing the VFD unit.
- B. Elapsed Time Meter: LED type flush mounted on the MCC section enclosure door containing the VFD unit.
- C. A separate line voltage monitor shall be included in the motor control center for each motor to interlock motor when either undervoltage, overvoltage phase loss or phase reversal occurs.
- D. Input Signal: All units shall be furnished to accept a 4- 20 mA control signal.
- E. Disconnecting Means: Include integral circuit breaker on the line side of each controller.
- F. Each MCC section containing the VFD unit shall be equipped with the following:
1. 0 to 30 mA D.C. ammeter to monitor 4-20 mA input signal from PID controller, (3-1/2 square minimum).

SECTION 16260 - VARIABLE FREQUENCY CONTROLLERS

2. Two position selector switch marked "DRIVE / BYPASS". When placed in the "DRIVE" position the motor shall start via the VFD. When placed in the "BYPASS" position the motor shall start via a bypass motor starter installed within the same MCC section as the VFD.
3. Ammeter and four position phase selector switch
4. Sewage Pumps Speed Control: Each unit shall have a front panel mounted "HAND/OFF/REMOTE" three position selector switch. Speed control when in "HAND" shall be based on the setting input via the operator interface. When in "OFF" position the unit shall not run. When in "REMOTE" position the unit shall be controlled by the remote SCADA control panel:
5. Power on push-to-test white pilot light mounted on the MCC section enclosure door.
6. VFD fault push-to-test amber alarm pilot light mounted on the MCC section enclosure door.
7. VFD run push-to-test amber alarm pilot light mounted on the MCC section enclosure door.
8. Overload push-to-test amber alarm pilot light mounted on the MCC section enclosure door.
9. Overload fault reset pushbutton mounted on the MCC section enclosure door.
10. 0-10 units D.C. analog amp meter to represent the motor speed in percent of full speed.
11. Isolation contactor, output contactor and bypass contactor (NEMA Rated)
12. Auxiliary NO and NC contacts
13. Lightning/surge arrester with individual line-to-line and individual line to ground protection. Clamping voltage levels shall be specifically sized for the applied system voltage.
14. Pilot lights and switches shall be door mounted as part of a door mounted control station. The control station shall be removable for the purpose of mounting and wiring the pilot devices. Contact blocks of the pilot devices shall be mounted in a recessed control station housing to minimize the hazard of accidental contact when the unit door is opened.

SECTION 16260 - VARIABLE FREQUENCY CONTROLLERS

15. Each MCC section equipped with a VFD shall be equipped with a large capacity cooling fan with finger guard to increase air circulation within the section.
- B. Provide solid-state overload relay on load side of bypass contactor and thermal overload relay on load side of output contactor as specified in Section 262913.
- C. Fast acting fuses on load side of main circuit breaker sized in accordance with manufacturers recommendations.
- D. Isolated 4-20 mA input for follower signal input.
- E. 4-20 mA scaled output proportional to drive speed. Input to PLC.
- F. Drive shall have three inputs for preset speeds initiated by remote contacts.
- G. Drive shall have speed contacts to close when speed is reached and be input to the PLC.
- H. Each variable speed drive have the following:
 1. Dynamic Braking Module and Resistor. Resistors shall be mounted at the top of the MCC. The dynamic brake module shall be inside the MCC.
 2. Broad Band Harmonic Filter for compliance with IEEE 519-1992.
- I. A critical speed avoidance circuit shall be included for the selection of three critical speeds with a rejection band centered on that speed. The drive shall ignore any speed signals requiring drive operation within the rejection band.
- J. PID (Proportional-Integral-Derivative) process controller shall be included, and shall be provided with a menu driven selection and programming via door-mounted keypad.
 1. Provide Acceleration/Deceleration time separately adjustable from 2 to 60 seconds. Set both initially at 45 seconds.
 2. When called upon to stop, the motor shall decelerate to minimum speed before stopping.
 3. Auto restarting after controller faults shall function in the "Auto" mode, and shall disable the drive after a pre-determined number of faults have occurred.
 4. The number of automatic restarts shall be set based on the on specific experience or equipment manufacturer's recommendations.

SECTION 16260 - VARIABLE FREQUENCY CONTROLLERS

- K. Each VFD shall include a comprehensive microprocessor based digital diagnostic system that monitors its own control functions and displays faults and operating conditions.
- L. Microprocessor systems must be products of the same manufacturer as the VFD (to assure single source responsibility, availability of service and access to spare parts).

2.07 – VARIABLE SPEED DRIVE FILTER NETWORK

- A. Interface between the outputs of the PID controllers and the variable speed drive analog inputs shall be provided with custom designed filter networks to attenuate both common mode and normal mode voltage transients induced by the drives.
- B. Filter networks shall be Model No. ECC-0231 as manufactured by Eagle Control Corporation, Yaphank, New York or approved equal.

2.08 - FABRICATION

- A. Wiring Terminations: Match conductor materials and sizes indicated.
- B. Enclosure: NEMA 250, Open Type.
- C. Finish: Manufacturer's standard enamel.

2.09 - SOURCE QUALITY CONTROL

- A. Inspect and production-test each product specified in this Section.
- B. Test shall include simulated operation.
- C. Notify Engineer at least five (5) days prior to test. Owner or Engineer may witness test.

PART 3 - EXECUTION

3.01 - INSTALLATION

- A. Controllers shall be factory installed in the motor control center by the MCC manufacturer. Install controller in accordance with manufacturer's written instructions and NEMA ICS 3.1.
- B. Tighten accessible connections and mechanical fasteners after placing controller. Install fuses in fusible switches.
- C. Select and install overload heater elements in controllers to match installed motor characteristics.

SECTION 16260 - VARIABLE FREQUENCY CONTROLLERS

- D. Provide engraved plastic nameplates as specified in Section 16075 – Identification for Electrical Systems.
- E. Provide neatly typed label inside each motor controller door identifying motor served, nameplate horsepower, full, load amperes, code letter, service factor, and voltage/phase rating.

3.02 - ADJUSTING

- A. Make final adjustments to installed drive to assure proper operation of system. Obtain performance requirements from installer of driven loads.

3.03 - DEMONSTRATION

- A. Demonstrate operation of controllers in automatic and manual modes.
- B. Provide the services of the manufacturer's trained personnel to completely check the VFD system installations and adjust the drive for operation.

+ + END OF SECTION + +

SECTION 16260 - VARIABLE FREQUENCY CONTROLLERS

+ + NO TEXT ON THIS PAGE + +

SECTION 16300 - MOTOR STARTERS

PART 1 - GENERAL

1.01 – SCOPE OF WORK

- A. This Section includes all labor, equipment, and materials necessary to furnish and install solid state reduced voltage motor controllers herein referred to as soft starts.

1.02 - REFERENCES

- A. National Electrical Manufacturers Association (NEMA) - No. ICS-1, General Standards for Industrial Control and Systems; No. ICS-2, Industrial Control Devices, Controllers and Assemblies; No. ICS-6, Enclosures for Industrial Control and Systems.
- B. ANSI/NFPA 70 - National Electrical Code.
- C. Underwriters Laboratories, Inc. (UL) - No. 845, Motor Control Centers, Electric.

1.03 – QUALITY ASSURANCE

- A. The soft start motor starter shall be listed by an independent testing laboratory in accordance with Electric Industrial Control Equipment Specification UL508.
- B. The soft start shall carry the CE mark for indication of compliance to low voltage and EMC directives.
- C. The manufacturer shall be a certified ISP 9002 facility.
- D. The equipment shall be manufactured by Siemens/Furnas.
- E. The brand name product specified was chosen based on past performance, and constitute a standard for quality and performance for the specific purpose for which it is intended. Products other than that specified will be considered for use under the provisions set forth as follows:
 - 1. The named products constitute the “Base Bid” system. All bidders are advised to provide “Base Bid” pricing since the magnitude of the expenses involved with engineering redesign or modifications may be difficult to determine during the bidding period. Refer to Section 012500 - Product Options regarding product substitutions.
 - 2. If an alternate unit is proposed, the Supplier shall prepare and submit to the Engineer three (3) copies of the “Evaluation Documentation” as listed below. The information shall be in a form that is neat, clear, precise, legible and computer drafted and prepared so as to allow the Engineer to evaluate the proposed equipment. The “Evaluation

SECTION 16300 - MOTOR STARTERS

Documentation" shall be hand delivered directly to the Engineer at least fifteen (15) calendar days prior to the date set for the bid opening. The pre-bid "Evaluation Documentation" shall consist of the following:

- a. Descriptive technical information for the proposed product(s) highlighted to show the differences between the proposed unit(s) and the specified unit(s). Descriptive technical information shall include model numbers, type, sizes, weights, performance data, and materials of construction.
 - b. List of facilities showing facility name, active contact name and telephone number, years in service, design conditions and parameters and design engineer's name and current telephone number of the company.
 - c. Equipment cuts showing dimensional data for all enclosure components.
3. The Supplier shall state if he/she is in compliance with each and all Sections of the Specifications. Any variance from the specified equipment shall be listed and a description of each variance must be in letter form. Facsimile transmissions will not be accepted.
 4. Failure to submit the above listed information fifteen (15) calendar days prior to the date set for the bid opening shall be cause for non-evaluation and the product will not be considered for the project.
- F. The Engineer will issue an addendum of approved products prior to the date set for the bid opening.
 - G. The acceptance of products prior to the bid date does not relieve the Contractor of his/her responsibility regarding the performance or ability to meet the requirements of the Contract Documents.
 - H. After Contract execution, the Contractor shall submit shop drawings of the system as specified herein and in compliance with the requirements contained in Section 01300 - Submittals. The Contractor shall remain fully responsible for all design revisions, including but not limited to, the following: structural, mechanical, electrical, and instrumentation because of utilization of substitute equipment. Refer to Section 12500 - Product Options for costs associated with redesigns and/or modifications caused by the use of a substitute product offered by the Contractor.
 - I. All costs, including other prime contractor, engineering, and legal costs, associated with accommodating alternate equipment shall be borne by the Contractor.

SECTION 16300 - MOTOR STARTERS

1.04 - WARRANTY

- A. The equipment furnished under this Section shall be free of defects in design, workmanship, and materials for a period of one (1) year commencing on the date that the equipment was placed in fault free operation. The manufacturer shall repair or replace a defective component during the warranty period free of all charges, including labor.

1.05 - SUBMITTALS

- A. Submit product data under provisions of Section 01300.
- B. Technical data including, but not limited to electrical ratings, dimensions, mounting, material, running overcurrent protection, branch circuit overcurrent protection, wiring diagrams and accessories.
- C. Operations and Maintenance Manuals prepared in accordance with the requirements contained in Section 017823.

1.06 – RECORD DRAWINGS

- A. Comply with the requirements contained in Section 01720.

1.07 – MANUFACTURER SUPPLIED FIELD SERVICES

- A. The Supplier shall supply and credit to the Owner the costs for field services as specified in Section 01660 - Quality Control.
- B. The following field services shall be provided as a minimum in accordance with the requirements contained in Section 017500 - Starting and Adjusting:
 - 1. Three (3) days totaling three (3) trips once the system has been installed to check the completed installation, make all necessary adjustments, startup the system, provide operations and maintenance instruction to the Owner, and otherwise place the system into permanent, fault free operation as specified in Section 017500 - Starting and Adjusting.
 - 2. Two (2) days, two (2) trips, approximately three (3) and six (6) months after system startup to review the operation with the plant superintendent and the Engineer and to make system adjustments, as necessary. Dates shall be selected by the Owner and may be used by the Owner any time within a one-(1) year period from the date of initial startup.

PART 2 – PRODUCTS

2.01 - MANUFACTURERS

A. Full Voltage Non-Reversing and Reversing (FVNR):

1. SIEMENS, Class 14.
2. Specifically approved equal.

2.02 - MOTOR STARTERS

A. Motor starters shall have the following features:

1. Enclosed type as shown on the Drawings.
2. Circuit breakers within the motor controller enclosures shall have external operating handles with lock-open padlocking provisions and shall indicate the ON and OFF positions.
3. Motor Control Circuits:
 - a. Shall operate at not more than 120 volts.
 - b. Shall be grounded except as follows:
 - 1) Where isolated control circuits as shown.
 - 2) Where manufacturers of equipment assemblies recommend that the control circuits be isolated.
 - c. Incorporate a separate, heavy duty, control transformer within each motor controller enclosure to provide the control voltage for each motor operating over 120 volts.
 - d. Incorporate overcurrent protection for control power transformers in accordance with NFPA 70.
4. Overload Current Protective Devices:
 - a. SIEMENS, Solid State Model ESP100 overloads for all contactors including bypass contactors. Provide only SIEMENS thermal overloads on all output contactors for variable speed drives.

SECTION 16300 - MOTOR STARTERS

- b. One for each pole.
 - c. Manual reset on the door of each motor controller enclosure to reset Motor from any condition which tripped motor, such as high pressure, overload or incomplete valve cycle.
 - d. Correctly sized for the associated motor's rated full load current.
- 5. Provide three (3) N.C. and (3) N.O. auxiliary contacts, H-O-A,O-C-A, sequence selectors selector switches, pilot lights, and other devices and accessories as shown on the Drawings for each starter.
- 6. Elapsed non-resettable time meters as indicated on the Drawings. As manufactured by Fourth Dimension, 2-1/2" diameter minimum.
- 7. Ammeters and 4 position phase selector switch (3-1/2" Square minimum) as manufactured by SIMPSON.
- 8. Provide current and potential transformers for all three phases for ammeters and voltmeters.
- 9. Voltmeters and seven position selector switches (3 1/2" square minimum) as manufactured by SIMPSON.
- 10. Enclosures:
 - a. Shall be the NEMA Type 1.
 - b. Where the types of motor controller enclosures are not indicated, they shall be the NEMA types which are the most suitable for the environmental conditions where the motor controllers are being installed.
 - c. Doors mechanically interlocked to prevent opening unless the breaker or switch within the enclosure is open.
 - d. Thoroughly clean and paint the enclosures at the factory with manufacturer's prime coat and standard finish.
- 11. Pilot lights shall be press-to test 30.5 mm Heavy Duty Oiltight pushbuttons.
- 12. Pushbuttons and selector switches shall be 30.5 mm Heavy Duty Oiltight.

SECTION 16300 - MOTOR STARTERS

- B. Motor controllers incorporated with equipment assemblies shall also be designed for the specific requirements of the assemblies.

2.03 - FULL VOLTAGE STARTERS

- A. All Full Voltage Starters shall be NEMA rated for the load it serves.
- B. Manufacturers: SIEMENS, Class 14.

2.04 - MISCELLANEOUS CONTROLS AND EQUIPMENT

- A. Provide phase failure/phase reversal relays and voltage sensitive relays for undervoltage and overvoltage protection for all phases. Relays shall be SIEMENS, or approved equal. The Contacts for these relays shall be in series with all Motor Starter Control Circuits.

PART 3 - EXECUTION

3.01 - INSTALLATION

- A. Installation shall be in accordance with NFPA 70 and as shown on the Drawings.
- B. All starters shall be factory installed in the Motor Control Center.

+ + END OF SECTION + +

PART 1 – GENERAL

1.01 – SECTION INCLUDES

- A. Magnetic motor starters.

1.02 – REFERENCES

- A. NFPA 70 - National Electrical Code.
- B. NECA "Standard of Installation," published by National Electrical Contractors Association.
- C. NEMA ICS 2 - Industrial Control Devices, Controllers and Assemblies.
- D. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
- E. NEMA KS 1 - Enclosed Switches.

1.03 – SUBMITTALS

- A. Refer to drawing for starter sizes on schedules.
- B. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.
- C. Test Reports: Indicate field test and inspection procedures and test results.

1.04 – QUALITY ASSURANCE

- A. Perform Work in accordance with NECA Standard of Installation.

1.05 – RELATED SECTIONS

- A. Section 260529 – Hangers and Supports for Electrical Systems.

1.06 – QUALITY ASSURANCE

- A. Perform work in accordance with NEMA ICS 2.3.

1.07 – REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.

SECTION 16310 – COMBINATION MOTOR CONTROLLERS

- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

1.08 – EXTRA MATERIALS

- A. Ten (10) spare pilot light bulbs.

PART 2 - PRODUCTS

2.01 - MANUFACTURERS

- A. SIEMENS, Class 18. Combination Heavy Duty Starter.
- B. SIEMENS, Class 32. Two Speed Heavy Duty Starter.
- C. Substitutions: Under provisions of Section 012500.

2.02 - AUTOMATIC CONTROLLERS

- A. Combination Magnetic Motor Controllers: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower.
- B. Motor starters shall be NEMA rated.
- C. Coil operating voltage: Coordinate voltage required with equipment to be installed and associated contractor(s).
- D. Auxiliary contacts: NEMA N/O Contacts rated up to 10 Amp. SIEMENS Model No. 49AAFO.
- E. Overload Relay: NEMA ICS; melting alloy overload.
- F. Enclosure: As shown in contract drawings.
- G. Circuit Breaker Disconnect Switch with external lockable handle.
- H. Incorporate a separate, heavy duty, control transformer within each motor controller enclosure to provide the control voltage for each motor operating over 120 volts.
 - a. Control transformer shall be 24V rated (U.O.N. on drawings), and sized to accommodate all pilot devices, motor starter coils, control relays and motorized louvers/dampers.

2.03 - PRODUCT OPTIONS AND FEATURES

- A. Auxiliary Contacts: NEMA ICS 2, 1 each normally open/closed contacts.
- B. Motor Running and overload indication lights. Pilot lights shall be heavy duty 30.5 mm oiltight press-to-test by SIEMENS or equal.
- C. Selector Switches: Hand-off-automatic selector switch shall be heavy duty 30.5 mm oiltight by SIEMENS or equal.
- D. Manual reset push button for overload.

PART 3 - EXECUTION

3.01 - INSTALLATION

- A. Install enclosed controllers size as indicated, on starter schedule, in accordance with manufacturer's instructions.
- B. Install enclosed controllers plumb in locations indicated on drawings. Provide supports in accordance with Section 16070.
- C. Select and install overload heater elements in motor controllers to match installed motor characteristics.
- D. Provide engraved plastic nameplates for each starter.
- E. Provide neatly typed label inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor and voltage/phase rating.

+ + END OF SECTION + +

SECTION 16310 – COMBINATION MOTOR CONTROLLERS

+ + NO TEXT ON THIS PAGE + +

SECTION 16440 – DISCONNECT SWITCHES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Local disconnect switches.

1.02 RELATED SECTION

- A. Section 16076 – Labeling and Identification.
- B. Section 16131 – Electric Conduit System

1.03 REFERENCES

- A. NEMA KS-1 - Enclosed Switches.
- B. All disconnects are non-fused.
- C. FS W-S 865 - Switch, Box (Enclosed), Surface Mounted.

1.04 SUBMITTALS

- A. Submit product data under provisions of the General Conditions and as specified under Division 1 of the Specifications.
- B. Submit drawings with dimensions and equipment ratings for voltage, capacity, horsepower, and short circuit current ratings.

1.05 EXTRA MATERIALS

- A. Provide one complete set of spare fuses based on number of poles of fuses for each fused disconnect switch.

PART 2 - PRODUCTS

2.01 DISCONNECT SWITCHES

- A. Disconnect switches shall be GENERAL ELECTRIC, heavy-duty Type TH, SQUARE-D Class 3130, CUTLER HAMMER Type DH or approved equal. Explosion proof disconnect switches shall be Crouse-Hinds Type EBM, Appleton Type EDS, or approved equal.
- B. 75C conductor ratings.
- C. Quick-break, quick-make, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF and ON position.
- D. Suitable for use as service entrance equipment where required.
- E. Non-fused.
- F. Enclosures: NEMA 4X stainless steel unless otherwise noted on electrical drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General:
 - 1. Mount equipment rigidly and securely to the building structure or to supporting devices, which are rigidly and securely supported to the building structure.
 - 2. All equipment shall be fastened with bolts and expansion shields on concrete or brick, with toggle bolts or hollow masonry units, and with machine screws or welded studs on steel rack.
 - 3. All mounting hardware shall be stainless steel.
 - 4. Mount equipment with sides parallel or perpendicular to walls or equipment, such that the local control station is installed in a neat and professional manner.
 - 5. Install all equipment such that door swing is not hampered.
- B. Grounding:
 - 1. Ground disconnect switches in accordance with NEC requirements.
 - 2. The use of two (2) locknuts and a grounding bushing will be required at all conduit terminations where hub type fittings are not required.

SECTION 16440 – DISCONNECT SWITCHES

C. Wires:

1. The wires within the equipment shall be neatly harnessed to prevent the door damaging the wires and to prevent the wires hampering the door operation.
2. All wires shall have identification markers on each end.
3. Marker numbers shall match the terminal block numbers.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Requirements for providing panelboards. Panelboards shall be provided in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.
- B. The panelboards shall include all power distribution, lighting, appliance and instrument panels.

1.02 RELATED SPECIFICATIONS

- A. Specification 16076 - Labeling and Identification

1.03 PAYMENT

- A. Payment for panelboards shall be made as provided in the proposal item no. 2 of the Specifications, unless noted otherwise in the specifications or drawings.

1.04 REFERENCES

- A. Panelboards shall comply with the latest applicable provisions and recommendations of the following:
 - 1. NFPA 70, National Electrical Code.
 - 2. UL Standard No. 50, Enclosures for Electrical Equipment.
 - 3. UL Standard No. 67, Panelboards.
 - 4. UL Standard No. 489, Molded Case Circuit Breakers.
 - 5. UL Standard No. 943, Ground Fault Circuit Interrupters.
 - 6. NEMA PB1, Panelboards.
 - 7. NEMA AB1, Molded Case Circuit Breakers.

1.05 SUBMITTALS

- A. Submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions and as specified under Division 1 of the Specifications.
- B. Working Drawings:
 - 1. Manufacturer's technical information for the panelboards proposed for use including all components.
 - 2. A listing of the panelboards with the number and size of circuit breakers identified.
 - 3. Dimensional drawings showing panelboard enclosure details.
 - 4. Panelboard anchorage details with design calculations signed by licensed Engineer.
- C. Certificates of Compliance: Seismic qualification certification from the manufacturer including mounting recommendations.
- D. Reports: Shop test reports shall be submitted.
- E. Submit Operations and Maintenance Manuals in accordance with the Specifications.

1.06 QUALITY ASSURANCE

- A. General:
 - 1. All panelboards shall conform to the applicable NEMA and UL Standards and shall be built by one approved manufacturer who shall use only best commercial materials and processes of manufacture.
 - 2. All panelboards shall be UL listed.
 - 3. The panelboards manufacturer shall use a shop test facility that has recently calibrated testing apparatus and qualified, experienced technicians, for all shop tests. Calibration of testing apparatus shall be within one year.
 - 4. All test equipment and instrument calibration shall be in accordance with the latest edition of the accuracy standard of the U.S. National Institute of Standards and Technology.
- B. The panelboards shall be designed, constructed and installed suitable for earthquake regulations in accordance with the seismic requirements of the Nassau County Building Code and the Uniform Building Code for zone 2A application.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Panelboards shall be delivered, stored, and handled in accordance with the Specifications and the manufacturer's recommendations.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Panelboards shall be manufactured by Square D by Schneider Electric, Cutler-Hammer, Siemens, General Electric Company or approved equal.

2.02 PANELBOARDS

- A. General:
 - 1. The panelboards shall be dead-front type with automatic trip-free, bolt-on, molded case circuit breakers.
 - 2. The panelboards shall be equipped with main breakers or main lugs, branch circuit breakers, 1-pole, 2-pole and 3-pole, as shown on the Contract Drawings.
 - 3. The panelboards shall be enclosed in flush or surface mounted cabinets as shown on the Contract Drawings.
- B. Ratings:
 - 1. Panelboard ampacities, voltage, number of phases and wires shall be as shown on the Contract Drawings. Panelboard frequency shall be 60 Hz.
 - 2. Panelboards shall be labeled with a UL short circuit rating. All panelboards shall be fully rated.
 - 3. Panelboards rated 240VAC or less shall have a short circuit rating of 22,000A RMS symmetrical, unless shown otherwise on the Contract Drawings.
 - 4. Panelboards rated 480VAC shall have a short circuit rating of 65,000A RMS symmetrical, unless shown otherwise on the Contract Drawings.
- C. Bus Bars:
 - 1. Bus bars shall be copper sized in accordance with UL standards to limit temperature rise on any current carrying part to a maximum of 65 degrees C above an ambient of 40 degrees C maximum.
 - 2. Bus bar taps for single-pole branches shall be arranged for sequence phasing of the branch circuit devices.
 - 3. A bonded ground bus shall be included in all panels.
 - 4. Full-size neutral bars shall be provided for panelboards, unless noted otherwise on the Contract Drawings.
 - 5. Where specifically shown on the Contract Drawings or stated in the Specifications, panelboards shall be provided with a 200 percent rated neutral bus suitable for use with non-linear loads. Neutral busing shall have a suitable lug for each outgoing feeder requiring a neutral connection.
- D. Cabinets:
 - 1. Cabinets shall be constructed of 12-gauge galvanized steel with stainless steel hardware. Fronts shall have doors over circuit breakers and trims of proper width. Doors shall be fastened to the trims with concealed hinges and shall be equipped with flush-type catches and locks. All locks shall be keyed alike.
 - 2. Cabinets shall have wiring gutters on the sides. Cabinets shall be at least 5-3/4 inches deep and 20 inches wide for panelboards with maximum branch circuit breakers of 100A. When branch circuit breakers are above 100A, cabinets shall be at least 9-1/2 inches deep and 31 inches wide.
 - 3. Cabinets shall be NEMA 12 for dry, indoor areas and NEMA 4X for corrosive areas. In hazardous locations, panelboards shall have a NEMA 7 rating.
 - 4. Cabinets shall have identifying nameplates in accordance with the requirements of Specification 16076 - Labeling and Identification.
 - 5. All panelboard directories shall have both the equipment name and the tag identification number. Where this will not physically fit in the standard panelboard directory, an

SECTION 16441 – PANELBOARDS

additional expanded directory mounted behind the standard directory shall be supplied containing the above information. All directories shall be typewritten, not handwritten.

- E. Circuit Breakers:
 - 1. Circuit breakers shall be the molded case type conforming to NEMA Standard AB-1.
 - 2. Breakers shall be the bolt-on type with quick-make, quick-break, toggle mechanism for manual as well as automatic operation. Breakers shall have 100-amp frames, with 15-amp trip elements as minimum, unless otherwise shown on the Contract Drawings. All 100-amp frame breakers shall be fixed thermal magnetic trip units. Frame sizes above 100 amp shall have interchangeable thermal magnetic trip units.
 - 3. Where specifically shown on the Contract Drawings or stated in the Specifications, breakers shall be provided with electronic trip units. Electronic trip units shall provide long time, short time, instantaneous and ground fault settings and time adjustments as minimum.
 - 4. Where specifically shown on the Contract Drawings or stated in the Specifications, ground fault circuit interrupters shall be provided. Ground fault breakers shall be equipped with solid state sensing and 5 milliamp sensitivity.
 - 5. Breakers used for lighting circuit switching shall be suitable for the purpose and shall be marked "SWD". Breakers requiring continuous operation shall be provided with a lock-on device.
 - 6. Where specifically shown on the Contract Drawings or stated in the Specifications, shunt trips, bell alarms, and auxiliary devices shall be provided.
- F. Directories:
 - 1. Provide each panel with a directory. Panel directories shall be typewritten and shall have designations of each branch circuit. The directory shall be protected by a glass or noncombustible plastic cover.
 - 2. Maintain in each panel, during the duration of the Contract, a handwritten directory clearly indicating the circuit breakers in service and the number of spares. This directory shall be updated as work progresses, and final, typewritten directories shall be provided at the end of the Contract.
 - 3. Where execution of the work under this Contract requires certain circuits to be modified, update the panelboard directories if available to reflect the modifications. Final typewritten directories shall be provided at the end of the Contract.

2.03 PAINTING

- A. All metal surfaces of the panelboard enclosures shall be thoroughly cleaned and given one coat of zinc chromate primer. All interior surfaces shall then be given one shop finishing coat of a nitro-cellulose enamel lacquer.
- B. All exterior surfaces shall be given three coats of the same lacquer. The color of finishing coats shall be light gray ANSI No. 61.

2.04 SHOP TESTS

- A. Shop tests shall be performed at the panelboard's manufacturer's plant prior to shipment. Shop tests shall demonstrate that the equipment tested conforms to the requirements specified.
- B. Each panelboard shall be given a 60 Hertz, AC, Hi-Pot test, phase to phase and phase to ground, at twice rated voltage plus 1000 volts for one minute, 1500 volts minimum.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Mount panelboards rigidly and securely to the building structure or to supporting devices which are rigidly and securely supported to the building structure. Anchor panelboards to satisfy seismic requirements in accordance with the anchorage details.
- B. Fasten panelboards with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on metal. All fasteners shall be stainless steel

SECTION 16441 – PANELBOARDS

- C. Mount all panelboards parallel or perpendicular to walls, such that panelboards are installed in a neat and professional manner.
- D. Wiring within the panelboards shall be neat. Wires shall be run vertically in the wire gutter and then terminate horizontally at a breaker.
- E. Install blanking devices within panelboard spaces so bus bars are not exposed.
- F. Install panelboard nameplates for identification of equipment.
- G. Install circuits to balance the loads on each panelboard.

END OF SECTION

PART 1 - GENERAL

1.01 - SECTION INCLUDES

- A. Motor Control Centers (MCC's).
- B. The MCC's included under this Section shall include, but not be limited to the following: main disconnect device, solid state motor starters and their bypass contactors, variable frequency drives, across the line motor starters, controls, feeder disconnecting devices, control wiring and interlocking.
- C. The MCC shop drawings shall not be submitted until the emergency transfer switch, variable frequency drives and load bank control panel submittals have been found to be in general compliance with the Contract Documents. The MCC shop drawings shall be based on the use of the approved equipment. Coordinate the factory fabrication of the MCC by arranging for the factory wiring and installation of all equipment at the MCC manufacturer's factory.

1.02 - REFERENCES

- A. National Electrical Manufacturers Association (NEMA) - No. ICS-1, General Standards for Industrial Control and Systems; No. ICS-2, Industrial Control Devices, Controllers and Assemblies; No. ICS-6, Enclosures for Industrial Control and Systems.
- B. ANSI/NFPA 70 - National Electrical Code.
- C. ASTM D 178 - Specification for Rubber Insulating Matting.
- D. Underwriters Laboratories, Inc. (UL) - No. 845, Motor Control Centers, Electric.

1.03 - SUBMITTALS

- A. Submit under provisions of Section 01330:
 - 1. Include electrical ratings, dimensions, mounting, material, running overcurrent protection, branch circuit overcurrent protection, wiring diagrams and accessories.
 - 2. Provide detailed control drawings on 24" x 36" blueprints for all motor controls that shall include all interface wiring between motor controls.
 - 3. Provide point-to-point wiring diagrams showing interface between motor controls and instrumentation components and control panels furnished as work of other construction contracts. Refer to Section 16010 for additional information concerning the submission of

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point-to-point wiring diagrams.

4. Provide detailed scaled $\frac{1}{2}$ inch = 1 foot drawings of motor control center including instrumentation and control drawings on 24" x 36" blueprints for floor plans showing MCC layout, locations and clearances.
 5. Provide detailed scaled $\frac{3}{4}$ inch = 1 foot elevation drawings of motor control center including instrumentation and controls. Elevation drawings shall show all switches, pilot lights, timers, keypads, timers and meters including scaled locations of all knockouts and cutouts on exterior of enclosures.
 6. Provide detailed scaled $\frac{3}{4}$ inch = 1 foot elevation drawings of motor control center including instrumentation and controls for interior mounting of all equipment. Drawings shall show scaled locations of all drives, starters, contactors, relays, protective devices, circuit breakers, fuses, wiring, timers, terminal blocks and cable connection points.
 7. Provide catalog cuts for every device type, including pilot lights, switches, timers, breakers, fuses, meters, protective devices, located within the MCC.
- B. Submit operations and maintenance manuals prepared in accordance with the requirements contained in Section 01700.
- C. Submit the following information pertaining to the manufacturer(s):
1. Certification that manufacturer has been producing MCCs for a minimum of ten (10) years.
 2. Complete literature, performance and technical data describing the proposed equipment and listing of items made by the manufacturer.
 3. Location of closest service office from which this equipment shall be serviced.
 4. Location of closest parts inventory for item installation.

1.05 – QUALITY ASSURANCE

- A. Comply with ANSI, IEEE, NEMA, NEC, UL, and all applicable Federal, State and municipal codes.
- B. In all cases where a device or part of the equipment is referred to in this Section in the singular (such as motor starter), it is intended that such references shall apply to as many such devices as are required to complete the installation.

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- C. Qualifications of Manufacturers: Products used in the work of this Section shall be produced by manufacturers regularly engaged in the manufacturing, installing and servicing of similar items with a history of successful production acceptable to the Engineer as specified herein.

1.06 – RECORD DRAWINGS

- A. Comply with the requirements contained in Section 01720.
- B. Final wiring schematics shall be provided in single sided 11 inch x 17 inch format and shall be laminated.

1.07 – MANUFACTURER SUPPLIED FIELD SERVICES

- A. Supply and credit to the Owner the costs for field services as specified in Section 01660 - Quality Control. The following field services shall be provided by the MCC manufacturer, as a minimum, in accordance with the requirements contained in Section 01650 - Starting and Adjusting:
 - 1. Five (5) days totaling five (5) trips to the project site, once the system has been installed, to check the completed installation, make all necessary adjustments, startup the system, provide operations and maintenance instruction to the Owner, and otherwise place the system into permanent, fault free operation as specified in Section 01650 - Starting and Adjusting.
 - 2. Two (2) days, two (2) trips, approximately three (3) and six (6) months after system startup of both MCC groups to review the operation with the plant superintendent and the Engineer and to make system adjustments, as necessary. Dates shall be selected by the Owner and may be used by the Owner any time within a one-(1) year period from the date of initial startup.

1.08 - WARRANTY

- A. Provide a Warranty Certificate typed on manufacturer letterhead and signed by an authorized officer of the manufacturer. A notary public in the state in which the company headquarters is located shall witness the certificate. The Warranty Certificate shall be submitted, verbatim and without exception, as follows:

"We, (MANUFACTURER) guarantee all components of the system specified in Section 16445 for the Glen Cove Wastewater Treatment Facility specifications to be free from defects in design, materials and workmanship for a period of one (1) year commencing on the date the system was permanently placed on-line.

During the guarantee period, if any part or equipment component is defective or fails to perform when operating at design conditions and if the equipment has been installed and

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is being operated and maintained in accordance with the written instructions we provided, then we shall repair or exchange such defective part (s).

The replacement or repair of parts normally consumed in service shall include pilot light bulbs and lubrication. These parts only shall be considered as part of routine maintenance and upkeep and shall not be considered eligible for exchange free of charge under this Warranty.

Agreed upon this _____ day
(DATE)

by _____ of
(NAME OF AUTHORIZED AGENT)

_____, who,
(NAME OF MANUFACTURER)

by signing this document, affirms that he/she is legally authorized to submit this warranty on behalf of the manufacturer.

AUTHORIZED SIGNATURE

DATE

NOTARY

1.09 - DELIVERY, STORAGE AND HANDLING

- A. Comply with the requirements contained in Section 01610 - Product Delivery, Storage and Handling.
- B. The MCC shall be wood crated and be delivered to the site. A truck equipped with a suitably sized lifting mechanism to off load the sections shall be provided.

1.10 – SPARE PARTS

- A. Provide the following spare parts in accordance with the requirements contained in Section 01610:
 - 1. Ten (10) Fuses of each type furnished.
 - 2. One (1) Contactor of each type furnished.
 - 3. One (1) Solid-State Overload Relay for each type furnished.
 - 4. Two (2) Contactor Coils for each type furnished.
 - 5. Two (2) Sets of Contact Kits for each type furnished.

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6. Four (4) Contactor Auxiliary Interlocks for each type furnished.
7. Two (2) Relays of each type furnished.
8. Two (2) Timing Relays for each type furnished.
9. One (1) Circuit Breaker of each type and size furnished.
10. Two (2) Phase Failure Undervoltage Relays of each type furnished.
11. One (1) Control Circuit Transformer of each type and size furnished.
12. One (1) Variable Frequency Drive for each size furnished. The contractor shall have all variable frequency drives furnished operate for a minimum of 30 days, remove one drive of each size and replace with a spare drive furnished. The original drive operational for 30 days shall be packaged in the "spare drives" factory packing and shall be the furnished spare drive.

PART 2 - PRODUCTS

2.01 - MANUFACTURERS

- A. The MCC shall be manufactured by SIEMENS System 89 or Allen-Bradley.
- B. Manufacturer of motor control center shall engage a custom switchgear manufacturer to custom build all incoming switchgear, including cubicles, top hats, corner section and custom bussing. Motor control center is based on SIEMENS dimensions. Contractor shall be responsible to meet dimension requirements.
- C. Substitute manufacturers shall be responsible to fit MCC line-up to the dimensions detailed on the drawings.

2.02 - MOTOR CONTROL CENTERS

- A. MCC enclosures shall be NEMA Type 1A with gasketed doors.
- B. Motor control center shall be same manufacturer for motor controls and all instrumentation and control cubicles.
- C. Motor control centers shall be complete, floor mounted, metal enclosed, grounded, indoor type. The motor control centers shall be NEMA Standard, Class 11, Type C except where other NEMA Standard classes and types are shown on the Drawings.

SECTION 16445 - MOTOR CONTROL CENTERS

- D. Ratings shall be 65,000 AIC for all motor control center and all circuit breakers. All ratings shall be stand alone not series rated. All circuit breakers rated 1000 amps or greater shall be equipped with ground fault protection in accordance with utility company requirements.
- E. The equipment shall conform to the arrangements and details of the Drawings and to the spaces designated for installation. All MCC door enclosures shall open 90 deg. with all accessories mounted. All doors shall be hinged left-hand side.
- F. All MCC doors shall be removable with a wiring plug harness for quick removal of doors with disconnecting wire terminations.
- G. Design the centers to withstand the mechanical stresses caused by rough handling during shipment in addition to the electrical and mechanical stresses that will occur during operation of the centers.
- H. Coordinate components of the centers and their arrangements electrically and mechanically. The components and the control wiring shall conform to the shop drawings found in general compliance with the contract documents as furnished for the various applicable electrical and mechanical sections of the specifications.
- I. Assemble, connect and wire the centers at the factory in accordance with the NEMA Standard class and type for each of the centers.
- J. Thoroughly clean, phosphatize, and paint the metal surfaces at the factory with primer and baked enamel or lacquer finishes.
- K. The centers shall have the following features:
 - 1. Standard Vertical Sections:
 - a. Approximately 90 inches high, front and rear line-up, fabricated by a single manufacturer.
 - b. Rugged steel assemblies with bracing, reinforcing gussets and jig-welding to assure rectangular rigidity. The sections shall be completely metal-enclosed, including their bottoms.
 - c. Steel shall not be less than code gauge, leveled.
 - d. Bolts, nuts and washers shall be stainless steel.
 - e. Spaces within the sections shall be suitable and adequate.

SECTION 16445 - MOTOR CONTROL CENTERS

- f. Mount the sections on adequate structural steel supports at the factory, front and rear, for the full length of each center. Install the centers so the supports will rest on top of the concrete floor surfaces except where concrete pads are indicated. Anchor the centers with bolts, not less than 1/2-inch diameter.
 - g. Each present and future motor controller shall have an individual door with hinges and latches.
 - h. End panels shall be screw-removable to facilitate future additions.
 - i. Removable panels shall have screws that remain in the panels when the panels are removed. Self-aligning, self-retaining nuts attached within the assemblies shall receive screws.
 - j. Isolated vertical full height wiring troughs.
2. Bus Bars and Interconnections:
- a. Shall be copper, rated as indicated on Contract Drawings. Minimum size shall be 800 amps. Bus bars shall be totally enclosed.
 - b. Bus bar joints and interconnection joints shall be plated, constant high-pressure type with high strength copper-silicon bolts and nuts.
 - c. Provide continuous bars through dead corner cubicles to adjoining cubicles.
 - d. Insulation:
 - 1) High strength polyester glass or equal.
 - 2) High track-resistance.
 - 3) High impulse and dielectric strength, especially at elevated temperatures, for withstanding the maximum short circuit currents.
 - 4) High flame-retardant, self-extinguishing.
 - 5) NEMA Standard for 65°C temperature rise shall apply.
 - e. Shall have horizontal main buses and vertical buses for connecting the motor controllers, circuit breakers, and switches and have an adequate ground bus that extends across the entire width of each center.

SECTION 16445 - MOTOR CONTROL CENTERS

- f. Bus bars shall be designed to extend to additional sections when so shown on the Drawings in addition to extending through dead corner cubicles.
 - g. Temperature rises shall not exceed the NEMA Standards.
- 3. Completely equipped spaces for future motor controllers, circuit breakers, and switches.
- 4. Motor Controllers:
 - a. Motor controllers shall be stab-on type except for large ratings that require bolted connections.
 - b. Motor starters shall be as specified in Section 16300 and be the products of a single manufacturer. They shall be interchangeable for the same ratings in all of the motor control centers being installed for this Contract.
 - c. Disconnecting contact devices:
 - 1) Silver-plated copper, full floating, self-aligning, self-coupling, designed for cleaning action during engaging and disengaging movements.
 - 2) Adequate flexibility between the stationary and movable components.
 - 3) Adequate pressure maintained on the contacts.
 - 4) Shall engage silver plated buses.
 - d. Doors mechanically interlocked to prevent their opening unless the disconnect is opened. Incorporate "defeater" mechanisms for inspection by qualified personnel.
 - e. External operating handles with lock-open padlocking provisions and ON and OFF position indicators.
- 5. Identify each motor controller, circuit breaker and switch with a separate nameplate of laminated black phenolic resin with white core and engraved lettering not less than $\frac{3}{16}$ -inch high. Identify each motor by its number or other designation and indicate function fulfilled by the motor. Identify pilot light with ON and OFF designation.
- 6. Line Monitoring Devices:
 - a. The motor control center shall be equipped with a three phase monitoring relay to

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interlock each starter upon phase failure, phase loss or phase reversal. The phase monitor shall be manufactured by FURNAS, Class 47. Three-phase monitoring shall be provided for each of all three-phase motors including motors controlled via variable frequency drives.

- L. The following control elements and features shall be provided for every motor operated unit powered from the MCC:
1. Power on push-to-test white pilot light mounted on the MCC section enclosure door.
 2. Red push-to-test pilot light indicating that the motor is running.
 3. Green push-to-test pilot light indicating that the motor is not running.
 4. Overload push-to-test amber alarm pilot light mounted on the MCC section enclosure door.
 5. Overload fault reset pushbutton mounted on the MCC section enclosure door.
 6. Elapsed Time Meter: LED type flush mounted on the MCC section enclosure door.
 7. Disconnecting Means: Include integral circuit breaker on the line side of each motor controller.
 8. Auxiliary NO and NC contacts
 9. Provide solid-state overload relay on load side of bypass contactor and thermal overload relay on load side of output contactor as specified in Section 16300.
 10. Fast acting fuses on load side of main circuit breaker sized in accordance with manufacturers recommendations.
 11. Pilot lights and switches shall be door mounted as part of a door mounted control station. The control station shall be removable for the purpose of mounting and wiring the pilot devices. Contact blocks of the pilot devices shall be mounted in a recessed control station housing to minimize the hazard of accidental contact when the unit door is opened.
 12. Pilot Lights shall be LED type with push-to-test capabilities. No incandescent pilot lights shall be permitted."
- M. Main circuit breaker and other circuit breakers as indicated on drawings shall be ground fault

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circuit interrupter in accordance with electric utility LIPA and NEC requirements. Provide MCP type breakers for motors.

2.03 - POWER MONITOR

- A. Manufacturer: ACCUENERGY
 - 1. Model No: ACUVIM II Series.
 - 2. 480 volt.
- B. Quantity: as indicated in drawings.
- C. Provide current and potential transformers for all three phases and neutral for digital ammeters/voltmeters.
- D. The power monitor shall incorporate a vacuum display and keypad to allow the user to read the following parameters:
 - 1. Voltage V1, V2, V3.
 - 2. Current I1, I2, I3, In, Iavg.
 - 3. Power P1, P2, P3, Psum.
 - 4. Reactive Power Q1, Q2, Q3, Qsum.
 - 5. Apparent Power S1, S2, S3, Ssum.
 - 6. Frequency.
 - 7. Power Factor.
 - 8. Energy.
 - 9. Reactive Energy.
 - 10. Apparent Energy.
 - 11. Demand.
 - 12. Load Features.
 - 13. Four Quadrant Powers.

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14. Power Quality.
15. Voltage Harmonics.
16. Current Harmonics.
17. Voltage Crest Factor.
18. Current K Factor.
19. Voltage Unbalance Factor.
20. Current Unbalance Factor.
21. Max/Min Statistics with Time Stamps.

E. Power monitor shall have the following features:

1. Alarms
2. I/O Option Module
3. Anti-tampering Seal
4. Data Logging (8mb)
5. Automatic Frequency adaption.
6. Power Quality Event Logging.
7. Communication
 - a. Modbus RTU Protocol and DNP 3.0 via RS485
 - b. Ethernet (Modbus TCP, HTTP, SMTP, SNTP)
 - c. Profibus DP
 - d. BACnet IP, BACnet MS/TP
 - e. Dual RS485 Communication Ports
8. 0.2% accuracy.

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- F. Power monitors shall be factory installed on the Switchboard enclosure doors as indicated on drawings.

2.04 – WIRING

- A. Control and power wiring shall be flame-retardant (VW-1) moisture, heat and oil resistant thermoplastic insulation rated 600V, 90EC, with stranded copper conductors, types MTW and THW.
- B. Control wires shall be red. Power wires shall be black. Neutral wires shall be white. Ground wires shall be green.
- C. Control wire size shall be #14 AWG minimum. Power wire size shall be #12 AWG minimum.

2.05 – SOURCE QUALITY CONTROL

- A. Test motor control centers at the factory to assure that the centers do not have defects.

2.06 - ACCESSORIES

- A. Electrical Matting: Dielectric strength 30,000 volts, 3 feet wide, 1/4 inch thick corrugated ASTM D 178 Type 2, Class II.

PART 3 - EXECUTION

3.01 – INSTALLATION

- A. General:
 - 1. Verify NEC clearances as shown on the Contract Drawings, prior to installation.
 - 2. The MCC shall be level, plumb and securely installed. Where MCC is to be installed on a concrete pad, leveling steel channels shall be installed in the concrete.
 - 3. Coordinate conduit entry locations through the floor slab with the General Contractor. Conduit locations shall be based on manufacturers shop drawings.
 - 4. Follow manufacturers instructions as to lifting requirements, connecting shipping splits and attachment to structure.
- B. Overload Heaters: Furnish and install all overload heaters required, based on motor nameplate data.

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- C. Wiring: Wire all equipment per Contract Drawings and as required.
- D. Install clear lexan window to allow visual indication of surge protection status.

3.02 - ADJUSTING

- A. Test and adjust all equipment within the MCC. This includes short circuit device settings, electronic trip settings of breakers, MCP settings, timing relay settings, etc. All devices shall be properly adjusted such that the MCC protection and control circuits operate correctly and safely.
- B. The MCCs shall be properly grounded per NEC requirements. The MCC ground bus shall be connected to ground grid where shown on the Contract Drawings.
- C. Conduits entering the MCC shall have insulated grounding bushings tied together with copper jumper cables.
- D. Provide electrical matting on the floor in front of the MCC, switchboard, and at locations selected by the Engineer. Matting shall be trimmed to fit in front of each MCC section. Extra matting shall be turned over to the Owner.
- E. Each MCC shall have identifying nameplates as specified in Section 16075.
- F. Install in accordance with NEC and manufacturer's instructions, and as shown on the Drawings.

3.03 - DEMONSTRATION

- A. Provide step-by-step procedures for manually testing the transfer switch and load bank. The procedure shall be typed in 18-point font and then laminated and attached to the front of the transfer switch section with loop tape. Submit draft for review. Demonstrate procedures with Owner.

+ + END OF SECTION + +

SECTION 16445 - MOTOR CONTROL CENTERS

+ + NO TEXT ON THIS PAGE + +

SECTION 16460 - DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.01 - SECTION INCLUDES

- A. Dry type transformers.
- B. PHASE CONVERTER

1.02 - REFERENCES

- A. ANSI/NFPA 70 - National Electric Code.
- B. NEMA ST20 - Dry Type Transformers for General Applications.

1.03 - SUBMITTALS

- A. Submit product data under provisions of Section 01300.
- B. Provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, KVA and impedance ratings and characteristics, tap configurations, insulation system type and rated temperature rise.

1.04 - REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc.

PART 2 - PRODUCTS

2.01 - MANUFACTURERS

- A. Dry type transformers shall be manufactured by General Electric Type QL.
- B. Phase converter shall be manufactured by American Rotary Type AI
- C. Approved equal.

2.02 - EQUIPMENT REQUIREMENTS

- A. Transformer
 - 1. Three-phase and Single-phase general purpose dry type transformers be self-cooled, with ratings (KVA) as indicated on the drawings.

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2. Copper windings.
3. Sound levels not to exceed the following:
 1. 0-9 KVA: 40 db.
 2. 10-50 KVA: 45 db.
 3. 51-150 KVA: 50 db.
 4. 151-300 KVA: 55 db.
 5. 301-500 KVA: 60 db.
 6. 501-700 KVA: 62 db.
4. Three-phase transformers rated above 15 KVA to be insulated with UL listed Class 220 rated materials; and have a maximum average full load temperature rise of 115 degrees C.
5. Transformers to have voltage ratios as indicated on drawings. Transformers between 15 KVA and 300 KVA to be provided with six 2-1/2% full capacity taps, two above and four below primary rated voltage.
6. Nameplate: Include transformer connection data.

B. Phase Converter

1. Enclosure: Nema 3R
2. Input Voltage: 240V/1Ø
3. Output Voltage: 240V/3Ø
4. Model: AI-20
5. KVA: 10

PART 3 - EXECUTION

3.01 - INSTALLATION

- A. Install transformers and phase converter in accordance with manufacturer's recommendations.

SECTION 16460 - DRY TYPE TRANSFORMERS

- B. Provide both primary and secondary protection as shown on drawings.
- C. Set transformer and phase converter plumb and level.
- D. Provide grounding and bonding in accordance with provisions of Section 16060.

3.02 - FIELD QUALITY CONTROL

- A. Check for damage and tight connections prior to energizing transformer.
- B. Measure primary and secondary voltage and make appropriate tap adjustments.

+ + END OF SECTION + +

SECTION 16460 - DRY TYPE TRANSFORMERS

+ + NO TEXT ON THIS PAGE + +

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provide, test and place into satisfactory operation manual and automatic transfer switches as shown on the Contract Drawings and specified herein.

1.02 RELATED SPECIFICATIONS

- A. Specification 16071 - Supporting Devices
- B. Specification 16076 - Labeling and Identification

1.03 PAYMENT

- A. Payment for transfer switches shall be made as provided in Division 1 of the Specifications.

1.04 REFERENCES

- A. Transfer switches shall comply with the latest applicable provisions and recommendations of the following:
 - 1. NFPA 70 National Electrical Code
 - 2. ANSI American National Standards Institute
 - 3. IEEE Institute of Electrical and Electronics Engineers
 - 4. NEMA National Electrical Manufacturers Association
 - 5. NFPA National Fire Protection Agency
 - 6. UL Underwriters Laboratories
 - 7. NETA International Electrical Testing Association

1.05 SUBMITTALS

- A. Submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions and as specified under Division 1 of the Specifications.
- B. Working Drawings
 - 1. Product data sheets identifying all materials used, electrical and short circuit ratings, environmental restrictions, and methods of fabrication.
 - 2. Complete assembly, layout and installation drawings with clearly marked dimensions.
 - 3. Weights of all component parts, assembled weight of units and approximate total shipping weight.
 - 4. Interconnection Wiring Diagrams
 - 5. List of Spare Parts
 - 6. List of Special Tools
 - 7. Painting procedures
 - 8. Installation instructions
 - 9. Transfer switch anchorage details with design calculations signed by licensed Engineer.
 - 10. Testing Methods
 - a. Submit description of shop and field-testing methods, procedures and apparatus with calibration dates. Testing methods and procedures shall be submitted at least 45 days in advance prior to conformation of witness testing dates and actual testing.
 - b. Qualifications of proposed testing firm to perform acceptance testing shall be submitted. Submit firm experience records at least 45 days in advance to actual testing, five recent references with phone numbers shall be submitted.
 - 11. Certificates of Compliance
 - a. Seismic qualification certificate from the manufacturer including mounting recommendations.
 - b. Data and results of witness tests accompanied by a certificate of authenticity sworn to before a notary public by an officer of the manufacturing company. Upon approval, release for shipment to site shall proceed.
 - 12. Reports
 - a. Shop test and field test reports shall be submitted.

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- b. Manufacturer's site visit and acceptance testing reports shall be submitted.
- 13. Operation and maintenance manuals shall be submitted in accordance with the Specifications.
 - a. Include instructions for operating equipment.
 - b. Include instructions for operating equipment under emergency conditions.
 - c. Identify operating limits which may result in hazardous or unsafe conditions, whether switch is being operated automatically or manually.
 - d. Document ratings of equipment and each major component.
 - e. Include manufacturer's recommended routine preventative maintenance schedule.
 - f. List any special tools, maintenance materials and recommended spare parts.
- 14. Submit the following information pertaining to the manufacturer(s):
 - a. Certification that manufacturer has been producing transfer switches for a minimum of five (5) years.

1.06 QUALITY ASSURANCE

A. General

- 1. Transfer switches shall be designed, built and tested in accordance with the latest applicable editions of ANSI/IEEE, NEMA, UL, and NFPA.
- 2. All structures shall be fabricated of code gauge steel. Steel surfaces shall be chemically cleaned, treated and finished with ANSI No. 61 indoor light grey paint.
- 3. The transfer switch manufacturer shall use a shop test facility that has recently calibrated testing apparatus and qualified, experienced technicians, for all factory tests. Calibration of testing apparatus shall be within one year.
- 4. All test equipment and instrument calibration shall be in accordance with the latest edition of the accuracy standard of the U.S. National Institute of Standards and Technology and the NETA acceptance testing specification.
- 5. Transfer switches shall be designed, constructed and installed suitable for earthquake regulations in accordance with the seismic requirements of the Nassau County Building Code and the Uniform Building Code for zone 2A application.
- 6. Products used in the work of this Section shall be produced by manufacturers regularly engaged in the manufacturing, installing and servicing of similar items with a history of successful production acceptable to the Engineer as specified herein and in accordance with Article 5 of the General Conditions.
- 7. Field Tests
 - a. The transfer switches shall be field tested. Field testing shall be performed in accordance with the requirements specified under article 3.2.
 - b. The services of the transfer switch manufacturer shall be retained for field service. Field service shall be in accordance with the requirements specified under Article 3.3.
 - c. Retain the service of an independent testing firm who shall perform field acceptance testing of the transfer switches. The testing firm shall have experience in the inspection and testing of the equipment and shall be a member company of NETA. Provide proof of membership or demonstrate that the standards and experience required for membership are possessed, all to the satisfaction of the Engineer. Acceptance testing shall be in accordance with the requirements specified under Article 3.4.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Transfer switch equipment shall be delivered, stored and handled in accordance with the Specifications, the manufacturer's instructions and the following.
 - 1. Transfer switch equipment shall be inspected for shipping damage or loose parts when received. Evidence of water which may have entered equipment during transit shall be checked.
 - 2. Transfer switch equipment shall be lifted, rolled or jacked into locations shown on the Contract Drawings.

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3. Transfer switch equipment shall be stored in a clean, dry location in which a uniform temperature is maintained. Equipment shall be protected with coverings and maintain air circulation.
4. Where dampness or condensation may be encountered, heaters shall be provided for equipment to prevent moisture damage.

1.08 SPARE PARTS

- A. Furnish and deliver to the Engineer, at that part of the site and at such time as the Engineer may direct, spare parts for the transfer switches in accordance with the Specifications.
- B. The spare parts shall be listed in an index and packed in containers suitable for long term storage, bearing labels clearly designating the manufacturer's part number with complete information for use and reordering.
- C. Spare parts shall be furnished in accordance with the manufacturer's recommendations.

1.09 SYSTEM DESCRIPTION

- A. In general, the transfer switches included under this Section shall include, but not be limited to, the following:
 1. Power Section
 2. Control Panel
 3. Enclosure

1.10 DESIGN REQUIREMENTS

- A. Review installation procedures under other Sections and Contracts and coordinate them with the work specified herein.
 1. Provide sufficient time for installation and coordination of interrelated items that are included in the Contract and that must be installed in conjunction with the work included in this Section.
 2. Proposal for any substitute equipment shall provide complete submittal data, as specified herein, to the Engineer for approval or disapproval. Physical dimensions of transfer switches are based on ONAN BTPC Series. Substitute equipment shall be field verified for adequate equipment spacing relative to other equipment to be installed in the same locations.

1.11 WARRANTY

- A. Provide a 5-year warranty and 5-year planned maintenance agreement from the manufacturer at no additional cost to the Owner. The agreement shall include, as a minimum, one service call per year. The services must be performed by the authorized distributor of the equipment furnished and may not be subcontracted. The following services shall be performed once a year at every location:
 1. Check switches for loose, bare or broken wiring (replace as needed).
 2. Test all transfer switch operation, time delays and manual operators.
 3. Test all transfer switch operations and plant exerciser.
 - a. Manufacturer's Instructions: The manufacturer's instructions shall indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation, installation and starting of product.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers shall be as follows:
 1. Automatic Switch Company (ASCO)
 2. Russ Electric Inc.
 3. Zenith Controls Inc.
 4. Or approved equal.

2.02 GENERAL

- A. Each transfer switch shall be rated for the voltage and ampacity as shown on the Contract Drawings and shall have 600-volt insulation on all parts in accordance with NEMA standards.
- B. The specified current rating shall be a continuous rating when the switch is installed in an unventilated enclosure and shall conform to NEMA temperature rise standards.
- C. The unit shall be rated based on all classes of loads, that is, resistive, tungsten, ballast and inductive loads. Switches rated 400 amperes or less shall be UL listed for 100% tungsten lamp load.
- D. All transfer switches complete with accessories shall be listed by Underwriters Laboratories, under Standard UL-1008 (transfer switches) and approved for use on transfer systems.
- E. Transfer switches shall comply with the applicable standards of UL, ANSI, NFPA, IEEE, and NEMA.
- F. The transfer switches shall be supplied with a solid-state based control panel.
- G. Automatic transfer switches shall be suitable for use with emergency power sources.

2.03 POWER SECTION

- A. The transfer switch shall be of double throw construction operated by a reliable electrical mechanism momentarily energized. There shall be a direct mechanical coupling to facilitate transfer in three (3) cycles or less. Switches composed of molded case breakers, lighting contactors or components thereof will not be acceptable.
- B. The Source #1 and Source #2 contacts shall be mechanically interlocked such that failure of any coil or disarrangement of any part shall not permit a neutral position.
- C. The transfer switch manufacturer shall certify sufficient arc interrupting capabilities for 50 cycles of operation between Source #1 and Source #2 that are 120 degrees out of phase at 480 volts, 600% of rated current at .50 power factor. This certification is to ensure that there will be no current flow between the two isolated sources during switching.
- D. The contact structure shall consist of a main current carrying contact which is a silver alloy with a minimum of 50% silver content. The current carrying contacts shall be protected by silver tungsten arcing contacts on all sizes. Contact assemblies shall have arc chutes for positive arc extinguishment. Arc chutes shall have insulating covers to prevent interphase flashover.
- E. Main and arcing contacts shall be visible without major disassembly to facilitate inspection and maintenance.
- F. A manual handle shall be provided for maintenance purposes with the switch deenergized. An operator disconnect switch shall be provided to defeat automatic operation during maintenance, inspection or manual operation (applies only to automatic transfer switches).
- G. For switches installed in systems having ground fault protective devices, and/or wired so as to be designated as a separately derived system by the NEC, a 4th pole shall be provided. This additional pole shall isolate the Source #1 and Source #2 neutrals. The neutral pole shall have the same withstand and operational ratings as the other poles and shall be arranged to break last and make first to minimize neutral switching transients. Add-on or accessory poles that are not of identical construction and withstand capability are not acceptable.
- H. The transfer switch shall have a 3-cycle and closing withstand rating of 100 kA. Current limiting fuses shall be used where required.
- I. Transfer switches shall be equipped with transparent protective covers over all live parts of the switch. These covers are to serve as protection to operators or service personnel from contact with live parts, and from contact with arcing by-products if the switches operate with the door open. Barriers shall be transparent to allow for visual inspection for contact position and for damage.
- J. Transfer switches utilizing components of molded case circuit breakers are not acceptable.

2.04 CONTROL PANEL

- A. Solid State Control System (Automatic Transfer Switch)
 - 1. The control system for the automatic transfer switch shall be solid state based and shall also contain all logic devices including control and voltage sensing relays, time delays and any auxiliary equipment required for proper operation.
 - 2. The controls shall include latching diagnostic indicators to pinpoint the last successful step in the sequence of control functions, and to indicate the present status of the control functions in real time, as follows:
 - a. Source 1 OK
 - b. Start Generator Set
 - c. Source 2 OK
 - d. Transfer Timing
 - e. Transfer Complete
 - f. Retransfer Timing
 - g. Retransfer Complete
 - h. Timing for Stop
 - 1) Sequence of Operation: Automatic switching shall occur from normal power to emergency power when there is a phase reversal or when any phase of the normal power drops between an adjustable voltage range of 75 to 98% voltage and to automatically restore the load to normal when all phases are between an adjustable voltage range of 75 to 98% normal voltage or phase rotation is corrected.
 - 2) Transfer switches shall be equipped with transparent protective covers over all live parts of the switch. These covers are to serve as protection to operators or service personnel from contact with live parts, and from contact with arcing by-products if the switches operate with the door open. Barriers shall be transparent to allow for visual inspection for contact position and for damage.
 - 3) Provide frequency sensing relay which will not permit transfer to emergency power until the generator set is operating at 60 Hz.
 - 4) Control wiring shall be terminated interlocking, plug-type connectors. Operating current for the transfer shall be obtained from the source to which the load is to be transferred.
 - 3. Manual Control System (Non-Automatic/Manual Transfer Switch)
 - a. Non-Automatic Transfer Switches are electrically operated units which are operated with manual control switches mounted on the face of the Manual Transfer Switch Enclosure.
 - b. Microprocessor based controller provides for addition of optional accessories.
 - c. Controller prevents inadvertent operation under low voltage conditions.
 - d. Source acceptability lights inform operator if sources are available to accept load.
 - e. Standard in-phase monitor can be activated for transferring motor loads.
 - 4. Location
 - a. All control devices shall be assembled on a door mounted, shielded panel.
 - b. Connect components with a numbered wiring harness equipped with a disconnect plug that allows isolation of the control panel.
 - 5. Control wiring shall be terminated interlocking, plug-type connectors. Operating current for the transfer shall be obtained from the source to which the load is to be transferred.

2.05 ENCLOSURE

- A. The entire transfer switch shall be completely assembled within one (1) enclosure. The enclosure shall be NEMA 12, in dry, indoor areas and NEMA 4X stainless steel in outdoor and corrosive areas.
- B. Exterior surfaces of NEMA 12 enclosures shall be painted gray to match color of motor control center, ANSI 61. Interior surfaces shall be painted white.

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- C. All controls which will be located on cabinets shall be key operated. Manual operating handles and all control switches, (other than key-operated switches) shall be accessible to authorized personnel only by opening the key-locking cabinet doors. Transfer switches with manual operating handles and/or non key-operated control switches located on the outside of the cabinet do not meet this specification and are not acceptable.

2.06 PERFORMANCE CRITERIA

2.07 RATINGS SHALL BE AS FOLLOWS:

- A. Voltage: As indicated in drawings.
- B. Switched Poles: 4 (overlapping neutral not acceptable).
- C. Load Inrush Rating: Combination Load.
- D. Continuous ampere ratings shall be as indicated in drawings.
1. All transfer switches shall meet the following withstand ratings as a minimum. In order to protect the system under current or possible future conditions, whether protected by circuit breakers or current limiting fuses, the transfer switches must meet both of the following molded case circuit breaker and current limiting fuse withstand and closing ratings as a minimum. Ratings are stated in symmetrical RMS amperes for three phase faults.

LOCATION	TRANSFER AMPERAGE	WCR @ 480 VOLTS W/ MOLDED CASE C/B'S	WCR @ 480 VOLTS W/ CURRENT LIMIT FUSES
Knott Drive	100	65,000	65,000
Morgan Park	600	65,000	65,000
Viola	200	65,000	65,000
Roslyn	600	65,000	65,000

2. Transfer switches shall be continuously rated in ambient temperatures of -40 to +50 degrees C, relative humidity up to 95% (non-condensing), and altitudes up to 10,000 feet.

2.08 OPERATION SEQUENCE

- A. Initiate Time Delay to Start Alternate Source Engine Generator: Upon initiation by normal source monitor.
- B. Time Delay to Start Alternate Source Engine Generator: 0 to 15 seconds, adjustable.
- C. Engine Start: Automatic controls shall signal the engine-generator set to start upon a signal from normal source sensors, after time delay to start has terminated. Manual controls shall signal the engine-generator set to start upon a signal from manual control switches mounted on the face of the Manual Transfer Switch Enclosure
- D. Initiate Transfer Load to Alternate Source: Upon initiation by normal source monitor and permission by alternate source monitor.
- E. Time Delay Before Transfer to Alternate Power Source: 2 to 120 seconds, adjustable.
- F. Initiate Retransfer Load to Normal Source: Upon permission by normal source monitor.
- G. Time Delay Before Retransfer to Normal Power: 0 to 30 minutes, adjustable; bypass time delay in the event of the alternate source failing.
- H. Time Delay Before Engine Shut Down: 0 to 10 minutes, adjustable, of unloaded operation; factory set at 5 minutes.
- I. Engine Exerciser: Exercisers shall, once a week, start the generator sets, transfer building load to the generator sets and after a set period of time, transfer the building load back to normal power. It shall be readily accessible and easy to start. All transfer switches shall be provided

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with the exerciser. Exercisers shall be furnished with load/no load selector switches. Provide bypass exerciser controls if the normal source fails during the exercise period.

2.09 ACCESSORIES

- A. Indicating Lights: Mounted in front panel of enclosure to indicate the following:
 - 1. NORMAL SOURCE AVAILABLE.
 - 2. EMERGENCY SOURCE AVAILABLE.
 - 3. NORMAL SWITCH POSITION.
 - 4. EMERGENCY SWITCH POSITION.
 - 5. GENERATOR FAILURE (INTERFACE WITH ANNUNCIATOR)
 - 6. AC POWER LOSS (INTERFACE WITH ANNUNCIATOR)
- B. Test Switches: Mounted in front panel of enclosure to simulate failure of normal source. Switches to be keyed operated. Provide TEST/NORMAL/RETRANSFER positions. Retransfer position to provide immediate Retransfer to normal, bypassing time delay. The test switch shall be capable of receiving a remote signal. The generator load shed control panel shall provide a signal to initiate transfer to emergency source based on facility load. After the facility load has reduced the PLC shall deenergize the start signal. The transfer switch shall retransfer to the normal source, and tie into engine cool-down mode 0-10 minutes adjustable.
- C. Emergency Kill Switch Pushbutton (Maintained): When depressed shall shut down generator. This switch shall be in series with emergency kill switch.
- D. Transfer Switch Main Shaft Auxiliary Contacts: Two normally open; two normally closed. Wired to terminal block for easy access for indication of switch position. Rated at 10 Amps continuous and 250 VAC maximum.
- E. Transfer switches are to be equipped with permanently attached operating handles and quick-break, quick-make mechanisms suitable for normal operation under load. Loose manual operating handles that need to be field attached for operation will not be acceptable.
- F. Transfer switches shall be provided with a field adjustable time delay during the switching in both directions, during which time the load is isolated from both power sources, to allow load residual voltage to decay before closure to opposite source. The delay feature shall have an adjustable range of 0 to 7.5 seconds. Phase angle monitor/in-phase type monitors are not acceptable.
- G. Transfer switches shall be provided with switched neutral poles (4 poles). The neutral poles shall be of the same construction and have the same ratings as the phase poles. All poles shall be switched simultaneously using a common crossbar. Equipment using add-on accessory overlapping contacts are not acceptable.
 - 1. Provide a voltage monitoring relay and pneumatic time delay relay control circuit to energize a relay contact when power to the load terminals of the transfer switch is lost for a pre-selected time interval. The voltage phase monitor relay shall monitor 3-phase voltage, phase failure, phase reversal and voltage imbalance. The phase monitor shall have a normally closed contact in Series with a time delay relay. The pneumatic time delay relay shall have a 0-5 minute timer with automatic reset when power is restored to the coil. The normally open contact of the time delay relay shall be input to the annunciator panel.
 - 2. Rubber mat shall meet OSHA requirements and the requirements of ANSI/ASTM D-178 J6-7 for Type 2, Class 2 insulating matting. The mat shall be 1/4 inch thick with beveled edges, canvas back, solid type with corrugations running the entire length of the mat. The mat shall be guaranteed extra quality, free from cracks, blow holes or other defects detrimental to their mechanical or electrical strength.

2.10 SHOP TESTS

- A. Certified Shop Tests
 - 1. Transfer switches shall be shop tested at the manufacturer's plant prior to shipment. Shop test shall be in accordance with the latest revisions of NEMA and UL and shall demonstrate that the equipment tested conforms to the requirements specified.

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2. Provide a shop test report. The report shall identify the tests performed and the results obtained.
3. Transfer switch shop tests shall include the following:
 - a. Physical inspection shall be performed including torque tests of bus bolts.
 - b. Mechanical operations shall be performed to insure proper functioning of operating mechanisms and interchangeability.
 - c. Continuity test shall be performed on power and control wires.
 - d. Functional operations test which shall include pick up, dropout, time delay, sequence and polarity.
 - e. Power cables and buses shall be tested, for insulation breakdown resistance and circuit isolation. Test voltage frequency shall not be less than the frequency of the rated voltage of the equipment tested.
 - 1) The transfer switch manufacturer shall submit test data for each size switch, showing it can withstand fault currents of the magnitude and the duration necessary to maintain the system integrity. Each ATS shall be in strict accordance and listed to UL 1008 withstand standards, including 3 cycle ratings.
 - 2) A dielectric test at the conclusion of the withstand and closing tests shall be performed.
 - 3) Temperature rise tests in accordance with UL 1008 shall have been conducted after the overload and endurance tests to confirm the ability of the units to carry their rated currents within the allowable temperature limits.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General

1. The transfer switches shall be furnished and installed as shown on the Drawings and in accordance with the manufacturer's installation instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment. The equipment shall be suitably protected until accepted by the Owner.
2. The equipment shall be installed and checked in accordance with the manufacturer's recommendations. This shall include but not limited to:
 - a. Checking to ensure that the pad location is level to within .125 inches if applicable.
 - b. Checking to ensure that all power connections are torque to the manufacturer's recommendations.
 - 1) Secure assemblies to foundation on floor channels if applicable.
 - 2) Measure and record Megger readings phase-to-phase, phase-to-ground, and neutral-to-ground (four-wire systems only).
 - 3) Transfer switches shall be fully assembled with all required devices, wiring, nameplates, terminal blocks and enclosures.
 - 4) Mount transfer switches rigidly and securely to the building structure or to supporting devices, which are rigidly and securely supported to the building structure.
 - 5) Transfer switches shall be fastened with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel work.
 - 6) Mount transfer switches with sides parallel or perpendicular to walls or equipment.
 - 7) Install all transfer switches such that door swing is not hampered.
 - 8) Transfer switches located on exterior of building shall be provided with NEMA 4X rated enclosure.
3. Locations and Sizes
 - a. Transfer switches locations shown on the Contract Drawings are approximate. Sizes shall be as dimensioned on the Contract Drawings, or, if not specifically dimensioned, as required to house all devices, terminal blocks and conduits which enter the enclosure.

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- b. All transfer switches sizes and locations shall be submitted by the Contractor for the Engineer's approval.
- 4. Grounding
 - a. All transfer switches shall be grounded in accordance with NEC requirements.
 - b. The use of two (2) locknuts and a grounding bushing shall be required at all conduit terminations where hub type fittings are not required. Conduit grounding bushings within transfer switches shall be bonded together with jumper cables where enclosure size or number of conduits warrants their use per NEC requirements.
- 5. Terminal Blocks
 - a. Terminal blocks shall be installed parallel or perpendicular to the transfer switch enclosure sides. Approximately 20 percent spare terminals shall be provided (minimum of two (2)). Terminals shall be lettered or numbered to conform to the wiring diagrams.
- 6. Wiring
 - a. The wiring within the transfer switch shall be neatly harnessed to prevent the door damaging the wiring and to prevent the wiring from hampering the door operation.
 - b. All conductors shall have identification markers on each end. Marker numbers shall match the terminal block numbers consistent with the Shop Drawings.

3.02 FIELD TESTS

- A. After installation, field test transfer switches for operation and conformance. Perform field testing in accordance with the Specifications. The field tests shall be witnessed by the Engineer and certified by the Contractor.
- B. Transfer switch testing shall be performed by the manufacturer's representative, prior to energizing equipment. The testing shall be in accordance with the recommendations of the manufacturer's representative. Equipment shall not be energized without the permission of the Engineer.

3.03 MANUFACTURER'S FIELD SERVICES

- A. A qualified manufacturer's representative shall assist in the installation of the transfer switches, check the transfer switch installation before it is placed into operation, assist in the performance of field tests, observe and assist initial operations and train the plant operations and maintenance staff in the care, operation and maintenance of the transfer switches.
- B. Provide equipment start-up services and training in accordance with the Specifications.
- C. Submit a field report from the manufacturer's representative for each visit to the site. The report shall include complete information on time, schedule, tasks performed, persons contacted, problems corrected, tests results, training, instruction and all other pertinent information.
- D. The service representative shall sign in with the Engineer on each day they are at the site.

3.04 ACCEPTANCE TESTING

- A. Provide acceptance testing of the transfer switches. All acceptance testing shall be performed by the testing firm, after the completion of the field tests specified under Article 3.2. The acceptance testing shall be witnessed by the Engineer and certified by the Contractor.
- B. Acceptance testing inspection shall be performed on each switchgear. Inspection shall include the following:
 - 1. Physical, electrical and mechanical condition shall be inspected.
 - 2. Proper anchorage, required area clearances, physical damage and proper alignment shall be checked.
 - 3. All connections shall be inspected for high resistance.
 - 4. Electrical and mechanical interlock systems shall be checked for proper operation.
 - 5. Insulators shall be inspected for evidence of damage or contamination.
 - 6. Equipment shall be cleaned and lubricated as required.
 - 7. Acceptance electrical testing shall be performed on each transfer switch. Testing shall include the following:

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- a. Ground-resistance tests shall be performed.
- b. Insulation-resistance tests shall be performed on each bus, phase-to-phase and phase-to-ground.
- c. Test each pole with other poles grounded. An over potential test shall be performed.
- d. Contact-resistance test shall be performed.
- e. Control and metering wiring performance test shall be performed.
8. All tests and values shall be in accordance with the manufacturer's recommendations and NETA, ATS Acceptance Testing Specification.
9. Provide an acceptance testing report. The report shall be in accordance with NETA, ATS Acceptance Testing Specification.

3.05 PAINTING

- A. After fabrication, bonderize, chemically clean and paint exterior and interior surfaces of the switchboard with a rust inhibiting primer followed by an ANSI 61 gray finish coat cathodic electro-deposition epoxy.
- B. Prior to final completion of the work, all metal surfaces of the equipment shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same lacquer as used for shop finishing coats.

3.06 IDENTIFICATION

- A. Identify each transfer switch with the identification number indicated on the Drawings. A nameplate shall be securely affixed in a conspicuous place on each transfer switch. Nameplates shall be as specified in Specification 16076 Labeling and Identification.

3.07 RUBBER MATS

- A. A three-foot wide rubber mat shall be furnished and installed on the floor in front of each transfer switch. The mat shall be long enough to cover the full length of the equipment line-up.

END OF SECTION

SECTION 16511 – LIGHTING FIXTURES AND DEVICES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Requirements for providing lighting fixtures and devices. Lighting fixtures and devices shall be provided in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.
- B. The lighting system shall be complete and include all luminaires, devices and accessories as required for the installation of the lighting fixtures and devices.

1.02 RELATED SECTIONS

- A. Specification 16076 - Labeling and Identification
- B. Specification 16131 - Electric Conduit System

1.03 PAYMENT

- A. Payment for lighting fixtures and devices shall be made as provided for in the Specifications.

1.04 REFERENCES

- A. Lighting fixtures and devices shall comply with the latest applicable provisions and recommendations of the following:
 - 1. NFPA 70, National Electric Code.
 - 2. UL Standard No. 20, General Use Snap Switches.
 - 3. UL Standard No. 844, Electric Lighting Fixtures for Use in Hazardous Locations.
 - 4. UL Standard No. 894, Switches for Use in Hazardous Locations.
 - 5. UL Standard No. 924, Emergency Lighting and Power Equipment.
 - 6. UL Standard No. 1010, Electrical Receptacle - Plug Combinations for Use in Hazardous Locations.
 - 7. UL Standard No. 8750, Light Emitting Diode (LED) Equipment for use in Lighting Products.
 - 8. American National Standard Institute, ANSI.
 - 9. Certified Ballast Manufacturers, CBM.

1.05 SUBMITTALS

- A. Submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions and as specified under Division 1 of the Specifications.
- B. Working Drawings:
 - 1. Prior to equipment submission, submit a list of proposed manufacturers with the products they produce proposed for the contract.
 - 2. Manufacturer's catalog cuts and drawings showing all technical information, and construction details for lighting fixtures, including dimensions, type of wiring, weight, size, installation methods and provisions for relamping lighting fixtures from the ground.
 - 3. Photometric data, fixture IES lighting classification, and isolux diagram developed for each fixture type.
 - 4. Lamp type and technical information.
 - 5. Ballast type and technical information including power factor, input watts and ballast factor.
 - 6. Scaled working drawings showing the locations of all fixtures and devices. The Drawings shall include the proposed routing of the branch circuits.
 - 7. Point-to-point photometric layout drawings detailing the footcandle levels at one foot intervals, six inches above the finished floor. For exterior areas, the footcandle levels shall be detailed at one foot intervals, six inches above grade. For stairways, the footcandle levels shall be detailed at one foot intervals, six inches above each step.
 - 8. Bills of material.
- C. Reports:
 - 1. Field test reports shall be submitted.

SECTION 16511 – LIGHTING FIXTURES AND DEVICES

2. Manufacturer's site visit report shall be submitted.

D. Submit Operations and Maintenance Manuals in accordance with the Specifications.

1.06 QUALITY ASSURANCE

A. General:

1. Lighting fixtures shall be UL listed. The lighting fixture types are noted within the fixture schedule. The descriptions and catalog numbers serve to establish the quality, appearance and performance of the specified lighting fixtures.
2. All lighting fixtures shall be the products of lighting equipment manufacturers who have previously demonstrated, by performance and reputation, the ability to manufacture products of the quality specified. Such manufacturers must maintain an organization and manufacturing facility capable of actually manufacturing the specified lighting fixtures. For the purpose of inspection, assure the Engineer, free and easy access to the manufacturing facilities and inventories of any manufacturer whose equipment the Contractor proposes to supply.
3. The Contractor shall be responsible to assure that inscription for exit and stairway signs required by local code is checked against that specified, prior to providing same. Advise the Engineer of changes required to conform to local codes before such changes are effected.
4. Review all drawings and coordinate with all trades the installation of lighting fixtures and devices. The lighting fixture and device finishes and construction shall be compatible with the wall and ceiling types based upon the Contractor's review of all Contract drawings.
5. Industrial fixtures shall be of the highest quality material and construction for their respective types.
6. Lamps for all lighting fixtures shall be in accordance with the Federal Energy Legislation for reduced energy consumption.
7. Fixtures shall be suitable for connection to concealed or exposed conduit runs as required in each particular location and shall be of sizes suitable for lamp sizes indicated on the Contract Drawings.
8. Fittings and other materials for special fixtures not definitely shown or specified shall be of approved material, make and quality and shall have a finish that will harmonize with other parts of the fixtures. Where suitable standard materials are not available such parts of the fixtures shall be specially manufactured.

B. Field Testing:

1. Field test the lighting fixtures. The field testing shall be performed in accordance with the requirements specified under Article 3.03.
2. Retain the services of the emergency inverter system manufacturer for field services. Field service shall be in accordance with the requirements specified under Article 3.04.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle lighting fixtures in accordance with the Specifications and the manufacturer's instructions.

1.08 SPARE PARTS

- A. Provide to the Engineer, at that part of the site and at such time as the Engineer may direct, spare parts for the lighting fixtures in accordance with the Specifications.
- B. The spare parts shall be listed in an index and packed in containers suitable for long term storage, bearing labels clearly designating the manufacturer's part number with complete information for use and reordering.
- C. The following spare parts shall be furnished:
1. 10 percent lamps shall be provided of each type of LED fixture, but not less than the requirement for five fixtures.
 2. 10 percent fuses shall be provided of each size and type, but not less than two.

PART 2 - PRODUCTS

2.01 LIGHT FIXTURES

- A. A lighting fixture shall be provided for each fixture symbol shown on the Contract Drawings. Provided light fixtures in accordance with the lighting fixture schedule shown in the Specifications.
- B. Provide light fixtures with all necessary hangers, supports, conduit adaptors, reducers, hooks, brackets and other support hardware. All hardware shall have a protective, non-corrosive finish.
- C. Provide recessed fixtures with trim moldings and frames suitable for the types of ceilings.
- D. Suspend pendent fixtures by means of an enclosed and gasketed cushion type hanger. The hanger shall be suitable to be mounted directly to the fixture outlet box and shall provide a minimum of 8 degrees swing from the vertical. Fixture stems shall be threaded rigid metal conduit, 1/2 inch minimum size. In corrosive areas stems shall be PVC coated.
- E. Where fixtures are subjected to moisture, or assembled of dissimilar metals, gaskets of approved material and thickness shall be provided.
- F. Explosion-proof type fixtures shall comply with the requirements of the National Electric Code for the hazardous locations indicated on the Contract Drawings.
- G. Fixtures shall be completely wired except where they will be directly connected to branch circuit wiring. The conductors shall be not less than No. 12 gauge, stranded, with approved heat resistant covering.
- H. Mounting heights of all fixtures shall be as shown on the Contract Drawings. For special types, the height shall be determined at the time of installation.

2.02 LAMPS

- A. LED Lamps shall have voltage ratings suitable for the voltages shown on the Contract Drawings.

2.03 BALLASTS

- A. General:
 - 1. Ballasts shall be matched for proper operation of lamps and shall meet the requirements for fixture light output, reliable starting and operation.
 - 2. Ballasts shall be UL listed and certified by Electrical Testing Laboratories and shall conform to certified ballast manufacturer's specifications.
 - 3. Ballasts shall be by Advance Transformer, Magnetek or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION OF LUMINAIRES

- A. Install luminaires at locations shown on the Contract Drawings. Luminaires locations shall be adjusted where necessary to clear conflicts and obstructions.
- B. Install luminaires complete with all hardware, and supporting devices necessary to make a safe complete and fully operative installation. Obtain from the manufacturer for each lighting fixture, diagrams, illustrations and other installation instructions. Install in conformance with such instructions and the requirements of NFPA 70 National Electrical Code.
- C. Install LED fixtures in conformance with manufacturer's recommendations and to suit the architectural details of the area involved. Independent supports from structural members of the building shall be provided. Unless otherwise shown on the Contract Drawings or stated in the Specifications, every fluorescent fixture shall have at least two supports, and continuous lines of LED fixtures shall be supported at 4-foot intervals.
- D. Pendant mounted fixtures shall be installed with pendants 1/2 inch for stems up to 5 feet and 3/4 inch for longer lengths.
- E. Furnish pendant stem hangers with suitable aligner canopies or outlet box covers so that the lighting fixtures hang vertical to the finished floor irrespective of the angle of the surface from

SECTION 16511 – LIGHTING FIXTURES AND DEVICES

which they are suspended. When lighting fixtures or hanger canopies are mounted flush to the ceiling or wall, and where raceways and outlet boxes serving the lighting fixtures are surface mounted to the ceiling or wall, finishing rings shall be provided to conceal the outlet box. All visible hanging devices and appurtenances shall have the same finish as the lighting fixture.

- F. Reflectors, lenses, diffusers, louvers and decorative elements of lighting fixtures shall not be installed until completion of plastering, ceiling tile work, painting, and general clean-up in the area.

3.02 FIELD TESTS

- A. After installation, the completed lighting system and receptacle devices shall be field tested for operation and conformance. The field tests shall be witnessed by the Engineer and certified by the Contractor. Provide testing consisting of the following:
 - 1. Wiring continuity test.
 - 2. Branch circuit load balance test.
 - 3. Fixture and control operation test.
 - 4. Emergency inverter system operation and functionality test shall be performed.
 - 5. Receptacle polarity and grounding.
- B. Submit a field test report. The report shall identify the test performed and the results obtained.

3.03 MANUFACTURER'S FIELD SERVICES

- A. A qualified manufacturer's service representative shall assist in the installation of the emergency inverter system, check the installation before it is placed into operation, assist in the performance of field tests, observe the initial operation and train the plant operations and maintenance staff in the care, operation and maintenance of the system.
- B. Provide equipment start-up services and training in accordance with the Specifications.
- C. Provide a field report from the manufacturer's representative for each visit to the site. The report shall include complete information on time, schedule, tasks performed, persons contacted, problems corrected, tests results, training instruction and all other pertinent information.
- D. The service representative shall sign in with the Engineer on each day they are at the site.

3.04 CLEANING OF LUMINAIRES

- A. Luminaires shall be cleaned inside and out to remove construction dust prior to substantial completion.
- B. Fixtures shall be relamped prior to substantial completion.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Packaged engine generator set.
- B. Exhaust piping, fittings, silencer and insulation.
- C. Control panels.
- D. Battery and charger.
- E. Vibration isolation.
- F. Base mounted fuel tank.
- G. Fuel.

1.02 PAYMENT

1.03 PAYMENT FOR WORK FURNISHED AND INSTALLED UNDER THIS SECTION SHALL BE INCLUDED IN THE LUMP SUM PRICE BID FOR THE CONTRACT, AS DESCRIBED IN SECTION 01150 – MEASUREMENT AND PAYMENT.

1.04 REFERENCES

- A. NEMA AB1 - Molded Case Circuit Breakers.
- B. NEMA MG1 - Motors and Generators.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. ANSI/NFPA 70 - National Electric Code.
- E. NFPA 110 - Emergency Standby Systems.
- F. NFPA 30 - Flammable and Combustible Liquids Code.
- G. NFPA 37 - Installation of Stationary Engines.
- H. NFPA 101 - Life Safety Code.
- I. UL - Standard for Safety for Steel Aboveground Tanks for Flammable and Combustible Liquids.
- J. USEPA Tier 3 Emissions Standards.
- K. Nassau County Department of Health.

1.05 SUBMITTALS

- A. Submit product data under provisions of Section 01300.
- B. Shop Drawings: Indicate electrical characteristics and connection requirements. Show plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, electrical diagrams including schematic and interconnection diagrams.
- C. Product Data: Provide data showing dimensions, weights, ratings, interconnection points and internal wiring diagrams for engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer, vibration isolators, radiator and derating schedules, operating performance, exhaust flow data, and cooling system data. Submit generator alternator output curves, deration curves and temperature data on the complete genset individual components.
- D. Test Reports: Indicate results of performance testing including 0.8 power factor test at 100 percent load.
- E. Prototype Test Reports: Submittals will not be received without submission of prototype test reports. No exceptions.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation and starting of product. Provide typical system interconnection wiring diagrams.
- G. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

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- H. Manufacturer's Field Reports: Submit under provisions of Section 017500. Indicate procedures and findings.
- I. Approval of Substitute Equipment: Design has been based on Cummins Power Generation generator. If substitute equipment is approved, the Contractor shall be responsible for the charges of any necessary revisions to the plans and specifications, drawings, and project documentation; and charges related to equipment spacing, enclosure sizes, foundation sizes, mounts, electrical wiring, ventilation equipment, fuel, exhaust components, etc., as well as any engineering costs. If a brand name other than that specified is proposed for use, identify the location of a locally available generator system for the Owner and Engineer to review and inspect, as well as witness testing to show compliance with the specifications. Also, the supplier must furnish a list of completed installations, including name, address and telephone number of at least five comparable installations which can prove the proposed products have operated satisfactorily for three years.
- J. Proposal for substitute equipment shall provide complete submittal data to the Engineer for approval or disapproval. Submit detailed sizing calculations for each generator to verify proposed model is capable of picking up the entire loads with voltage dips as herein specified

1.06 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01782.
- B. Operation Data: Include instructions for normal operation.
- C. Maintenance Data: Include instructions for routine maintenance requirements, service manuals for engine and day tank, oil sampling and analysis for engine wear, and emergency maintenance procedures.

1.07 QUALITY ASSURANCE

- A. Perform work in accordance with NFPA 110.
- B. Tank and secondary containment structure shall be submitted to and approved by the Nassau County Health Department.

1.08 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten years experience, and with an authorized distributor offering 24-hour parts and service availability within 50 miles of the project. The manufacturer shall fabricate the engines, generators and control panel. Automatic transfer switches and generator enclosures shall be supplied, warranted and serviced by a single system source supplier.
- B. Supplier: Authorized distributor of specified manufacturer with minimum six years documented experience with specified products and factory-trained service technicians. The supplier must be factory authorized to perform warranty service on the entire system, including but not limited to, the engines, generators, control panels and automatic transfer switches. The supplier must show proof of factory trained service technicians on all components.
- C. The complete engine generator system shall be standard of a single manufacturer. It shall be factory built, tested and shipped by this single manufacturer.

1.09 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70 and NFPA 110.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.
- C. Generator shall be EPA Tier 3-Certified for Stationary Emergency Applications.

1.10 WARRANTY

- A. Provide a 5-year manufacturer's limited warranty, including 100% parts and labor. The complete electrical power system, including but not limited to, generator set, controls, associated switches, enclosures, and accessories, as provided by the single source manufacturer, shall be warranted by the manufacturer against defects in materials and

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workmanship for a period of five (5) years from the date of system startup. Coverage shall include parts, labor, travel expenses, and labor to remove/reinstall the equipment, per manufacturer's standard published limited warranty. Supplier must be factory authorized to perform warranty service on the entire system, including, but not limited to, the engine, the generator, the control panels, and the automatic transfer switches. Provide separate warranty for fuel tanks not integral to the generator.

1.11 EXTRA SERVICES

- A. Provide from manufacturer's local authorized service representative a 5-year planned maintenance agreement at no additional cost to the Owner. Agreement shall include, as a minimum, one service call per year. The services must be performed by the authorized distributor of the equipment furnished, and may not be subcontracted. The following services shall be performed once a year.
1. Replace engine-lubricating oil and remove used oil from premises.
 2. Replace oil and fuel filters.
 3. Check oil/water separator. Remove water from premises.
 4. Check coolant system for proper levels and condition. Replace coolant filters and add corrosion inhibitor as needed.
 5. Check air filter.
 6. Check and clean crankcase breathers.
 7. Check turbocharger free-spin and end play.
 8. Check and adjust belts as required.
 9. Check engine for loose, bare or broken wiring. Replace as needed.
 10. Fuel tanks and lines to be inspected for the purpose of determining if excessive sludge or rust is collecting.
 11. Check entire equipment for fuel or water leaks.
 12. Check condition of batteries and report any action necessary for recharging or replacing.
 13. In presence of the Owner:
 - a. Start and run all engines. Check temperatures and pressures.
 - b. Test engine safety shutdown systems.
 - c. Test all transfer switches operation and time delays.
 - d. Submit a report of this inspection to the Owner and advise of any further work required.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Cummins Power Generation, Inc, Minneapolis, MN, Kohler Power Systems, Kohler, WI, Caterpillar, or specifically approved equal.
- B. It is intended that all products specified herein be of standard ratings, therefore, the KW and KVA, starting KVA and maximum allowable voltage dip, ratings, etc., shall be the manufacturer's next size or rating to exactly meet the specifications. No exceptions.

2.02 SYSTEM REQUIREMENTS

- A. The engine generator shall start and provide continuous power to the loads with 100 percent block loading at the time of transfer.

2.03 DIESEL ENGINE GENERATOR SET

- A. Rating: The AC engine generator set shall be Cummins Model C150D6D with Model ADS212 alternator, and shall be rated by the manufacturer for standby operation at 150 KW/188KVA at 0.8 PF, 60 Hz, 1800 RPM for use at 120/208 volts, 3-phase, 4 wire. Ratings shall be at an elevation of 500 feet above sea level, and at 122 degrees F.
1. Voltage regulation shall be +/- 1.0 percent of rated voltage for any constant load between no load and rated load.
 2. Frequency regulation shall be isochronous under varying from no load to 100% rated load.

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3. Random Voltage Variation: The cyclic variations in RMS voltage shall not exceed +/- 0.5% of rated speed for constant loads from no load to rated load, with constant ambient and operating temperature.
4. Random Frequency Variation: Speed variations for constant loads from no load to rated load shall not exceed plus or minus 0.25% of rated speed, with constant ambient and operating temperature.
5. Telephone Harmonic Distortion: The sum of AC voltage waveform harmonics, from no load to full linear load, shall not exceed 5% of rated voltage (L-N, L-L, L-L-L) and no single harmonic shall exceed 3% of rated voltage.
6. Telephone Influence Factor: TIF shall be less than 50 per NEMA MG1-22.43.
7. The diesel engine generator set shall be capable of picking up 100% of nameplate KW and power factor in one step with the engine generator set at operating temperature, in accordance with NFPA Standard 110, Paragraph 5-13.2.6.
8. The engine generator shall start and provide power to the loads in the following step starting sequence with a maximum instantaneous voltage dip of 25% and a maximum frequency dip of 5%.

Step No.	Description	Load	Volts/Phase	Motor Code	Load Type	Starting Method
1	Misc. Load	.24kW	120/1	-	Misc. Load	Full Voltage
1	Lighting	.36kW	120/1	-	Lighting Load	Full Voltage
1	Exhaust and supply fans Control Building	.75HP	120/1	N	Motor	Full Voltage
1	Battery Charger	.72kW	208/1	-	Misc. Load	Full Voltage
1	Electric Heater	5kW	208/3	-	Resist.	Full Voltage
1	Scada and Misc. Panels	2.5kW	120/1	-	Misc. Load	Full Voltage
1	Workshop Heater	5kW	208/3	-	Resist.	Full Voltage
1	Concession Stand	29kW	208/3	-	Misc. Load	Full Voltage
1	Park Lighting Panel	30kW	208/3	-	Misc. Load	Solid State
1	Sewage Grinder	3HP	208/3	K	Motor	Solid State
2	Sewage Pump	40HP	208/3	G	Motor	Solid State

9. The generator as a packaged unit (engine, alternator, and controls) shall provide a minimum 920 SKVA motor starting (PMG) at 90% sustained voltage.
10. The alternator performance shall be designed at a maximum voltage dip of 24%.
11. The following performance verifications shall be provided for substitute generators.
 - a. Submit two copies of generator sizing program based upon the specified step/starting sequence and associated voltage/frequency dips and required starting KVA.
 - b. As part of the substitution requirements the contractor shall enter all design step/starting sequence loads into the manufacturer's generator sizing program in the presence of the engineer to verify model proposed by substitute manufacturer meets the specified requirements for ambient temperature, site altitude, voltage dip, frequency dip, and starting KVA.

2.04 AC GENERATOR, REGULATOR AND EXCITER UNIT

- A. The AC generator, exciter and voltage regulator shall be designed and manufactured by the engine generator set manufacturer as a complete generator system.
- B. The AC generator shall be synchronous, four pole, revolving field, drip proof construction, single pre-lubricated sealed bearing, air cooled by a direct drive centrifugal blower fan and directly connected to the engine with flexible drive discs. The armature shall have skewed laminations of insulated electrical grade steel, two-thirds pitch windings in order to minimize field heating and voltage harmonics. The rotors shall have amortisseur (damper windings)

layer wound mechanically wedged winding construction. The rotors shall be dynamically balanced. The exciters shall be brushless, three phase, with full wave silicon diodes mounted on the rotating shaft and a surge suppressor connected in parallel with the field winding. Field discharge resistors shall not be acceptable. Systems using three wire solid state devices (such as SCRs or transistors) mounted on the rotor shaft shall not be acceptable.

- C. All insulation system components shall meet NEMA MG1 standard temperature limits for Class H insulation system. Actual temperature rise measured by resistance method at full load shall not exceed 105 degrees C to provide additional allowance for internal hot spots. The main generator and exciter insulation systems must be suitably impregnated for operation in severe environments for resistance to sand, salt and sea spray.
- D. Generator shall be a Permanent Magnet Generator (PMG). Permanent magnet generators shall provide excitation power to the auto-matic voltage regulator for immunity from voltage distortion caused by nonlinear SCR controlled loads on the generator. The PMG's shall sustain main field excitation power for optimum motor starting and to sustain short circuit current for selective operation and coordination of system overcurrent devices.

2.05 ENGINE GENERATOR SET CONTROLS

- A. The generator sets shall be provided with microprocessor-based control systems which are designed to provide automatic starting, monitoring, and control functions for the generator set. The control systems shall also be designed to allow local monitoring and control of the generator sets, and remote monitoring and control as described in this specification. The controls shall be mounted on the generator sets and shall be vibration isolated and prototype tested to verify the durability of all components in the system under vibration conditions encountered. The controls shall be UL-508 labeled, CSA282-M1989 certified, and meet IEC-8528 part 4. All switches, lamps and meters shall be oil-tight and dust-tight, and the enclosure doors shall be gasketed. There shall be no exposed points in the controls (with the door open) that operate in excess of 50 volts. The controls shall meet or exceed the requirements of Mil-Std 461C part 9, and IEC Std. 801.2, 801.3 and 801.5 for susceptibility, conducted and radiated electromagnetic emissions. The entire controls shall be tested and meet the requirements of IEEE587 for voltage surge resistance. The generator set mounted controls shall include the following features and functions:
 - 1. The generator control panel shall provide a network interface for the SCADA System. This network interface shall communicate all the generator status, control, display messages, troubleshooting and safety features as described below. Software shall be available for interfacing PLC Software with generator control panel communications. This interface and software development will be performed by another contract.
 - 2. Three position control switch labeled RUN/OFF/AUTO. In the RUN position the generator set shall automatically start and accelerate to rated speed and voltage. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
 - 3. Red "mushroom-head" push-button EMERGENCY STOP switch. Depressing the emergency stop switch shall cause the generator set to immediately shut down and be locked out from automatic restarting.
 - 4. Push-button RESET Switch: The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
 - 5. Generator Set AC Output Metering: The generator set shall be provided with a metering set with the following features and functions:
 - a. 2.5-inch, 90-degree scale analog voltmeter, ammeter, frequency meter, and kilowatt (KW) meter. These meters shall be provided with a phase select switch and an indicating lamp for upper and lower scale on the meters. Ammeter and KW meter scales shall be color coded in the following fashion: readings from 0-90% of generator set standby rating: green; readings from 90-100% of standby rating: amber; readings in excess of 100%: red.

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- b. Digital metering set, 0.5% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three phase voltages (line to neutral or line to line) simultaneously.
- c. Generator Set Alarm and Status Message Display: The generator set shall be provided with alarm and status indicating lamps to indicate non-automatic generator status, and existing alarm and shutdown conditions. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. The generator set control shall indicate the existence of the following alarm and shutdown conditions on a digital display panel:
 - 1) Low Oil Pressure (alarm)
 - 2) Low Oil Pressure (shutdown)
 - 3) Oil Pressure Sender Failure (alarm)
 - 4) Low Coolant Temperature (alarm)
 - 5) High Coolant Temperature (alarm)
 - 6) High Coolant Temperature (shutdown)
 - 7) Engine Temperature Sender Failure (alarm)
 - 8) Fail to Crank (shutdown)
 - 9) Overcrank (shutdown)
 - 10) Overspeed (shutdown)
 - 11) Low DC Voltage (alarm)
 - 12) Low Coolant Level (alarm or shutdown-selectable)
 - 13) High DC Voltage (alarm)
 - 14) Weak Battery (alarm)
 - 15) Low Fuel-Bellytank (alarm)
 - 16) High AC Voltage (shutdown)
 - 17) Low AC Voltage (shutdown)
 - 18) Under Frequency (shutdown)
 - 19) Over Current (warning)
 - 20) Over Current (shutdown)
 - 21) Short Circuit (shutdown)
 - 22) Ground Fault (alarm)
 - 23) Over Load (alarm)
 - 24) Emergency Stop (shutdown)
 - 25) In addition, provisions shall be made for indication of two customer-specified or future alarm or shutdown conditions. These two alarm conditions shall be interfaced with leak detection/overfill alarm panel for overfill and leak detection. Labeling of the customer specified or future alarm or shutdown conditions shall be of the same type and quality as the above specified conditions. The non-automatic indicating lamp shall be red and shall flash to indicate the generator set is not able to automatically respond to a command to start from a remote location.
- d. Engine Status Monitoring: The following information shall be available from a digital status panel on the generator set control:
 - 1) Engine Oil Pressure (psi or kPA)
 - 2) Engine Coolant Temperature for left and right block temperatures (degrees F or C; both)
 - 3) Engine Oil Temperature (degrees F or C)
 - 4) Engine Speed (rpm)
 - 5) Number of Hours of Operation (hours)
 - 6) Number of Start Attempts
 - 7) Battery Voltage (DC volts)
- e. Control Functions: The control system shall provide for the following functions:

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- 1) The control system provided shall include a cycle cranking system, which allows for user selected crank time, reset time, and number of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15 second rest period between cranking periods.
- 2) The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled.
- 3) The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and ramping function to control engine speed and limit exhaust smoke while the unit is starting. The governor control shall be suitable for use in paralleling applications without component changes.
- 4) The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.
- 5) The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components, and an actual failure condition.
- f. Alternator Control Functions: The generator set control shall include the following alternator control functions:
 - 1) The generator set shall include an automatic voltage regulation system which is matched, and prototype tested with the governing system provided. It shall be immune from mis-operation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The systems shall include a torque-matched characteristic, which shall reduce output voltage in proportion to frequency below a threshold of [58-59] HZ. The voltage regulator shall include adjustments for gain, damping and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alpha-numeric LED readout to indicate setting level.
 - 2) The voltage regulation system shall include provisions for reactive load sharing and electronic voltage matching for paralleling applications. Motorized voltage adjust pot is not acceptable for voltage matching.
 - 3) Controls shall be provided to monitor the output current of the generator set and initiate an alarm when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator.
 - 4) Controls shall be provided to monitor the KW load on the generator set, and initiate an alarm condition when total load on the generator set exceeds the generator set rating for in excess of 5 seconds.
 - 5) Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.
 - 6) An AC over/under voltage monitoring system which responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.
 - 7) A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage is less than 25VDC or more than 32VDC. During engine starting, the low voltage limit shall be disabled, and if DC voltage drops to less than 14.4 volts for more than two seconds a "weak battery" alarm shall be initiated.

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- 8) The control system shall include a ground fault monitoring relay. The relay shall be adjustable from 100-1200 amps and include an adjustable time delay of 0-1.0 seconds. The relay shall be for indication only, and not trip or shut down the generator set. Note bonding and grounding requirements for the generator set and provide relay which will function correctly in system as installed.
- g. Control Interfaces for Remote Monitoring: All control and interconnection points from the generator set to remote components shall be brought to a separate connection box. No field connections shall be made in the control enclosure or in the AC power output enclosure. Provide the following features in the control system:
 - 1) Form "C" dry common alarm contact set rated 2A @ 30VDC to indicate existence of any alarm or shutdown condition on the generator set.
 - 2) One set of contacts rated 2A @ 30VDC to indicate generator set is ready to load. The contacts shall operate when voltage and frequency are greater than 90% of rated condition.
 - 3) A fused 10 amp switched 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit whenever the generator set is running.
 - 4) A fused 20 amp 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit at all times from the engine starting/control batteries.
 - 5) The control shall be provided with provisions for connection of remote monitoring equipment as described herein or shown on the drawings.

2.06 ENGINES

- A. The diesel engine shall be manufactured by Cummins Engine Company and designed specifically for generator set duty. The diesel engine shall be 4 cycle, diesel fueled, direct injection, 1800 RPM, with forged steel crankshaft and connecting rods. The cylinder blocks shall be cast iron with replaceable wet liners and have four valves per cylinder. The engines shall be turbocharged and aftercooled.
- B. Two cycle engines will not be acceptable.
- C. Electronic governor systems shall provide automatic isochronous frequency regulation. The engine governing systems shall not utilize any exposed operating linkage.
- D. The engines shall be cooled by a unit-mounted closed loop radiator system including belt-driven pusher fan, coolant pump and thermostat temperature control. The cooling systems shall be rated for full rated load operation in 104 degrees F (40 degrees C) ambient condition. The cooling capability of the generator sets shall be demonstrated by prototype tests on a representative generator set model conducted by the generator set manufacturer; calculated data from the radiator manufacturer only is not sufficient. Radiators shall be provided with a duct adapter flange permitting the attachment of an air discharge duct to direct the radiator air outside according to the manufacturer's instructions.
- E. Rotating parts shall be guarded against accidental contact per OSHA requirements.
- F. Engine Schedule:

PARAMETER	MORGAN PARK
Radiator Cooling System Air Flow	10800 SCFM
Combustion Air	522 SCFM
Maximum Allowable static Restriction	0.5 inches of water

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Engine Displacement	408 Cubic inches
Minimum number of cylinders	6

- G. The entire cooling air system is based on the above data. All costs incurred if an alternate manufacturer is purchased shall be the responsibility of the Contractor. These costs shall include costs to all other trades as well as any associated engineering fees.

2.07 ENGINE ACCESSORY EQUIPMENT

- A. The engine generator sets shall include the following accessories:
1. Electric starters capable of three complete cranking attempts without overheating, before overcrank shutdown (75 seconds).
 2. Positive displacement, mechanical, full pressure, lubrication oil pumps. Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicators. Provide bypass oil filters.
 3. Engine driven, mechanical, positive displacement fuel pumps. Fuel filters with replaceable spin-on canister elements. Replaceable heavy-duty dry element air cleaners with restriction indicators and safety element. Flexible fire rated supply and return fuel lines.
 4. Engine mounted battery charging alternators, 70 ampere and solid-state voltage regulators.
 5. Fuel water separators.
 6. Anti-condensation heater for alternator.

2.08 BASES

- A. The engine-generator set shall be mounted on a heavy-duty steel base to maintain proper alignment between components. The engine-generator set shall incorporate battery trays with battery hold-down clamps on the base rails. Provisions for stub up of electrical connections shall be within the footprint of the generator set base rails and within the base tanks as specified in the housing section of the specification. Vibration isolators, spring type, shall be provided to be mounted under the generator set base.

2.09 GENERATOR SETS CIRCUIT BREAKERS

- A. Generator main circuit breaker shall be solid state UL listed, molded case type, rated as listed below. Circuit breakers shall be mounted in a separate NEMA 1 enclosure and be shipped completely wired to the gensets. No exceptions. Enclosures shall include neutral blocks for field connection.
- B. Solid State circuit breakers shall be 100% rated: Refer to drawings for sizes.
- C. Circuit breaker (CB) shall be long time current and instantaneous pickup with solid state trip unit. CB shall have visible mechanical fault indicator and push button trip.
- D. Circuit breakers shall be rated at 65,000 AIC.
- E. Provide auxiliary contacts on breaker position.

2.10 ACCESSORIES

- A. Vibration isolators: Spring type with vertical restraint, painted steel housing and neoprene base pad rated for Seismic Zone 2, Ace Mountings Co., Inc. Type 821.
- B. Starting and Control Batteries: Two (2) 12 volt starting batteries each genset, lead acid type, 12 volt DC, sized to accommodate 45 seconds of cranking at an ambient of 0 degrees F without being recharged.
- C. Battery Chargers: One 100 amp voltage regulated battery charger shall be provided for each engine-generator set. Input AC voltage and DC output voltage shall be as required. Chargers shall be equipped with float, taper and equalize charge settings. Operational monitors shall

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provide visual output along with individual form C contacts rated at 4 amps, 120 VAC, 30 VDC for remote indication of:

1. Loss of AC Power - red light.
2. Low Battery Voltage - red light.
3. High Battery Voltage - red light.
4. Power ON - green light (no relay contact).
5. Block Heaters: Thermostatically controlled jacket water heater shall be supplied for each genset with a minimum size shall be 2500 watts. Input voltage of heaters shall be 208 VAC 1 phase.
6. Electrical Matting: Dielectric strength 30,000 volts, 2 feet wide, 1/4 inch thick corrugated ASTM D 178 Type 2, Class II.
7. Fuel Oil: Fuel Oil shall not contain dirt or sediment, or be of a structure to cause clogging of piping and nozzles, and prevent proper operation of the equipment. The ultra-low sulfur diesel (ULSD) fuel supplied under this contract shall meet the following specifications:
 - a. Viscosity: 1.3 to 4.1 cenistrokes at 104 degrees F.
 - b. Cetane Number: 42 minimum above 32 degrees F; 45 minimum below 32 degrees F.
 - c. Sulfur Content: not to exceed .0015 mass percent (15 ppm) sulfur content.
 - d. Active Sulfur: Copper Strip Corrosion not to exceed Number 3 rating after 3 hours at 122 degrees F.
 - e. Water Sediment: not to exceed 0.05 volume percent
 - f. Carbon residue: Not to exceed 0.35 mass percent on 10 volume-percent residuum
 - g. Density: 0.816 to 0.876 grams per cubic centimeter at 59 degrees F.
 - h. Cloud Point: 11 degrees F below lowest ambient temperature at which fuel is expected to operate.
 - i. Ash: Not to exceed 0.02 mass-percent
 - j. Distillation: 10 volume-percent at 540 degrees F maximum, 90 volume-percent at 680 degrees F maximum, 100 volume-percent at 725 degrees F maximum. The distillation curve must be smooth and continuance.
 - k. Lubricity: HFFR – maximum of 0.20 inches Wear Scar Diameter (WSD) at 140 degrees F: SLBOCLE – minimum of 3100 grams.
8. Provide generator 20 light remote annunciator located on the transfer switch cubicle. Interface generator set controls with battery charger and fuel tank alarms for all status conditions. Provide all power, control wiring including conduits.

2.11 EXHAUST SYSTEMS

- A. One exhaust silencer shall be provided for the generator set. The silencer shall be super critical grade. The silencer shall reduce total noise to a maximum dBA level of 85 at 7 meters.
- B. Exhaust silencer within buildings shall be GT Exhaust Slim Line Silencer super critical bottom inlet/side outlet hung from the building ceiling. Provide all fittings, reducers, couplings elbows, spool pieces and supports.
- C. All fittings, accessories, bolts, nuts and hardware shall be type 304 stainless steel. Provide heat resistant gaskets between all flanged connections to serve as dielectric protectors.
- D. The exhaust gas temperature shall not exceed 872 degrees F. The maximum back pressure shall not exceed 40.19 inches of water. The design of the entire exhaust system is based on the above data. If a substitution of model specified is made, all costs incurred to redesign as well as costs to other trades to modify the layout shall be the complete responsibility of the Contractor.
- E. Provide stainless steel flexible exhaust connections for the engine as required for connection between the engine exhaust manifolds and exhaust lines in compliance with applicable codes and standards.
- F. Provide an exhaust system condensation trap with manual drain valve to trap and drain off exhaust condensation and to prevent condensation from enter-ing the engine.

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- G. Provide a suitable weather cap at the stack outlet with all necessary flanges and fittings for proper installation. The weather cap shall have the proper counter weights attached to prevent banging while generator is unloaded.
- H. Thermal jacket for interior exhaust lines and silencer by FIRWIN CORP. or engineered approved equal. Jacket thickness shall be sufficient to maintain a surface temperature of less than 200 degrees F.
- I. Exhaust mufflers shall be installed by enclosure manufacturer, so their weight is not supported by the engines.

2.12 FUEL TANKS

- A. The diesel oil base tank shall be rated at 6701 gallons and shall be placed in a rupture basin of 110% capacity for secondary containment, in accordance with Nassau County requirements.
- B. Minimum 12 gauge steel shall be used for tank body, and minimum 3/16-inch steel shall be used for rupture basin. Tanks shall be UL 142 listed and labeled, have vent, emergency vent, lockable fill, fuel level gauge, and fuel level contacts. Rupture basin shall have contacts to indicate a leak in the fuel tank. Tanks shall be factory tested for leaks under pressure prior to shipment. Submit report on leak test results to the Engineer prior to shipment. Bottom of rupture basin shall be raised 1-3/4 inch minimum off concrete pad on stainless steel channels so bottom does not rest on concrete pad. Exterior of tank and rupture basin and base rails shall be painted with coal tar epoxy primer and exterior epoxy paint to prevent corrosion.
 - 1. There shall be separation between the dike/sub-base and the mounting pad, to prevent the accumulation of moisture.
 - 2. Provide a five (5) gallon fill containment.
 - 3. Provide a "scully" type fill connection.
 - 4. Secondary containment shall be supplied with a removal inspection plate large enough to enable visual inspection of the primary tank.
 - 5. Tank shall be equipped with an audible/visual high-level alarm/leak detection alarm under Section 16279. The alarm shall be set to indicate when fuel has reached 90% of tank capacity.
 - 6. A positive fuel shut off shall be installed in the fuel supply line.
 - 7. The fuel supply and return lines shall be fire rated, U.L listed and labeled.
 - 8. Fuel connections shall be liquid tight.
 - 9. Provide 1/4 turn fuel shut off valve.
 - 10. Check valve shall be installed down stream of liquid tight connection for prevention of blow back.
 - 11. Tank shall be elevated so that it does not touch the pad.
 - 12. Tank vents shall terminate outside of building.
 - 13. Fuel Level Gauge, spiral or mechanical float arm, Rochester Gauges or approved equal.
 - 14. Overfill Protection Valve: Universal Valve Company, Part No. 49, or approved equal.
 - 15. Tanks shall be labeled with a plate permanently affixed to the top of the tank near the lifting lug. Plate shall contain year of manufacture of the tank, manufacturer's name, UL identification number, tank model number, capacity and dimensions, design ratings and manufacturer's identification number. A second plate as above, but also containing the date of tank installation, shall be permanently affixed at the fill port.
 - 16. The tank end shall be stenciled with tank manufacturer, capacity and UL identification number. Letters shall be 1-1/2 inches high minimum.
 - 17. Tanks shall be provided with a remote fill port within a lockable 5-gallon containment box.

2.13 - ENCLOSURE

- A. The generator set shall be provided with a Level 2 factory-installed sound attenuated housing which allows the generator set to operate at full rated load in the ambient conditions previously specified. The enclosure shall reduce the sound level of the generator set while operating at full rate load to an 8-position average of 69.3 dBA and maximum of 70.6 dBA at any location 7 meters from the generator set in a free field environment. Housing materials used shall be

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steel and aluminum. Fiberglass and plastic are not acceptable. Acoustical materials used shall be oil and water resistant. No foam materials shall be used.

- B. The enclosure shall include hinged doors for access to both sides of the engine and alternator, and the control equipment and a hinged rear see-through control door. Key-locking and padlockable door latches shall be provided for all doors. Door hinges shall be stainless steel.
- C. The enclosure shall be provided with an exhaust silencer which is mounted on top of the enclosure and allows the generator set package to meet specified sound level requirements. Silencer and exhaust shall include a rain cap and rain shield.
- D. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturers standard color using a two-step electrocoating paint process, or equal meeting the performance requirements specified below. Metal part surfaces shall be prepared, primed and painted. The painting process shall result in a coating which meets the following requirements:
 - 1. Primer thickness, 0.5-2.0 mils. Top coat thickness, 0.8-1.2 mils.
 - 2. Gloss, per ASTM D523, 80% plus or minus 5%. Gloss retention after one year shall exceed 50%.
 - 3. Crosshatch adhesion, per ASTM D3359, 4B-5B.
 - 4. Impact resistance, per ASTM D2794, 120-160 inch pounds.
 - 5. Salt spray, per ASTM B117, 1000+ hours.
 - 6. Humidity, per ASTM D2247, 1000+ hours.
 - 7. Water Soak, per ASTM D2247, 1000+ hours.
 - 8. Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts will not be acceptable. Fasteners used shall be corrosion resistant and designed to minimize marring of the painted surface when removed for normal installation or service work. The enclosure shall be built and tested by the engine generator manufacturer.
 - 9. Louver and baffles shall be provided on air inlet to deter entry of rain and snow.
 - 10. Equip with rodent guards.

2.14 SOURCE QUALITY CONTROL

- A. To provide proven reliability of the system, three series of tests shall be performed: prototype model tests, production model tests and field tests. The manufacturer shall provide documentation demonstrating satisfactory prototype and production test results. Generator sets that have not been prototype tested and factory tested at 0.8 PF will not be acceptable.
- B. Generator Set Factory Production Tests and Evaluation: These tests and evaluations must have been performed on a prototype generator set representative of the Model specified. A summary of the generator set testing results shall be submitted for review. The manufacturer's standard series of components development tests on the generator system, engine and other major components shall also be performed and available for review, but shall not be acceptable as a substitute for prototype testing on the complete representative generator set prototype.
- C. Torsiograph Analysis and Test: The manufacturer of the generator set shall verify that the engine generator set, as configured, is free from harmful torsional stresses. The analysis shall include correlation of empirical data from tests on a representative prototype. The empirical data must include spectrum analysis of the torsional transducer output within the operating speed range of the engine generator set. Calculations based on engine and generator separately are not acceptable.
- D. Temperature Rise Test: Complete thermal evaluation of a prototype generator rotor and starter must include actual measurement of internal generator and exciter temperatures by embedded detector method, and measurement of average temperature rise by resistance method. No position measured any place in the windings may exceed the temperature rise limits of NEMA for the particular type of insulation system used. Resistance method temperature rise data shall be confirmed by a full load test on the generator set prototype to include conducted and radiated heat from the engine.

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- E. Short Circuit Test: A test on a prototype generator set shall have demonstrated that the generator set is designed to withstand the mechanical forces associated with a short circuit condition. With the generator set operating at rated load and speed, the generator terminals must be short circuited on all three phases for a duration of 20 seconds. At the conclusion of this test, the generator set must be capable of full load operation.
- F. Endurance Run Test: A minimum of 500 continuous hours of endurance testing with a representative generator set prototype operating as defined by the manufacturer's standby rating shall have been performed. Endurance testing shall be used to verify structural soundness and durability.
- G. Maximum Power Test: With the prototype generator set at normal operating temperature and with all power consuming auxiliaries in place, the maximum power available at rated speed shall be determined with the governor set at its fuel stop. The generator set shall maintain this power for a minimum of two minutes.
- H. Linear Vibration Test: A test for in-line motion of components occurring along a repeatable path shall meet the manufacturer's acceptance criteria.
- I. Cooling System Test: A cooling system test shall demonstrate the ability of the generator set cooling system to maintain normal operating temperature while operating at full rated load and power factor at the highest ambient temperature (122°F) of the system rating. Cooling air requirements, radiator air flow and maximum allowable restriction at radiator discharge, shall be verified by this test.
- J. Maximum Motor Starting KVA: Motor starting KVA shall be determined by test, based on a sustained RMS recovery voltage of at least 90 percent of no load voltage with the specified load KVA at near zero power factor applied to the generator set.
- K. Transient Response, Steady State Speed Control and Voltage Regulation: Prototype generator set tests shall demonstrate consistent performance as follows; stable voltage and frequency at all loads from no load to full rated load, consistent frequency backwidth with steady state load, maximum voltage and frequency kp on load acceptance and rejection and restoration to steady state after sudden load changes. Transient response is a complete generator set (engine, generator, exciter, and regulator) performance criteria and cannot be established on generator data alone.

2.15 MANUFACTURERS SERVICES

- A. Supply and credit to the Owner field services
- B. Provide the following field services as a minimum at each site:
 - 1. One (1) day for providing installation supervision to the Contractor.
 - 2. One (1) day totaling one (1) trip once the system has been installed to check the completed installations, make all necessary adjustments and otherwise place the system into permanent operation. Electrical wiring shall be verified by the representative. During trip, to be held before substantial completion, provide operation and maintenance instruction to the Owner. A complete review of the Operations and Maintenance Manual shall be presented at this time.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Submit application for installation of generator fuel tank to the Nassau County Department of Health.
- B. Notify the Engineer in writing a minimum of six (6) business days prior to installation to allow for the required minimum five (5) day notification to the Nassau County Department of Health.
- C. Coordinate actions with the Department of Health and the Engineer to allow observation of all significant phases of construction and testing.

3.02 INSTALLATION

- A. Install engine generator and all appurtenances in accordance with manufacturer's recommendations.
- B. Install exhaust components as shown on the drawings and as required to comply with NFPA 37 and local codes and regulations. Components shall be sized to assure full load operation without excessive backpressure sized as per manufacturer's recommendations with actual site dimensions when installed as shown on the drawing. Make provisions as required for pipe expansion and contraction.
- C. Install anchor bolts.
- D. Installation shall comply with applicable State and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.
- E. Fuel tank shall be installed by a Nassau County licensed tank installer and shall conform to compliance with all Nassau County Article III requirements.
- F. Install leak/overfill panel with individual lights and an alarm horn centered five (5) feet above grade within viewing and hearing distance of the fuel fill.
- G. Provide electrical matting on the floor around the perimeter of the generator. Trim matting to fit.

3.03 FIELD QUALITY CONTROL

- A. Initial startup and field acceptance tests are to be conducted by the authorized representative of the system manufacturer who supplies the equipment.
- B. After approval by Nassau County Department of Health, provide fuel to conduct start-up and acceptance tests.
- C. Test data shall be collected and recorded on the following: time of day, coolant temperature, operating oil pressure, battery charging rate, cranking time, crank-to-rated frequency time, voltage and frequency overshoot, load assumption-to-steady state voltage and frequency stabilization time, operating voltage, frequency, current, kilowatts and power factor. All data shall be taken every fifteen (15) minutes.
- D. Procedure: Generator manufacturer shall conduct a six (6) hour load bank test at 1.0 power factor for each generator set. Provide temporary load bank for testing generator set at 100% load. Load bank test shall test generator at full nameplate KW rating. Generator manufacturer's representative shall record test data, as described in (B) above. Test data shall be tabulated and typed for submission and approval by the Engineer for final acceptance. No handwritten field notes will be allowed.
- E. Conduct a test of the generator and transfer switch to provide power to the facility for a period of 2 hours. At the end of the test period, transfer back to the normal power source.
- F. Follow completion of all tests, provide fuel to fill the fuel tank to 90% of capacity.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Packaged engine generator set.
- B. Exhaust piping, fittings, silencer and insulation.
- C. Control panels.
- D. Battery and charger.
- E. Vibration isolation.
- F. Base mounted fuel tank.
- G. Fuel.

1.02 PAYMENT

1.03 PAYMENT FOR WORK FURNISHED AND INSTALLED UNDER THIS SECTION SHALL BE INCLUDED IN THE LUMP SUM PRICE BID FOR THE CONTRACT, AS DESCRIBED IN SECTION 01150 – MEASUREMENT AND PAYMENT.

1.04 REFERENCES

- A. NEMA AB1 - Molded Case Circuit Breakers.
- B. NEMA MG1 - Motors and Generators.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. ANSI/NFPA 70 - National Electric Code.
- E. NFPA 110 - Emergency Standby Systems.
- F. NFPA 30 - Flammable and Combustible Liquids Code.
- G. NFPA 37 - Installation of Stationary Engines.
- H. NFPA 101 - Life Safety Code.
- I. UL - Standard for Safety for Steel Aboveground Tanks for Flammable and Combustible Liquids.
- J. USEPA Tier 3 Emissions Standards.
- K. Nassau County Department of Health.

1.05 SUBMITTALS

- A. Submit product data under provisions of Section 01300.
- B. Shop Drawings: Indicate electrical characteristics and connection requirements. Show plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, electrical diagrams including schematic and interconnection diagrams.
- C. Product Data: Provide data showing dimensions, weights, ratings, interconnection points and internal wiring diagrams for engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer, vibration isolators, radiator and derating schedules, operating performance, exhaust flow data, and cooling system data. Submit generator alternator output curves, deration curves and temperature data on the complete genset individual components.
- D. Test Reports: Indicate results of performance testing including 0.8 power factor test at 100 percent load.
- E. Prototype Test Reports: Submittals will not be received without submission of prototype test reports. No exceptions.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation and starting of product. Provide typical system interconnection wiring diagrams.
- G. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

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- H. Manufacturer's Field Reports: Submit under provisions of Section 017500. Indicate procedures and findings.
- I. Approval of Substitute Equipment: Design has been based on Cummins Power Generation generator. If substitute equipment is approved, the Contractor shall be responsible for the charges of any necessary revisions to the plans and specifications, drawings, and project documentation; and charges related to equipment spacing, enclosure sizes, foundation sizes, mounts, electrical wiring, ventilation equipment, fuel, exhaust components, etc., as well as any engineering costs. If a brand name other than that specified is proposed for use, identify the location of a locally available generator system for the Owner and Engineer to review and inspect, as well as witness testing to show compliance with the specifications. Also, the supplier must furnish a list of completed installations, including name, address and telephone number of at least five comparable installations which can prove the proposed products have operated satisfactorily for three years.
- J. Proposal for substitute equipment shall provide complete submittal data to the Engineer for approval or disapproval. Submit detailed sizing calculations for each generator to verify proposed model is capable of picking up the entire loads with voltage dips as herein specified

1.06 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01782.
- B. Operation Data: Include instructions for normal operation.
- C. Maintenance Data: Include instructions for routine maintenance requirements, service manuals for engine and day tank, oil sampling and analysis for engine wear, and emergency maintenance procedures.

1.07 QUALITY ASSURANCE

- A. Perform work in accordance with NFPA 110.
- B. Tank and secondary containment structure shall be submitted to and approved by the Nassau County Health Department.

1.08 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten years experience, and with an authorized distributor offering 24-hour parts and service availability within 50 miles of the project. The manufacturer shall fabricate the engines, generators and control panel. Automatic transfer switches and generator enclosures shall be supplied, warranted, and serviced by a single system source supplier.
- B. Supplier: Authorized distributor of specified manufacturer with minimum six years documented experience with specified products and factory-trained service technicians. The supplier must be factory authorized to perform warranty service on the entire system, including but not limited to, the engines, generators, control panels and automatic transfer switches. The supplier must show proof of factory trained service technicians on all components.
- C. The complete engine generator system shall be standard of a single manufacturer. It shall be factory built, tested and shipped by this single manufacturer.

1.09 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70 and NFPA 110.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.
- C. Generator shall be EPA Tier 3-Certified for Stationary Emergency Applications.

1.10 WARRANTY

- A. Provide a 5-year manufacturer's limited warranty, including 100% parts and labor. The complete electrical power system, including but not limited to, generator set, controls, associated switches, enclosures, and accessories, as provided by the single source manufacturer, shall be warranted by the manufacturer against defects in materials and

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workmanship for a period of five (5) years from the date of system startup. Coverage shall include parts, labor, travel expenses, and labor to remove/reinstall the equipment, per manufacturer's standard published limited warranty. Supplier must be factory authorized to perform warranty service on the entire system, including, but not limited to, the engine, the generator, the control panels, and the automatic transfer switches. Provide separate warranty for fuel tanks not integral to the generator.

1.11 EXTRA SERVICES

- A. Provide from manufacturer's local authorized service representative a 5-year planned maintenance agreement at no additional cost to the Owner. Agreement shall include, as a minimum, one service call per year. The services must be performed by the authorized distributor of the equipment furnished and may not be subcontracted. The following services shall be performed once a year.
 - 1. Replace engine-lubricating oil and remove used oil from premises.
 - 2. Replace oil and fuel filters.
 - 3. Check oil/water separator. Remove water from premises.
 - 4. Check coolant system for proper levels and condition. Replace coolant filters and add corrosion inhibitor as needed.
 - 5. Check air filter.
 - 6. Check and clean crankcase breathers.
 - 7. Check turbocharger free-spin and end play.
 - 8. Check and adjust belts as required.
 - 9. Check engine for loose, bare or broken wiring. Replace as needed.
 - 10. Fuel tanks and lines to be inspected for the purpose of determining if excessive sludge or rust is collecting.
 - 11. Check entire equipment for fuel or water leaks.
 - 12. Check condition of batteries and report any action necessary for recharging or replacing.
 - 13. In presence of the Owner:
 - a. Start and run all engines. Check temperatures and pressures.
 - b. Test engine safety shutdown systems.
 - c. Test all transfer switches operation and time delays.
 - d. Submit a report of this inspection to the Owner and advise of any further work required.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Cummins Power Generation, Inc, Minneapolis, MN, Kohler Power Systems, Kohler, WI, Caterpillar, or specifically approved equal.
- B. It is intended that all products specified herein be of standard ratings, therefore, the KW and KVA, starting KVA and maximum allowable voltage dip, ratings, etc., shall be the manufacturer's next size or rating to exactly meet the specifications. No exceptions.

2.02 SYSTEM REQUIREMENTS

- A. The engine generator shall start and provide continuous power to the loads with 100 percent block loading at the time of transfer.

2.03 DIESEL ENGINE GENERATOR SET

- A. Rating: The AC engine generator set shall be Cummins Model C200D6D with Model ADS342 alternator, and shall be rated by the manufacturer for standby operation at 200KW/250KVA at 0.8 PF, 60 Hz, 1800 RPM for use at 277/480 volts, 3-phase, 4 wire. Ratings shall be at an elevation of 500 feet above sea level, and at 122 degrees F.
 - 1. Voltage regulation shall be +/- 1.0 percent of rated voltage for any constant load between no load and rated load.
 - 2. Frequency regulation shall be isochronous under varying from no load to 100% rated load.

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3. Random Voltage Variation: The cyclic variations in RMS voltage shall not exceed +/- 0.5% of rated speed for constant loads from no load to rated load, with constant ambient and operating temperature.
4. Random Frequency Variation: Speed variations for constant loads from no load to rated load shall not exceed plus or minus 0.25% of rated speed, with constant ambient and operating temperature.
5. Telephone Harmonic Distortion: The sum of AC voltage waveform harmonics, from no load to full linear load, shall not exceed 5% of rated voltage (L-N, L-L, L-L-L) and no single harmonic shall exceed 3% of rated voltage.
6. Telephone Influence Factor: TIF shall be less than 50 per NEMA MG1-22.43.
7. The diesel engine generator set shall be capable of picking up 100% of nameplate KW and power factor in one step with the engine generator set at operating temperature, in accordance with NFPA Standard 110, Paragraph 5-13.2.6.
8. The engine generator shall start and provide power to the loads in the following step starting sequence with a maximum instantaneous voltage dip of 18% and a maximum frequency dip of 3%.

Step No.	Description	Load	Volts/ Phase	Motor Code	Load Type	Starting Method
1	Misc. Load	7.25kW	120/1	-	Misc. Load	Full Voltage
1	Lighting	4.84kW	120/1	-	Lighting Load	Full Voltage
1	Heating	47.5 kW	208/3	-	Resist.	Full Voltage
1	Generator Exhaust Fans	.75HP	480/3	-	Motor	Across the Line
1	EF Wet Well	5HP	480/3		Motor	Across the Line
1	EF Wet Well	5HP	480/3		Motor	Across the Line
1	EF Wet Well	5HP	480/3		Motor	Across the Line
1	EF Wet Well	5HP	480/3		Motor	Across the Line
1	Emergency Storage Chamber				-	Full Voltage
1	Sump Pump No. 1					Full Voltage
1	Sump Pump No. 2					Full Voltage
1	Exhaust and supply fans Control Building	-	120	-	Motor	Full Voltage
1	Electric Heater No.1 Control Building	-	-/3	-	Resist.	Full Voltage
1	Sewage Grinder	4.4 kW	480/3	J	Motor	Full Voltage
2	Seal Water Pump	3 HP	480/3	N	Motor	Full Voltage
2	Seal Water Pump	3 HP	480/3	N	Motor	Full Voltage
2	Sewage Pump	72 HP	480/3	G	Motor	Full Voltage
3	Overhead Crane	2 HP	480/3	L	Motor	Full Voltage

9. The generator as a packaged unit (engine, alternator, and controls) shall provide a minimum 920 SKVA motor starting (PMG) at 90% sustained voltage.
10. The alternator performance shall be designed at a maximum voltage dip of 35%.
11. The following performance verifications shall be provided for substitute generators.
 - a. Submit two copies of generator sizing program based upon the specified step/starting sequence and associated voltage/frequency dips and required starting KVA.
 - b. As part of the substitution requirements the contractor shall enter all design step/starting sequence loads into the manufacturer's generator sizing program in the presence of the engineer to verify model proposed by substitute manufacturer meets

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the specified requirements for ambient temperature, site altitude, voltage dip, frequency dip, and starting KVA.

2.04 AC GENERATOR, REGULATOR AND EXCITER UNIT

- A. The AC generator, exciter and voltage regulator shall be designed and manufactured by the engine generator set manufacturer as a complete generator system.
- B. The AC generator shall be synchronous, four pole, revolving field, drip proof construction, single pre-lubricated sealed bearing, air cooled by a direct drive centrifugal blower fan and directly connected to the engine with flexible drive discs. The armature shall have skewed laminations of insulated electrical grade steel, two-thirds pitch windings in order to minimize field heating and voltage harmonics. The rotors shall have amortisseur (damper windings) layer wound mechanically wedged winding construction. The rotors shall be dynamically balanced. The exciters shall be brush-less, three phase, with full wave silicon diodes mounted on the rotating shaft and a surge suppressor connected in parallel with the field winding. Field discharge resistors shall not be acceptable. Systems using three wire solid state devices (such as SCRs or transistors) mounted on the rotor shaft shall not be acceptable.
- C. All insulation system components shall meet NEMA MG1 standard temperature limits for Class H insulation system. Actual temperature rise measured by resistance method at full load shall not exceed 105 degrees C to provide additional allowance for internal hot spots. The main generator and exciter insulation systems must be suitably impregnated for operation in severe environments for resistance to sand, salt and sea spray.
- D. Generator shall be a Permanent Magnet Generator (PMG). Permanent magnet generators shall provide excitation power to the automatic voltage regulator for immunity from voltage distortion caused by nonlinear SCR controlled loads on the generator. The PMG's shall sustain main field excitation power for optimum motor starting and to sustain short circuit current for selective operation and coordination of system overcurrent devices.

2.05 ENGINE GENERATOR SET CONTROLS

- A. The generator sets shall be provided with microprocessor-based control systems which are designed to provide automatic starting, monitoring, and control functions for the generator set. The control systems shall also be designed to allow local monitoring and control of the generator sets, and remote monitoring and control as described in this specification. The controls shall be mounted on the generator sets, and shall be vibration isolated and prototype tested to verify the durability of all components in the system under vibration conditions encountered. The controls shall be UL-508 labeled, CSA282-M1989 certified, and meet IEC-8528 part 4. All switches, lamps and meters shall be oil-tight and dust-tight, and the enclosure doors shall be gasketed. There shall be no exposed points in the controls (with the door open) that operate in excess of 50 volts. The controls shall meet or exceed the requirements of Mil-Std 461C part 9, and IEC Std. 801.2, 801.3 and 801.5 for susceptibility, conducted and radiated electromagnetic emissions. The entire controls shall be tested and meet the requirements of IEEE587 for voltage surge resistance. The generator set mounted controls shall include the following features and functions:
 - 1. The generator control panel shall provide a network interface for the SCADA System. This network interface shall communicate all the generator status, control, display messages, troubleshooting and safety features as described below. Software shall be available for interfacing PLC Software with generator control panel communications. This interface and software development will be performed by another contract.
 - 2. Three position control switch labeled RUN/OFF/AUTO. In the RUN position the generator set shall automatically start, and accelerate to rated speed and voltage. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
 - 3. Red "mushroom-head" push-button EMERGENCY STOP switch. Depressing the emergency stop switch shall cause the generator set to immediately shut down, and be locked out from automatic restarting.

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4. Push-button RESET Switch: The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
5. Generator Set AC Output Metering: The generator set shall be provided with a metering set with the following features and functions:
 - a. 2.5-inch, 90 degree scale analog voltmeter, ammeter, frequency meter, and kilowatt (KW) meter. These meters shall be provided with a phase select switch and an indicating lamp for upper and lower scale on the meters. Ammeter and KW meter scales shall be color coded in the following fashion: readings from 0-90% of generator set standby rating: green; readings from 90-100% of standby rating: amber; readings in excess of 100%: red.
 - b. Digital metering set, 0.5% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three phase voltages (line to neutral or line to line) simultaneously.
 - c. Generator Set Alarm and Status Message Display: The generator set shall be provided with alarm and status indicating lamps to indicate non-automatic generator status, and existing alarm and shutdown conditions. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. The generator set control shall indicate the existence of the following alarm and shutdown conditions on a digital display panel:
 - 1) Low Oil Pressure (alarm)
 - 2) Low Oil Pressure (shutdown)
 - 3) Oil Pressure Sender Failure (alarm)
 - 4) Low Coolant Temperature (alarm)
 - 5) High Coolant Temperature (alarm)
 - 6) High Coolant Temperature (shutdown)
 - 7) Engine Temperature Sender Failure (alarm)
 - 8) Fail to Crank (shutdown)
 - 9) Overcrank (shutdown)
 - 10) Overspeed (shutdown)
 - 11) Low DC Voltage (alarm)
 - 12) Low Coolant Level (alarm or shutdown-selectable)
 - 13) High DC Voltage (alarm)
 - 14) Weak Battery (alarm)
 - 15) Low Fuel-Daytank (alarm)
 - 16) High AC Voltage (shutdown)
 - 17) Low AC Voltage (shutdown)
 - 18) Under Frequency (shutdown)
 - 19) Over Current (warning)
 - 20) Over Current (shutdown)
 - 21) Short Circuit (shutdown)
 - 22) Ground Fault (alarm)
 - 23) Over Load (alarm)
 - 24) Emergency Stop (shutdown)
 - 25) In addition, provisions shall be made for indication of two customer-specified or future alarm or shutdown conditions. These two alarm conditions shall be interfaced with leak detection/overfill alarm panel for overfill and leak detection. Labeling of the customer specified or future alarm or shutdown conditions shall be of the same type and quality as the above specified conditions. The non-automatic indicating lamp shall be red, and shall flash to indicate the generator set is not able to automatically respond to a command to start from a remote location.
 - d. Engine Status Monitoring: The following information shall be available from a digital status panel on the generator set control:
 - 1) Engine Oil Pressure (psi or kPA)

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- 2) Engine Coolant Temperature for left and right block temperatures (degrees F or C; both)
- 3) Engine Oil Temperature (degrees F or C)
- 4) Engine Speed (rpm)
- 5) Number of Hours of Operation (hours)
- 6) Number of Start Attempts
- 7) Battery Voltage (DC volts)
- e. Control Functions: The control system shall provide for the following functions:
 - 1) The control system provided shall include a cycle cranking system, which allows for user selected crank time, reset time, and number of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15 second rest period between cranking periods.
 - 2) The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled.
 - 3) The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and ramping function to control engine speed and limit exhaust smoke while the unit is starting. The governor control shall be suitable for use in paralleling applications without component changes.
 - 4) The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.
 - 5) The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components, and an actual failure condition.
- f. Alternator Control Functions: The generator set control shall include the following alternator control functions:
 - 1) The generator set shall include an automatic voltage regulation system which is matched and prototype tested with the governing system provided. It shall be immune from misoperation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase RMS sensing and shall control build up of AC generator voltage to provide a linear rise and limit overshoot. The systems shall include a torque-matched characteristic, which shall reduce output voltage in proportion to frequency below a threshold of [58-59] HZ. The voltage regulator shall include adjustments for gain, damping and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alpha-numeric LED readout to indicate setting level.
 - 2) The voltage regulation system shall include provisions for reactive load sharing and electronic voltage matching for paralleling applications. Motorized voltage adjust pot is not acceptable for voltage matching.
 - 3) Controls shall be provided to monitor the output current of the generator set and initiate an alarm when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator.
 - 4) Controls shall be provided to monitor the KW load on the generator set, and initiate an alarm condition when total load on the generator set exceeds the generator set rating for in excess of 5 seconds.
 - 5) Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.
 - 6) An AC over/under voltage monitoring system which responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set

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- voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.
- 7) A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage is less than 25VDC or more than 32VDC. During engine starting, the low voltage limit shall be disabled, and if DC voltage drops to less than 14.4 volts for more than two seconds a “weak battery” alarm shall be initiated.
 - 8) The control system shall include a ground fault monitoring relay. The relay shall be adjustable from 100-1200 amps, and include adjustable time delay of 0-1.0 seconds. The relay shall be for indication only, and not trip or shut down the generator set. Note bonding and grounding requirements for the generator set, and provide relay which will function correctly in system as installed.
 - g. Control Interfaces for Remote Monitoring: All control and interconnection points from the generator set to remote components shall be brought to a separate connection box. No field connections shall be made in the control enclosure or in the AC power output enclosure. Provide the following features in the control system:
 - 1) Form “C” dry common alarm contact set rated 2A @ 30VDC to indicate existence of any alarm or shutdown condition on the generator set.
 - 2) One set of contacts rated 2A @ 30VDC to indicate generator set is ready to load. The contacts shall operate when voltage and frequency are greater than 90% of rated condition.
 - 3) A fused 10 amp switched 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit whenever the generator set is running.
 - 4) A fused 20 amp 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit at all times from the engine starting/control batteries.
 - 5) The control shall be provided with provisions for connection of remote monitoring equipment as described herein or shown on the drawings.

2.06 ENGINES

- A. The diesel engine shall be manufactured by Cummins Engine Company and designed specifically for generator set duty. The diesel engine shall be 4 cycle, diesel fueled, direct injection, 1800 RPM, with forged steel crankshaft and connecting rods. The cylinder blocks shall be cast iron with replaceable wet liners and have four valves per cylinder. The engines shall be turbocharged and aftercooled.
- B. Two cycle engines will not be acceptable.
- C. Electronic governor systems shall provide automatic isochronous frequency regulation. The engine governing systems shall not utilize any exposed operating linkage.
- D. The engines shall be cooled by a unit-mounted closed loop radiator system including belt-driven pusher fan, coolant pump and thermostat temperature control. The cooling systems shall be rated for full rated load operation in 104 degrees F (40 degrees C) ambient condition. The cooling capability of the generator sets shall be demonstrated by prototype tests on a representative generator set model conducted by the generator set manufacturer; calculated data from the radiator manufacturer only is not sufficient. Radiators shall be provided with a duct adapter flange permitting the attachment of an air discharge duct to direct the radiator air outside according to the manufacturer's instructions.
- E. Rotating parts shall be guarded against accidental contact per OSHA requirements.
- F. Engine Schedule:

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Radiator Cooling System Air Flow	5000 SCFM
Combustion Air	244 CFM
Maximum Allowable static Restriction	0.5 inches of water
Engine Displacement	276 Cubic inches
Minimum number of cylinders	4

- G. The entire cooling air system is based on the above data. All costs incurred if an alternate manufacturer is purchased shall be the responsibility of the Contractor. These costs shall include costs to all other trades as well as any associated engineering fees.

2.07 ENGINE ACCESSORY EQUIPMENT

- A. The engine generator sets shall include the following accessories:
1. Electric starters capable of three complete cranking attempts without overheating, before overcrank shutdown (75 seconds).
 2. Positive displacement, mechanical, full pressure, lubrication oil pumps. Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicators. Provide bypass oil filters.
 3. Engine driven, mechanical, positive displacement fuel pumps. Fuel filters with replaceable spin-on canister elements. Replaceable heavy-duty dry element air cleaners with restriction indicators and safety element. Flexible fire rated supply and return fuel lines.
 4. Engine mounted battery charging alternators, 70 ampere and solid-state voltage regulators.
 5. Fuel water separators.
 6. Anti-condensation heater for alternator.

2.08 BASES

- A. The engine-generator set shall be mounted on a heavy-duty steel base to maintain proper alignment between components. The engine-generator set shall incorporate battery trays with battery hold-down clamps on the base rails. Provisions for stub up of electrical connections shall be within the footprint of the generator set base rails and within the base tanks as specified in the housing section of the specification. Vibration isolators, spring type, shall be provided to be mounted under the generator set base.

2.09 GENERATOR SETS CIRCUIT BREAKERS

- A. Generator main circuit breaker shall be solid state UL listed, molded case type, rated as listed below. Circuit breakers shall be mounted in a separate NEMA 1 enclosure and be shipped completely wired to the gensets. No exceptions. Enclosures shall include neutral blocks for field connection.
- B. Solid State circuit breakers shall be 100% rated: Refer to drawings for sizes.
- C. Circuit breaker (CB) shall be long time current and instantaneous pickup with solid state trip unit. CB shall have visible mechanical fault indicator and push button trip.
- D. Circuit breakers shall be rated at 65,000 AIC.
- E. Provide auxiliary contacts on breaker position.

2.10 ACCESSORIES

- A. Vibration isolators: Spring type with vertical restraint, painted steel housing and neoprene base pad rated for Seismic Zone 2, Ace Mountings Co., Inc. Type 821.

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- B. Starting and Control Batteries: Two (2) 12 volt starting batteries each genset, lead acid type, 12 volt DC, sized to accommodate 45 seconds of cranking at an ambient of 0 degrees F without being recharged.
- C. Battery Chargers: One 10 amp voltage regulated battery charger shall be provided for each engine-generator set. Input AC voltage and DC output voltage shall be as required. Chargers shall be equipped with float, taper and equalize charge settings. Operational monitors shall provide visual output along with individual form C contacts rated at 4 amps, 120 VAC, 30 VDC for remote indication of:
 - 1. Loss of AC Power - red light.
 - 2. Low Battery Voltage - red light.
 - 3. High Battery Voltage - red light.
 - 4. Power ON - green light (no relay contact).
 - 5. Block Heaters: Thermostatically controlled jacket water heater shall be supplied for each genset with a minimum size shall be 2500 watts. Input voltage of heaters shall be 208 VAC 1 phase.
 - 6. Electrical Matting: Dielectric strength 30,000 volts, 2 feet wide, 1/4 inch thick corrugated ASTM D 178 Type 2, Class II.
 - 7. Fuel Oil: Fuel Oil shall not contain dirt or sediment, or be of a structure to cause clogging of piping and nozzles, and prevent proper operation of the equipment. The ultra-low sulfur diesel (ULSD) fuel supplied under this contract shall meet the following specifications:
 - a. Viscosity: 1.3 to 4.1 cenistrokes at 104 degrees F.
 - b. Cetane Number: 42 minimum above 32 degrees F; 45 minimum below 32 degrees F.
 - c. Sulfur Content: not to exceed .0015 mass percent (15 ppm) sulfur content.
 - d. Active Sulfur: Copper Strip Corrosion not to exceed Number 3 rating after 3 hours at 122 degrees F.
 - e. Water Sediment: not to exceed 0.05 volume percent
 - f. Carbon residue: Not to exceed 0.35 mass percent on 10 volume-percent residuum
 - g. Density: 0.816 to 0.876 grams per cubic centimeter at 59 degrees F.
 - h. Cloud Point: 11 degrees F below lowest ambient temperature at which fuel is expected to operate.
 - i. Ash: Not to exceed 0.02 mass-percent
 - j. Distillation: 10 volume-percent at 540 degrees F maximum, 90 volume-percent at 680 degrees F maximum, 100 volume-percent at 725 degrees F maximum. The distillation curve must be smooth and continuance.
 - k. Lubricity: HFFR – maximum of 0.20 inches Wear Scar Diameter (WSD) at 140 degrees F; SLBOCLE – minimum of 3100 grams.
 - 8. Provide generator 20 light remote annunciator located on the transfer switch cubicle. Interface generator set controls with battery charger and fuel tank alarms for all status conditions. Provide all power, control wiring including conduits.

2.11 EXHAUST SYSTEMS

- A. One exhaust silencer shall be provided for the generator set. The silencer shall be super critical grade. The silencer shall reduce total noise to a maximum dBA level of 85 at 7 meters.
- B. Exhaust silencer within buildings shall be Nelson Exhaust Fleetguard Silencer critical '300' level, or engineered approved equal, bottom inlet/side outlet hung from the building ceiling. Provide all fittings, reducers, couplings elbows, spool pieces and supports.
- C. All fittings, accessories, bolts, nuts and hardware shall be type 304 stainless steel. Provide heat resistant gaskets between all flanged connections to serve as dielectric protectors.
- D. The exhaust gas temperature shall not exceed 1074 degrees F. The maximum back pressure shall not exceed 40 inches of water. The design of the entire exhaust system is based on the above data. If a substitution of model specified is made, all costs incurred to redesign as well as costs to other trades to modify the layout shall be the complete responsibility of the Contractor.

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- E. Provide stainless steel flexible exhaust connections for the engine as required for connection between the engine exhaust manifolds and exhaust lines in compliance with applicable codes and standards.
- F. Provide an exhaust system condensation trap with manual drain valve to trap and drain off exhaust condensation and to prevent condensation from entering the engine.
- G. Provide a suitable weather cap at the stack outlet with all necessary flanges and fittings for proper installation. The weather cap shall have the proper counter weights attached to prevent banging while generator is unloaded.
- H. Thermal jacket for interior exhaust lines and silencer by FIRWIN CORP. or engineered approved equal. Jacket thickness shall be sufficient to maintain a surface temperature of less than 200 degrees F.
- I. Exhaust mufflers shall be installed by enclosure manufacturer so their weight is not supported by the engines.

2.12 SOURCE QUALITY CONTROL

- A. To provide proven reliability of the system, three series of tests shall be performed: prototype model tests, production model tests and field tests. The manufacturer shall provide documentation demonstrating satisfactory prototype and production test results. Generator sets that have not been prototype tested and factory tested at 0.8 PF will not be acceptable.
- B. Generator Set Factory Production Tests and Evaluation: These tests and evaluations must have been performed on a prototype generator set representative of the Model specified. A summary of the generator set testing results shall be submitted for review. The manufacturer's standard series of components development tests on the generator system, engine and other major components shall also be performed and available for review, but shall not be acceptable as a substitute for prototype testing on the complete representative generator set prototype.
- C. Torsiograph Analysis and Test: The manufacturer of the generator set shall verify that the engine generator set, as configured, is free from harmful torsional stresses. The analysis shall include correlation of empirical data from tests on a representative prototype. The empirical data must include spectrum analysis of the torsional transducer output within the operating speed range of the engine generator set. Calculations based on engine and generator separately are not acceptable.
- D. Temperature Rise Test: Complete thermal evaluation of a prototype generator rotor and starter must include actual measurement of internal generator and exciter temperatures by embedded detector method, and measurement of average temperature rise by resistance method. No position measured any place in the windings may exceed the temperature rise limits of NEMA for the particular type of insulation system used. Resistance method temperature rise data shall be confirmed by a full load test on the generator set prototype to include conducted and radiated heat from the engine.
- E. Short Circuit Test: A test on a prototype generator set shall have demonstrated that the generator set is designed to withstand the mechanical forces associated with a short circuit condition. With the generator set operating at rated load and speed, the generator terminals must be short circuited on all three phases for a duration of 20 seconds. At the conclusion of this test, the generator set must be capable of full load operation.
- F. Endurance Run Test: A minimum of 500 continuous hours of endurance testing with a representative generator set prototype operating as defined by the manufacturer's standby rating shall have been performed. Endurance testing shall be used to verify structural soundness and durability.
- G. Maximum Power Test: With the prototype generator set at normal operating temperature and with all power consuming auxiliaries in place, the maximum power available at rated speed shall be determined with the governor set at its fuel stop. The generator set shall maintain this power for a minimum of two minutes.

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- H. Linear Vibration Test: A test for in-line motion of components occurring along a repeatable path shall meet the manufacturer's acceptance criteria.
- I. Cooling System Test: A cooling system test shall demonstrate the ability of the generator set cooling system to maintain normal operating temperature while operating at full rated load and power factor at the highest ambient temperature (122°F) of the system rating. Cooling air requirements, radiator air flow and maximum allowable restriction at radiator discharge, shall be verified by this test.
- J. Maximum Motor Starting KVA: Motor starting KVA shall be determined by test, based on a sustained RMS recovery voltage of at least 90 percent of no load voltage with the specified load KVA at near zero power factor applied to the generator set.
- K. Transient Response, Steady State Speed Control and Voltage Regulation: Prototype generator set tests shall demonstrate consistent performance as follows; stable voltage and frequency at all loads from no load to full rated load, consistent frequency bandwidth with steady state load, maximum voltage and frequency kp on load acceptance and rejection and restoration to steady state after sudden load changes. Transient response is a complete generator set (engine, generator, exciter, and regulator) performance criteria and cannot be established on generator data alone.

2.13 MANUFACTURERS SERVICES

- A. Supply and credit to the Owner field services
- B. Provide the following field services as a minimum at each site:
 - 1. One (1) day for providing installation supervision to the Contractor.
 - 2. One (1) day totaling one (1) trip once the system has been installed to check the completed installations, make all necessary adjustments and otherwise place the system into permanent operation. Electrical wiring shall be verified by the representative. During trip, to be held before substantial completion, provide operation and maintenance instruction to the Owner. A complete review of the Operations and Maintenance Manual shall be presented at this time.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Submit application for installation of generator fuel tank to the Nassau County Department of Health.
- B. Notify the Engineer in writing a minimum of six (6) business days prior to installation to allow for the required minimum five (5) day notification to the Nassau County Department of Health.
- C. Coordinate actions with the Department of Health and the Engineer to allow observation of all significant phases of construction and testing.

3.02 INSTALLATION

- A. Install engine generator and all appurtenances in accordance with manufacturer's recommendations.
- B. Install exhaust components as shown on the drawings and as required to comply with NFPA 37 and local codes and regulations. Components shall be sized to assure full load operation without excessive backpressure sized as per manufacturer's recommendations with actual site dimensions when installed as shown on the drawing. Make provisions as required for pipe expansion and contraction.
- C. Install anchor bolts.
- D. Installation shall comply with applicable State and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.
- E. Fuel tank shall be installed by a Nassau County licensed tank installer and shall conform to compliance with all Nassau County Article III requirements.

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- F. Install leak/overflow panel with individual lights and an alarm horn centered five (5) feet above grade within viewing and hearing distance of the fuel fill.
- G. Provide electrical matting on the floor around the perimeter of the generator. Trim matting to fit.

3.03 FIELD QUALITY CONTROL

- A. Initial startup and field acceptance tests are to be conducted by the authorized representative of the system manufacturer who supplies the equipment.
- B. After approval by Nassau County Department of Health, provide fuel to conduct start-up and acceptance tests.
- C. Test data shall be collected and recorded on the following: time of day, coolant temperature, operating oil pressure, battery charging rate, cranking time, crank-to-rated frequency time, voltage and frequency overshoot, load assumption-to-steady state voltage and frequency stabilization time, operating voltage, frequency, current, kilowatts and power factor. All data shall be taken every fifteen (15) minutes.
- D. Procedure: Generator manufacturer shall conduct a six (6) hour load bank test at 1.0 power factor for each generator set. Provide temporary load bank for testing generator set at 100% load. Load bank test shall test generator at full nameplate KW rating. Generator manufacturer's representative shall record test data, as described in (B) above. Test data shall be tabulated and typed for submission and approval by the Engineer for final acceptance. No handwritten field notes will be allowed.
- E. Conduct a test of the generator and transfer switch to provide power to the facility for a period of 2 hours. At the end of the test period, transfer back to the normal power source.
- F. Follow completion of all tests, provide fuel to fill the fuel tank to 90% of capacity.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Packaged engine generator set.
- B. Exhaust piping, fittings, silencer and insulation.
- C. Control panels.
- D. Battery and charger.
- E. Vibration isolation.
- F. Base mounted fuel tank.
- G. Fuel.

1.02 PAYMENT

1.03 PAYMENT FOR WORK FURNISHED AND INSTALLED UNDER THIS SECTION SHALL BE INCLUDED IN THE LUMP SUM PRICE BID FOR THE CONTRACT, AS DESCRIBED IN SECTION 01150 – MEASUREMENT AND PAYMENT.

1.04 REFERENCES

- A. NEMA AB1 - Molded Case Circuit Breakers.
- B. NEMA MG1 - Motors and Generators.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. ANSI/NFPA 70 - National Electric Code.
- E. NFPA 110 - Emergency Standby Systems.
- F. NFPA 30 - Flammable and Combustible Liquids Code.
- G. NFPA 37 - Installation of Stationary Engines.
- H. NFPA 101 - Life Safety Code.
- I. UL - Standard for Safety for Steel Aboveground Tanks for Flammable and Combustible Liquids.
- J. USEPA Tier 3 Emissions Standards.
- K. Nassau County Department of Health.

1.05 SUBMITTALS

- A. Submit product data under provisions of Section 01300.
- B. Shop Drawings: Indicate electrical characteristics and connection requirements. Show plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, electrical diagrams including schematic and interconnection diagrams.
- C. Product Data: Provide data showing dimensions, weights, ratings, interconnection points and internal wiring diagrams for engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer, vibration isolators, radiator and derating schedules, operating performance, exhaust flow data, and cooling system data. Submit generator alternator output curves, deration curves and temperature data on the complete genset individual components.
- D. Test Reports: Indicate results of performance testing including 0.8 power factor test at 100 percent load.
- E. Prototype Test Reports: Submittals will not be received without submission of prototype test reports. No exceptions.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation and starting of product. Provide typical system interconnection wiring diagrams.
- G. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

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- H. Manufacturer's Field Reports: Submit under provisions of Section 017500. Indicate procedures and findings.
- I. Approval of Substitute Equipment: Design has been based on Cummins Power Generation generator. If substitute equipment is approved, the Contractor shall be responsible for the charges of any necessary revisions to the plans and specifications, drawings, and project documentation; and charges related to equipment spacing, enclosure sizes, foundation sizes, mounts, electrical wiring, ventilation equipment, fuel, exhaust components, etc., as well as any engineering costs. If a brand name other than that specified is proposed for use, identify the location of a locally available generator system for the Owner and Engineer to review and inspect, as well as witness testing to show compliance with the specifications. Also, the supplier must furnish a list of completed installations, including name, address and telephone number of at least five comparable installations which can prove the proposed products have operated satisfactorily for three years.
- J. Proposal for substitute equipment shall provide complete submittal data to the Engineer for approval or disapproval. Submit detailed sizing calculations for each generator to verify proposed model is capable of picking up the entire loads with voltage dips as herein specified

1.06 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01782.
- B. Operation Data: Include instructions for normal operation.
- C. Maintenance Data: Include instructions for routine maintenance requirements, service manuals for engine and day tank, oil sampling and analysis for engine wear, and emergency maintenance procedures.

1.07 QUALITY ASSURANCE

- A. Perform work in accordance with NFPA 110.
- B. Tank and secondary containment structure shall be submitted to and approved by the Nassau County Health Department.

1.08 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten years experience, and with an authorized distributor offering 24-hour parts and service availability within 50 miles of the project. The manufacturer shall fabricate the engines, generators and control panel. Automatic transfer switches and generator enclosures shall be supplied, warranted and serviced by a single system source supplier.
- B. Supplier: Authorized distributor of specified manufacturer with minimum six years documented experience with specified products and factory-trained service technicians. The supplier must be factory authorized to perform warranty service on the entire system, including but not limited to, the engines, generators, control panels and automatic transfer switches. The supplier must show proof of factory trained service technicians on all components.
- C. The complete engine generator system shall be standard of a single manufacturer. It shall be factory built, tested and shipped by this single manufacturer.

1.09 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70 and NFPA 110.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.
- C. Generator shall be EPA Tier 3-Certified for Stationary Emergency Applications.

1.10 WARRANTY

- A. Provide a 5-year manufacturer's limited warranty, including 100% parts and labor. The complete electrical power system, including but not limited to, generator set, controls, associated switches, enclosures, and accessories, as provided by the single source manufacturer, shall be warranted by the manufacturer against defects in materials and

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workmanship for a period of five (5) years from the date of system startup. Coverage shall include parts, labor, travel expenses, and labor to remove/reinstall the equipment, per manufacturer's standard published limited warranty. Supplier must be factory authorized to perform warranty service on the entire system, including, but not limited to, the engine, the generator, the control panels, and the automatic transfer switches. Provide separate warranty for fuel tanks not integral to the generator.

1.11 EXTRA SERVICES

- A. Provide from manufacturer's local authorized service representative a 5-year planned maintenance agreement at no additional cost to the Owner. Agreement shall include, as a minimum, one service call per year. The services must be performed by the authorized distributor of the equipment furnished and may not be subcontracted. The following services shall be performed once a year.
 - 1. Replace engine-lubricating oil and remove used oil from premises.
 - 2. Replace oil and fuel filters.
 - 3. Check oil/water separator. Remove water from premises.
 - 4. Check coolant system for proper levels and condition. Replace coolant filters and add corrosion inhibitor as needed.
 - 5. Check air filter.
 - 6. Check and clean crankcase breathers.
 - 7. Check turbocharger free-spin and end play.
 - 8. Check and adjust belts as required.
 - 9. Check engine for loose, bare or broken wiring. Replace as needed.
 - 10. Fuel tanks and lines to be inspected for the purpose of determining if excessive sludge or rust is collecting.
 - 11. Check entire equipment for fuel or water leaks.
 - 12. Check condition of batteries and report any action necessary for recharging or replacing.
 - 13. In presence of the Owner:
 - a. Start and run all engines. Check temperatures and pressures.
 - b. Test engine safety shutdown systems.
 - c. Test all transfer switches operation and time delays.
 - d. Submit a report of this inspection to the Owner and advise of any further work required.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Cummins Power Generation, Inc, Minneapolis, MN, Kohler Power Systems, Kohler, WI, Caterpillar, or specifically approved equal.
- B. It is intended that all products specified herein be of standard ratings, therefore, the KW and KVA, starting KVA and maximum allowable voltage dip, ratings, etc., shall be the manufacturer's next size or rating to exactly meet the specifications. No exceptions.

2.02 SYSTEM REQUIREMENTS

- A. The engine generator shall start and provide continuous power to the loads with 100 percent block loading at the time of transfer.

2.03 DIESEL ENGINE GENERATOR SET

- A. Rating: The AC engine generator set shall be Cummins Model C60D6 with Model CA125-P14 alternator, and shall be rated by the manufacturer for standby operation at 50KW/75KVA at 0.8 PF, 60 Hz, 1800 RPM for use at 277/480 volts, 3-phase, 4 wire. Ratings shall be at an elevation of 500 feet above sea level, and at 122 degrees F.
 - 1. Voltage regulation shall be +/- 1.0 percent of rated voltage for any constant load between no load and rated load.
 - 2. Frequency regulation shall be isochronous under varying from no load to 100% rated load.

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3. Random Voltage Variation: The cyclic variations in RMS voltage shall not exceed +/- 0.5% of rated speed for constant loads from no load to rated load, with constant ambient and operating temperature.
4. Random Frequency Variation: Speed variations for constant loads from no load to rated load shall not exceed plus or minus 0.25% of rated speed, with constant ambient and operating temperature.
5. Telephone Harmonic Distortion: The sum of AC voltage waveform harmonics, from no load to full linear load, shall not exceed 5% of rated voltage (L-N, L-L, L-L-L) and no single harmonic shall exceed 3% of rated voltage.
6. Telephone Influence Factor: TIF shall be less than 50 per NEMA MG1-22.43.
7. The diesel engine generator set shall be capable of picking up 100% of nameplate KW and power factor in one step with the engine generator set at operating temperature, in accordance with NFPA Standard 110, Paragraph 5-13.2.6.
8. The engine generator shall start and provide power to the loads in the following step starting sequence with a maximum instantaneous voltage dip of 18% and a maximum frequency dip of 3%.

Step No.	Description	Load	Volts/ Phase	Motor Code	Load Type	Starting Method
1	Misc. Load	.24	120/1	-	Misc. Load	Full Voltage
1	Lighting	.36	120/1	-	Misc. Load	Full Voltage
1	Well Fan	1/4HP	120/1	-	Motor	Full Voltage
1	Electric Heater	10kW	480/3	-	Resist.	Full Voltage
1	Control Panels	1.5kW	120/1	-	Misc. Load	Full Voltage
1	Battery Charger	1.5kW	120/1	-	Misc. Load	Full Voltage
1	Sewage Grinder	3HP	480/3	L	Motor	Solid State
2	Sewage Pump	10HP	480/3	G	Motor	Solid State

9. The generator as a packaged unit (engine, alternator, and controls) shall provide a minimum 607 SKVA motor starting (PMG) at 90% sustained voltage.
10. The alternator performance shall be designed at a maximum voltage dip of 35%.
11. The following performance verifications shall be provided for substitute generators.
 - a. Submit two copies of generator sizing program based upon the specified step/starting sequence and associated voltage/frequency dips and required starting KVA.
 - b. As part of the substitution requirements the contractor shall enter all design step/starting sequence loads into the manufacturer's generator sizing program in the presence of the engineer to verify model proposed by substitute manufacturer meets the specified requirements for ambient temperature, site altitude, voltage dip, frequency dip, and starting KVA.

2.04 AC GENERATOR, REGULATOR AND EXCITER UNIT

- A. The AC generator, exciter and voltage regulator shall be designed and manufactured by the engine generator set manufacturer as a complete generator system.
- B. The AC generator shall be synchronous, four pole, revolving field, drip proof construction, single pre-lubricated sealed bearing, air cooled by a direct drive centrifugal blower fan and directly connected to the engine with flexible drive discs. The armature shall have skewed laminations of insulated electrical grade steel, two-thirds pitch windings in order to minimize field heating and voltage harmonics. The rotors shall have amortisseur (damper windings) layer wound mechanically wedged winding construction. The rotors shall be dynamically balanced. The exciters shall be brush-less, three phase, with full wave silicon diodes mounted on the rotating shaft and a surge suppressor connected in parallel with the field winding. Field discharge resistors shall not be acceptable. Systems using three wire solid state devices (such as SCRs or transistors) mounted on the rotor shaft shall not be acceptable.

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- C. All insulation system components shall meet NEMA MG1 standard temperature limits for Class H insulation system. Actual temperature rise measured by resistance method at full load shall not exceed 105 degrees C to provide additional allowance for internal hot spots. The main generator and exciter insulation systems must be suitably impregnated for operation in severe environments for resistance to sand, salt and sea spray.
- D. Generator shall be a Permanent Magnet Generator (PMG). Permanent magnet generators shall provide excitation power to the auto-matic voltage regulator for immunity from voltage distortion caused by nonlinear SCR controlled loads on the generator. The PMG's shall sustain main field excitation power for optimum motor starting and to sustain short circuit current for selective operation and coordination of system overcurrent devices.

2.05 ENGINE GENERATOR SET CONTROLS

- A. The generator sets shall be provided with microprocessor-based control systems which are designed to provide automatic starting, monitoring, and control functions for the generator set. The control systems shall also be designed to allow local monitoring and control of the generator sets, and remote monitoring and control as described in this specification. The controls shall be mounted on the generator sets, and shall be vibration isolated and prototype tested to verify the durability of all components in the system under vibration conditions encountered. The controls shall be UL-508 labeled, CSA282-M1989 certified, and meet IEC-8528 part 4. All switches, lamps and meters shall be oil-tight and dust-tight, and the enclosure doors shall be gasketed. There shall be no exposed points in the controls (with the door open) that operate in excess of 50 volts. The controls shall meet or exceed the requirements of Mil-Std 461C part 9, and IEC Std. 801.2, 801.3 and 801.5 for susceptibility, conducted and radiated electromagnetic emissions. The entire controls shall be tested and meet the requirements of IEEE587 for voltage surge resistance. The generator set mounted controls shall include the following features and functions:
 - 1. The generator control panel shall provide a network interface for the SCADA System. This network interface shall communicate all the generator status, control, display messages, troubleshooting and safety features as described below. Software shall be available for interfacing PLC Software with generator control panel communications. This interface and software development will be performed by another contract.
 - 2. Three position control switch labeled RUN/OFF/AUTO. In the RUN position the generator set shall automatically start, and accelerate to rated speed and voltage. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
 - 3. Red "mushroom-head" push-button EMERGENCY STOP switch. Depressing the emergency stop switch shall cause the generator set to immediately shut down, and be locked out from automatic restarting.
 - 4. Push-button RESET Switch: The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
 - 5. Generator Set AC Output Metering: The generator set shall be provided with a metering set with the following features and functions:
 - a. 2.5-inch, 90 degree scale analog voltmeter, ammeter, frequency meter, and kilowatt (KW) meter. These meters shall be provided with a phase select switch and an indicating lamp for upper and lower scale on the meters. Ammeter and KW meter scales shall be color coded in the following fashion: readings from 0-90% of generator set standby rating: green; readings from 90-100% of standby rating: amber; readings in excess of 100%: red.
 - b. Digital metering set, 0.5% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three phase voltages (line to neutral or line to line) simultaneously.
 - c. Generator Set Alarm and Status Message Display: The generator set shall be provided with alarm and status indicating lamps to indicate non-automatic generator

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status, and existing alarm and shutdown conditions. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. The generator set control shall indicate the existence of the following alarm and shutdown conditions on a digital display panel:

- 1) Low Oil Pressure (alarm)
 - 2) Low Oil Pressure (shutdown)
 - 3) Oil Pressure Sender Failure (alarm)
 - 4) Low Coolant Temperature (alarm)
 - 5) High Coolant Temperature (alarm)
 - 6) High Coolant Temperature (shutdown)
 - 7) Engine Temperature Sender Failure (alarm)
 - 8) Fail to Crank (shutdown)
 - 9) Overcrank (shutdown)
 - 10) Overspeed (shutdown)
 - 11) Low DC Voltage (alarm)
 - 12) Low Coolant Level (alarm or shutdown-selectable)
 - 13) High DC Voltage (alarm)
 - 14) Weak Battery (alarm)
 - 15) Low Fuel-Daytank (alarm)
 - 16) High AC Voltage (shutdown)
 - 17) Low AC Voltage (shutdown)
 - 18) Under Frequency (shutdown)
 - 19) Over Current (warning)
 - 20) Over Current (shutdown)
 - 21) Short Circuit (shutdown)
 - 22) Ground Fault (alarm)
 - 23) Over Load (alarm)
 - 24) Emergency Stop (shutdown)
 - 25) In addition, provisions shall be made for indication of two customer-specified or future alarm or shutdown conditions. These two alarm conditions shall be interfaced with leak detection/overfill alarm panel for overfill and leak detection. Labeling of the customer specified or future alarm or shutdown conditions shall be of the same type and quality as the above specified conditions. The non-automatic indicating lamp shall be red, and shall flash to indicate the generator set is not able to automatically respond to a command to start from a remote location.
- d. Engine Status Monitoring: The following information shall be available from a digital status panel on the generator set control:
- 1) Engine Oil Pressure (psi or kPA)
 - 2) Engine Coolant Temperature for left and right block temperatures (degrees F or C; both)
 - 3) Engine Oil Temperature (degrees F or C)
 - 4) Engine Speed (rpm)
 - 5) Number of Hours of Operation (hours)
 - 6) Number of Start Attempts
 - 7) Battery Voltage (DC volts)
- e. Control Functions: The control system shall provide for the following functions:
- 1) The control system provided shall include a cycle cranking system, which allows for user selected crank time, reset time, and number of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15 second rest period between cranking periods.
 - 2) The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled.

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- 3) The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and ramping function to control engine speed and limit exhaust smoke while the unit is starting. The governor control shall be suitable for use in paralleling applications without component changes.
- 4) The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.
- 5) The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components, and an actual failure condition.
- f. Alternator Control Functions: The generator set control shall include the following alternator control functions:
 - 1) The generator set shall include an automatic voltage regulation system which is matched and prototype tested with the governing system provided. It shall be immune from misoperation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase RMS sensing and shall control build up of AC generator voltage to provide a linear rise and limit overshoot. The systems shall include a torque-matched characteristic, which shall reduce output voltage in proportion to frequency below a threshold of [58-59] HZ. The voltage regulator shall include adjustments for gain, damping and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alpha-numeric LED readout to indicate setting level.
 - 2) The voltage regulation system shall include provisions for reactive load sharing and electronic voltage matching for paralleling applications. Motorized voltage adjust pot is not acceptable for voltage matching.
 - 3) Controls shall be provided to monitor the output current of the generator set and initiate an alarm when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator.
 - 4) Controls shall be provided to monitor the KW load on the generator set, and initiate an alarm condition when total load on the generator set exceeds the generator set rating for in excess of 5 seconds.
 - 5) Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.
 - 6) An AC over/under voltage monitoring system which responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.
 - 7) A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage is less than 25VDC or more than 32VDC. During engine starting, the low voltage limit shall be disabled, and if DC voltage drops to less than 14.4 volts for more than two seconds a "weak battery" alarm shall be initiated.
 - 8) The control system shall include a ground fault monitoring relay. The relay shall be adjustable from 100-1200 amps, and include adjustable time delay of 0-1.0 seconds. The relay shall be for indication only, and not trip or shut down the generator set. Note bonding and grounding requirements for the generator set, and provide relay which will function correctly in system as installed.
- g. Control Interfaces for Remote Monitoring: All control and interconnection points from the generator set to remote components shall be brought to a separate connection

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box. No field connections shall be made in the control enclosure or in the AC power output enclosure. Provide the following features in the control system:

- 1) Form "C" dry common alarm contact set rated 2A @ 30VDC to indicate existence of any alarm or shutdown condition on the generator set.
- 2) One set of contacts rated 2A @ 30VDC to indicate generator set is ready to load. The contacts shall operate when voltage and frequency are greater than 90% of rated condition.
- 3) A fused 10 amp switched 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit whenever the generator set is running.
- 4) A fused 20 amp 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit at all times from the engine starting/control batteries.
- 5) The control shall be provided with provisions for connection of remote monitoring equipment as described herein or shown on the drawings.

2.06 ENGINES

- A. The diesel engine shall be manufactured by Cummins Engine Company and designed specifically for generator set duty. The diesel engine shall be 4 cycle, diesel fueled, direct injection, 1800 RPM, with forged steel crankshaft and connecting rods. The cylinder blocks shall be cast iron with replaceable wet liners and have four valves per cylinder. The engines shall be turbocharged and aftercooled.
- B. Two cycle engines will not be acceptable.
- C. Electronic governor systems shall provide automatic isochronous frequency regulation. The engine governing systems shall not utilize any exposed operating linkage.
- D. The engines shall be cooled by a unit-mounted closed loop radiator system including belt-driven pusher fan, coolant pump and thermostat temperature control. The cooling systems shall be rated for full rated load operation in 104 degrees F (40 degrees C) ambient condition. The cooling capability of the generator sets shall be demonstrated by prototype tests on a representative generator set model conducted by the generator set manufacturer; calculated data from the radiator manufacturer only is not sufficient. Radiators shall be provided with a duct adapter flange permitting the attachment of an air discharge duct to direct the radiator air outside according to the manufacturer's instructions.
- E. Rotating parts shall be guarded against accidental contact per OSHA requirements.
- F. Engine Schedule:

PARAMETER	VIOLA
Radiator Cooling System Air Flow	5000 SCFM
Combustion Air	244 CFM
Maximum Allowable static Restriction	0.5 inches of water
Engine Displacement	276 Cubic inches
Minimum number of cylinders	4

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- G. The entire cooling air system is based on the above data. All costs incurred if an alternate manufacturer is purchased shall be the responsibility of the Contractor. These costs shall include costs to all other trades as well as any associated engineering fees.

2.07 ENGINE ACCESSORY EQUIPMENT

- A. The engine generator sets shall include the following accessories:
 - 1. Electric starters capable of three complete cranking attempts without overheating, before overcrank shutdown (75 seconds).
 - 2. Positive displacement, mechanical, full pressure, lubrication oil pumps. Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicators. Provide bypass oil filters.
 - 3. Engine driven, mechanical, positive displacement fuel pumps. Fuel filters with replaceable spin-on canister elements. Replaceable heavy-duty dry element air cleaners with restriction indicators and safety element. Flexible fire rated supply and return fuel lines.
 - 4. Engine mounted battery charging alternators, 70 ampere and solid-state voltage regulators.
 - 5. Fuel water separators.
 - 6. Anti-condensation heater for alternator.

2.08 BASES

- A. The engine-generator set shall be mounted on a heavy-duty steel base to maintain proper alignment between components. The engine-generator set shall incorporate battery trays with battery hold-down clamps on the base rails. Provisions for stub up of electrical connections shall be within the footprint of the generator set base rails and within the base tanks as specified in the housing section of the specification. Vibration isolators, spring type, shall be provided to be mounted under the generator set base.

2.09 GENERATOR SETS CIRCUIT BREAKERS

- A. Generator main circuit breaker shall be solid state UL listed, molded case type, rated as listed below. Circuit breakers shall be mounted in a separate NEMA 1 enclosure and be shipped completely wired to the gensets. No exceptions. Enclosures shall include neutral blocks for field connection.
- B. Solid State circuit breakers shall be 100% rated: Refer to drawings for sizes.
- C. Circuit breaker (CB) shall be long time current and instantaneous pickup with solid state trip unit. CB shall have visible mechanical fault indicator and push button trip.
- D. Circuit breakers shall be rated at 65,000 AIC.
- E. Provide auxiliary contacts on breaker position.

2.10 ACCESSORIES

- A. Vibration isolators: Spring type with vertical restraint, painted steel housing and neoprene base pad rated for Seismic Zone 2, Ace Mountings Co., Inc. Type 821.
- B. Starting and Control Batteries: Two (2) 12 volt starting batteries each genset, lead acid type, 12 volt DC, sized to accommodate 45 seconds of cranking at an ambient of 0 degrees F without being recharged.
- C. Battery Chargers: One 10 amp voltage regulated battery charger shall be provided for each engine-generator set. Input AC voltage and DC output voltage shall be as required. Chargers shall be equipped with float, taper and equalize charge settings. Operational monitors shall provide visual output along with individual form C contacts rated at 4 amps, 120 VAC, 30 VDC for remote indication of:
 - 1. Loss of AC Power - red light.
 - 2. Low Battery Voltage - red light.
 - 3. High Battery Voltage - red light.
 - 4. Power ON - green light (no relay contact).

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5. Block Heaters: Thermostatically controlled jacket water heater shall be supplied for each genset with a minimum size shall be 2500 watts. Input voltage of heaters shall be 208 VAC 1 phase.
6. Electrical Matting: Dielectric strength 30,000 volts, 2 feet wide, 1/4 inch thick corrugated ASTM D 178 Type 2, Class II.
7. Fuel Oil: Fuel Oil shall not contain dirt or sediment, or be of a structure to cause clogging of piping and nozzles, and prevent proper operation of the equipment. The ultra-low sulfur diesel (ULSD) fuel supplied under this contract shall meet the following specifications:
 - a. Viscosity: 1.3 to 4.1 cenistrokes at 104 degrees F.
 - b. Cetane Number: 42 minimum above 32 degrees F; 45 minimum below 32 degrees F.
 - c. Sulfur Content: not to exceed .0015 mass percent (15 ppm) sulfur content.
 - d. Active Sulfur: Copper Strip Corrosion not to exceed Number 3 rating after 3 hours at 122 degrees F.
 - e. Water Sediment: not to exceed 0.05 volume percent
 - f. Carbon residue: Not to exceed 0.35 mass percent on 10 volume-percent residuum
 - g. Density: 0.816 to 0.876 grams per cubic centimeter at 59 degrees F.
 - h. Cloud Point: 11 degrees F below lowest ambient temperature at which fuel is expected to operate.
 - i. Ash: Not to exceed 0.02 mass-percent
 - j. Distillation: 10 volume-percent at 540 degrees F maximum, 90 volume-percent at 680 degrees F maximum, 100 volume-percent at 725 degrees F maximum. The distillation curve must be smooth and continuance.
 - k. Lubricity: HFFR – maximum of 0.20 inches Wear Scar Diameter (WSD) at 140 degrees F: SLBOCLE – minimum of 3100 grams.
8. Provide generator 20 light remote annunciator located on the transfer switch cubicle. Interface generator set controls with battery charger and fuel tank alarms for all status conditions. Provide all power, control wiring including conduits.

2.11 EXHAUST SYSTEMS

- A. One exhaust silencer shall be provided for the generator set. The silencer shall be super critical grade. The silencer shall reduce total noise to a maximum dBA level of 85 at 7 meters.
- B. Exhaust silencer within buildings shall be Nelson Exhaust Fleetguard Silencer critical '300' level, or engineered approved equal, bottom inlet/side outlet hung from the building ceiling. Provide all fittings, reducers, couplings elbows, spool pieces and supports.
- C. All fittings, accessories, bolts, nuts and hardware shall be type 304 stainless steel. Provide heat resistant gaskets between all flanged connections to serve as dielectric protectors.
- D. The exhaust gas temperature shall not exceed 1074 degrees F. The maximum back pressure shall not exceed 40 inches of water. The design of the entire exhaust system is based on the above data. If a substitution of model specified is made, all costs incurred to redesign as well as costs to other trades to modify the layout shall be the complete responsibility of the Contractor.
- E. Provide stainless steel flexible exhaust connections for the engine as required for connection between the engine exhaust manifolds and exhaust lines in compliance with applicable codes and standards.
- F. Provide an exhaust system condensation trap with manual drain valve to trap and drain off exhaust condensation and to prevent condensation from enter-ing the engine.
- G. Provide a suitable weather cap at the stack outlet with all necessary flanges and fittings for proper installa-tion. The weather cap shall have the proper counterweights attached to prevent banging while generator is unloaded.
- H. Thermal jacket for interior exhaust lines and silencer by FIRWIN CORP. or engineered approved equal. Jacket thickness shall be sufficient to maintain a surface temperature of less than 200 degrees F.

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- I. Exhaust mufflers shall be installed by enclosure manufacturer so their weight is not supported by the engines.

2.12 FUEL TANKS

- A. The diesel oil base tank shall be rated at 560 gallons and shall be placed in a rupture basin of 110% capacity for secondary containment, in accordance with Nassau County requirements.
- B. Minimum 12 gauge steel shall be used for tank body, and minimum 3/16-inch steel shall be used for rupture basin. Tanks shall be UL 142 listed and labeled, have vent, emergency vent, lockable fill, fuel level gauge, and fuel level contacts. Rupture basin shall have contacts to indicate a leak in the fuel tank. Tanks shall be factory tested for leaks under pressure prior to shipment. Submit report on leak test results to the Engineer prior to shipment. Bottom of rupture basin shall be raised 1-¾ inch minimum off concrete pad on stainless steel channels so bottom does not rest on concrete pad. Exterior of tank and rupture basin and base rails shall be painted with coal tar epoxy primer and exterior epoxy paint to prevent corrosion.
 1. There shall be separation between the dike/sub-base and the mounting pad, to prevent the accumulation of moisture.
 2. Provide a five (5) gallon fill containment.
 3. Provide a "scully" type fill connection.
 4. Secondary containment shall be supplied with a removal inspection plate large enough to enable visual inspection of the primary tank.
 5. Tank shall be equipped with an audible/visual high-level alarm/leak detection alarm under Section 16279. The alarm shall be set to indicate when fuel has reached 90% of tank capacity.
 6. A positive fuel shut off shall be installed in the fuel supply line.
 7. The fuel supply and return lines shall be fire rated, U.L listed and labeled.
 8. Fuel connections shall be liquid tight.
 9. Provide ¼ turn fuel shut off valve.
 10. Check valve shall be installed down stream of liquid tight connection for prevention of blow back.
 11. Tank shall be elevated so that it does not touch the pad.
 12. Tank vents shall terminate outside of building.
 13. Fuel Level Gauge, spiral or mechanical float arm, Rochester Gauges or approved equal.
 14. Overfill Protection Valve: Universal Valve Company, Part No. 49, or approved equal.
 15. Tanks shall be labeled with a plate permanently affixed to the top of the tank near the lifting lug. Plate shall contain year of manufacture of the tank, manufacturer's name, UL identification number, tank model number, capacity and dimensions, design ratings and manufacturer's identification number. A second plate as above, but also containing the date of tank installation, shall be permanently affixed at the fill port.
 16. The tank end shall be stenciled with tank manufacturer, capacity and UL identification number. Letters shall be 1-1/2 inches high minimum.
 17. Tanks shall be provided with a remote fill port within a lockable 5-gallon containment box.

2.13 SOURCE QUALITY CONTROL

- A. To provide proven reliability of the system, three series of tests shall be performed: prototype model tests, production model tests and field tests. The manufacturer shall provide documentation demonstrating satisfactory prototype and production test results. Generator sets that have not been prototype tested and factory tested at 0.8 PF will not be acceptable.
- B. Generator Set Factory Production Tests and Evaluation: These tests and evaluations must have been performed on a prototype generator set representative of the Model specified. A summary of the generator set testing results shall be submitted for review. The manufacturer's standard series of components development tests on the generator system, engine and other major components shall also be performed and available for review, but shall not be acceptable as a substitute for prototype testing on the complete representative generator set prototype.
- C. Torsiograph Analysis and Test: The manufacturer of the generator set shall verify that the engine generator set, as configured, is free from harmful torsional stresses. The analysis shall

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include correlation of empirical data from tests on a representative prototype. The empirical data must include spectrum analysis of the torsional transducer output within the operating speed range of the engine generator set. Calculations based on engine and generator separately are not acceptable.

- D. Temperature Rise Test: Complete thermal evaluation of a prototype generator rotor and starter must include actual measurement of internal generator and exciter temperatures by embedded detector method, and measurement of average temperature rise by resistance method. No position measured any place in the windings may exceed the temperature rise limits of NEMA for the particular type of insulation system used. Resistance method temperature rise data shall be confirmed by a full load test on the generator set prototype to include conducted and radiated heat from the engine.
- E. Short Circuit Test: A test on a prototype generator set shall have demonstrated that the generator set is designed to withstand the mechanical forces associated with a short circuit condition. With the generator set operating at rated load and speed, the generator terminals must be short circuited on all three phases for a duration of 20 seconds. At the conclusion of this test, the generator set must be capable of full load operation.
- F. Endurance Run Test: A minimum of 500 continuous hours of endurance testing with a representative generator set prototype operating as defined by the manufacturer's standby rating shall have been performed. Endurance testing shall be used to verify structural soundness and durability.
- G. Maximum Power Test: With the prototype generator set at normal operating temperature and with all power consuming auxiliaries in place, the maximum power available at rated speed shall be determined with the governor set at its fuel stop. The generator set shall maintain this power for a minimum of two minutes.
- H. Linear Vibration Test: A test for in-line motion of components occurring along a repeatable path shall meet the manufacturer's acceptance criteria.
- I. Cooling System Test: A cooling system test shall demonstrate the ability of the generator set cooling system to maintain normal operating temperature while operating at full rated load and power factor at the highest ambient temperature (122°F) of the system rating. Cooling air requirements, radiator air flow and maximum allowable restriction at radiator discharge, shall be verified by this test.
- J. Maximum Motor Starting KVA: Motor starting KVA shall be determined by test, based on a sustained RMS recovery voltage of at least 90 percent of no load voltage with the specified load KVA at near zero power factor applied to the generator set.
- K. Transient Response, Steady State Speed Control and Voltage Regulation: Prototype generator set tests shall demonstrate consistent performance as follows; stable voltage and frequency at all loads from no load to full rated load, consistent frequency bandwidth with steady state load, maximum voltage and frequency kp on load acceptance and rejection and restoration to steady state after sudden load changes. Transient response is a complete generator set (engine, generator, exciter, and regulator) performance criteria and cannot be established on generator data alone.

2.14 MANUFACTURERS SERVICES

- A. Supply and credit to the Owner field services
- B. Provide the following field services as a minimum at each site:
 - 1. One (1) day for providing installation supervision to the Contractor.
 - 2. One (1) day totaling one (1) trip once the system has been installed to check the completed installations, make all necessary adjustments and otherwise place the system into permanent operation. Electrical wiring shall be verified by the representative. During trip, to be held before substantial completion, provide operation and maintenance instruction to the Owner. A complete review of the Operations and Maintenance Manual shall be presented at this time.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Submit application for installation of generator fuel tank to the Nassau County Department of Health.
- B. Notify the Engineer in writing a minimum of six (6) business days prior to installation to allow for the required minimum five (5) day notification to the Nassau County Department of Health.
- C. Coordinate actions with the Department of Health and the Engineer to allow observation of all significant phases of construction and testing.

3.02 INSTALLATION

- A. Install engine generator and all appurtenances in accordance with manufacturer's recommendations.
- B. Install exhaust components as shown on the drawings and as required to comply with NFPA 37 and local codes and regulations. Components shall be sized to assure full load operation without excessive backpressure sized as per manufacturer's recommendations with actual site dimensions when installed as shown on the drawing. Make provisions as required for pipe expansion and contraction.
- C. Install anchor bolts.
- D. Installation shall comply with applicable State and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.
- E. Fuel tank shall be installed by a Nassau County licensed tank installer and shall conform to compliance with all Nassau County Article III requirements.
- F. Install leak/overflow panel with individual lights and an alarm horn centered five (5) feet above grade within viewing and hearing distance of the fuel fill.
- G. Provide electrical matting on the floor around the perimeter of the generator. Trim matting to fit.

3.03 FIELD QUALITY CONTROL

- A. Initial startup and field acceptance tests are to be conducted by the authorized representative of the system manufacturer who supplies the equipment.
- B. After approval by Nassau County Department of Health, provide fuel to conduct start-up and acceptance tests.
- C. Test data shall be collected and recorded on the following: time of day, coolant temperature, operating oil pressure, battery charging rate, cranking time, crank-to-rated frequency time, voltage and frequency overshoot, load assumption-to-steady state voltage and frequency stabilization time, operating voltage, frequency, current, kilowatts and power factor. All data shall be taken every fifteen (15) minutes.
- D. Procedure: Generator manufacturer shall conduct a six (6) hour load bank test at 1.0 power factor for each generator set. Provide temporary load bank for testing generator set at 100% load. Load bank test shall test generator at full nameplate KW rating. Generator manufacturer's representative shall record test data, as described in (B) above. Test data shall be tabulated and typed for submission and approval by the Engineer for final acceptance. No handwritten field notes will be allowed.
- E. Conduct a test of the generator and transfer switch to provide power to the facility for a period of 2 hours. At the end of the test period, transfer back to the normal power source.
- F. Follow completion of all tests, provide fuel to fill the fuel tank to 90% of capacity.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Packaged engine generator set.
- B. Exhaust piping, fittings, silencer, and insulation.
- C. Control panels.
- D. Battery and charger.
- E. Vibration isolation.
- F. Base mounted fuel tank.
- G. Fuel.

1.02 PAYMENT

1.03 PAYMENT FOR WORK FURNISHED AND INSTALLED UNDER THIS SECTION SHALL BE INCLUDED IN THE LUMP SUM PRICE BID FOR THE CONTRACT, AS DESCRIBED IN SECTION 01150 – MEASUREMENT AND PAYMENT.

1.04 REFERENCES

- A. NEMA AB1 - Molded Case Circuit Breakers.
- B. NEMA MG1 - Motors and Generators.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. ANSI/NFPA 70 - National Electric Code.
- E. NFPA 110 - Emergency Standby Systems.
- F. NFPA 30 - Flammable and Combustible Liquids Code.
- G. NFPA 37 - Installation of Stationary Engines.
- H. NFPA 101 - Life Safety Code.
- I. UL - Standard for Safety for Steel Aboveground Tanks for Flammable and Combustible Liquids.
- J. USEPA Tier 3 Emissions Standards.
- K. Nassau County Department of Health.

1.05 SUBMITTALS

- A. Submit product data under provisions of Section 01300.
- B. Shop Drawings: Indicate electrical characteristics and connection requirements. Show plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, electrical diagrams including schematic and interconnection diagrams.
- C. Product Data: Provide data showing dimensions, weights, ratings, interconnection points and internal wiring diagrams for engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer, vibration isolators, radiator and derating schedules, operating performance, exhaust flow data, and cooling system data. Submit generator alternator output curves, deration curves and temperature data on the complete genset individual components.
- D. Test Reports: Indicate results of performance testing including 0.8 power factor test at 100 percent load.
- E. Prototype Test Reports: Submittals will not be received without submission of prototype test reports. No exceptions.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation and starting of product. Provide typical system interconnection wiring diagrams.
- G. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

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- H. Manufacturer's Field Reports: Submit under provisions of Section 017500. Indicate procedures and findings.
- I. Approval of Substitute Equipment: Design has been based on Cummins Power Generation generator. If substitute equipment is approved, the Contractor shall be responsible for the charges of any necessary revisions to the plans and specifications, drawings, and project documentation; and charges related to equipment spacing, enclosure sizes, foundation sizes, mounts, electrical wiring, ventilation equipment, fuel, exhaust components, etc., as well as any engineering costs. If a brand name other than that specified is proposed for use, identify the location of a locally available generator system for the Owner and Engineer to review and inspect, as well as witness testing to show compliance with the specifications. Also, the supplier must furnish a list of completed installations, including name, address and telephone number of at least five comparable installations which can prove the proposed products have operated satisfactorily for three years.
- J. Proposal for substitute equipment shall provide complete submittal data to the Engineer for approval or disapproval. Submit detailed sizing calculations for each generator to verify proposed model is capable of picking up the entire loads with voltage dips as herein specified

1.06 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01782.
- B. Operation Data: Include instructions for normal operation.
- C. Maintenance Data: Include instructions for routine maintenance requirements, service manuals for engine and day tank, oil sampling and analysis for engine wear, and emergency maintenance procedures.

1.07 QUALITY ASSURANCE

- A. Perform work in accordance with NFPA 110.
- B. Tank and secondary containment structure shall be submitted to and approved by the Nassau County Health Department.

1.08 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten years experience, and with an authorized distributor offering 24-hour parts and service availability within 50 miles of the project. The manufacturer shall fabricate the engines, generators and control panel. Automatic transfer switches and generator enclosures shall be supplied, warranted and serviced by a single system source supplier.
- B. Supplier: Authorized distributor of specified manufacturer with minimum six years documented experience with specified products and factory-trained service technicians. The supplier must be factory authorized to perform warranty service on the entire system, including but not limited to, the engines, generators, control panels and automatic transfer switches. The supplier must show proof of factory trained service technicians on all components.
- C. The complete engine generator system shall be standard of a single manufacturer. It shall be factory built, tested and shipped by this single manufacturer.

1.09 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70 and NFPA 110.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purposes specified and indicated.
- C. Generator shall be EPA Tier 3-Certified for Stationary Emergency Applications.

1.10 WARRANTY

- A. Provide a 5-year manufacturer's limited warranty, including 100% parts and labor. The complete electrical power system, including but not limited to, generator set, controls, associated switches, enclosures, and accessories, as provided by the single source manufacturer, shall be warranted by the manufacturer against defects in materials and

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workmanship for a period of five (5) years from the date of system startup. Coverage shall include parts, labor, travel expenses, and labor to remove/reinstall the equipment, per manufacturer's standard published limited warranty. Supplier must be factory authorized to perform warranty service on the entire system, including, but not limited to, the engine, the generator, the control panels, and the automatic transfer switches. Provide separate warranty for fuel tanks not integral to the generator.

1.11 EXTRA SERVICES

- A. Provide from manufacturer's local authorized service representative a 5-year planned maintenance agreement at no additional cost to the Owner. The agreement shall include, as a minimum, one service call per year. The services must be performed by the authorized distributor of the equipment furnished, and may not be subcontracted. The following services shall be performed once a year.
 - 1. Replace engine-lubricating oil and remove used oil from the premises.
 - 2. Replace oil and fuel filters.
 - 3. Check oil/water separator. Remove water from premises.
 - 4. Check coolant system for proper levels and condition. Replace coolant filters and add corrosion inhibitor as needed.
 - 5. Check air filter.
 - 6. Check and clean crankcase breathers.
 - 7. Check turbocharger free-spin and end play.
 - 8. Check and adjust belts as required.
 - 9. Check engine for loose, bare or broken wiring. Replace as needed.
 - 10. Fuel tanks and lines to be inspected for the purpose of determining if excessive sludge or rust is collecting.
 - 11. Check entire equipment for fuel or water leaks.
 - 12. Check the condition of batteries and report any action necessary for recharging or replacing.
 - 13. In presence of the Owner:
 - a. Start and run all engines. Check temperatures and pressures.
 - b. Test engine safety shutdown systems.
 - c. Test all transfer switches operation and time delays.
 - d. Submit a report of this inspection to the Owner and advise of any further work required.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Cummins Power Generation, Inc, Minneapolis, MN, Kohler Power Systems, Kohler, WI, Caterpillar, or specifically approved equal.
- B. It is intended that all products specified herein be of standard ratings, therefore, the KW and KVA, starting KVA and maximum allowable voltage dip, ratings, etc., shall be the manufacturer's next size or rating to exactly meet the specifications. No exceptions.

2.02 SYSTEM REQUIREMENTS

- A. The engine generator shall start and provide continuous power to the loads with 100 percent block loading at the time of transfer.

2.03 DIESEL ENGINE GENERATOR SET

- A. Rating: The AC engine generator set shall be Cummins Model C10D6 with Model CA115-J14 alternator, and shall be rated by the manufacturer for standby operation at 10 KW/12.5KVA at 0.8 PF, 60 Hz, 1800 RPM for use at 120/240 volts, 1-phase, 3 wire. Ratings shall be at an elevation of 500 feet above sea level, and at 122 degrees F.
 - 1. Voltage regulation shall be +/- 1.0 percent of rated voltage for any constant load between no load and rated load.
 - 2. Frequency regulation shall be isochronous under varying from no load to 100% rated load.

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3. Random Voltage Variation: The cyclic variations in RMS voltage shall not exceed +/- 0.5% of rated speed for constant loads from no load to rated load, with constant ambient and operating temperature.
4. Random Frequency Variation: Speed variations for constant loads from no load to rated load shall not exceed plus or minus 0.25% of rated speed, with constant ambient and operating temperature.
5. Telephone Harmonic Distortion: The sum of AC voltage waveform harmonics, from no load to full linear load, shall not exceed 5% of rated voltage (L-N, L-L, L-L-L) and no single harmonic shall exceed 3% of rated voltage.
6. Telephone Influence Factor: TIF shall be less than 50 per NEMA MG1-22.43.
7. The diesel engine generator set shall be capable of picking up 100% of nameplate KW and power factor in one step with the engine generator set at operating temperature, in accordance with NFPA Standard 110, Paragraph 5-13.2.6.
8. The engine generator shall start and provide power to the loads in the following step starting sequence with a maximum instantaneous voltage dip of 18% and a maximum frequency dip of 3%.

Step No.	Description	Load	Volts/ Phase	Motor Code	Load Type	Starting Method
1	Misc. Load	.24 kW	120/1	-	Misc. Load	Full Voltage
1	Lighting	.36 kW	120/1	-	Misc. Load	Full Voltage
1	Exhaust Fan	1/6 HP	120/1	-	Motor	Full Voltage
1	Control Panel	1 kW	120/1	-	Resist.	Full Voltage
1	Battery Charger	15A	120/1	-	Motor	Solid State
2	Sewage Pump (via Phase Converter)	3 HP	240/3	-	Motor	Solid State

9. The generator as a packaged unit (engine, alternator, and controls) shall provide a minimum 62 SKVA motor starting (EBS) at 90% sustained voltage.
10. The alternator performance shall be designed at a maximum voltage dip of 35%.
11. The following performance verifications shall be provided for substitute generators.
 - a. Submit two copies of generator sizing program based upon the specified step/starting sequence and associated voltage/frequency dips and required starting KVA.
 - b. As part of the substitution requirements the contractor shall enter all design step/starting sequence loads into the manufacturer's generator sizing program in the presence of the engineer to verify model proposed by substitute manufacturer meets the specified requirements for ambient temperature, site altitude, voltage dip, frequency dip, and starting KVA.

2.04 AC GENERATOR, REGULATOR AND EXCITER UNIT

- A. The AC generator, exciter and voltage regulator shall be designed and manufactured by the engine generator set manufacturer as a complete generator system.
- B. The AC generator shall be synchronous, four pole, revolving field, drip proof construction, single pre-lubricated sealed bearing, air cooled by a direct drive centrifugal blower fan and directly connected to the engine with flexible drive discs. The armature shall have skewed laminations of insulated electrical grade steel, two-thirds pitch windings in order to minimize field heating and voltage harmonics. The rotors shall have amortisseur (damper windings) layer wound mechanically wedged winding construction. The rotors shall be dynamically balanced. The exciters shall be brush-less, three phase, with full wave silicon diodes mounted on the rotating shaft and a surge suppressor connected in parallel with the field winding. Field discharge resistors shall not be acceptable. Systems using three wire solid state devices (such as SCRs or transistors) mounted on the rotor shaft shall not be acceptable.
- C. All insulation system components shall meet NEMA MG1 standard temperature limits for Class H insulation system. Actual temperature rise measured by resistance method at full load shall

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not exceed 105 degrees C to provide additional allowance for internal hot spots. The main generator and exciter insulation systems must be suitably impregnated for operation in severe environments for resistance to sand, salt and sea spray.

- D. Generator shall be a Excitation Boost System (EBS). EBS generators shall provide excitation power to the auto-matic voltage regulator for immunity from voltage distortion caused by nonlinear SCR controlled loads on the generator. The EBS's shall sustain main field excitation power for optimum motor starting and to sustain short circuit current for selective operation and coordination of system overcurrent devices.

2.05 ENGINE GENERATOR SET CONTROLS

- A. The generator sets shall be provided with microprocessor-based control systems which are designed to provide automatic starting, monitoring, and control functions for the generator set. The control systems shall also be designed to allow local monitoring and control of the generator sets, and remote monitoring and control as described in this specification. The controls shall be mounted on the generator sets, and shall be vibration isolated and prototype tested to verify the durability of all components in the system under vibration conditions encountered. The controls shall be UL-508 labeled, CSA282-M1989 certified, and meet IEC-8528 part 4. All switches, lamps and meters shall be oil-tight and dust-tight, and the enclosure doors shall be gasketed. There shall be no exposed points in the controls (with the door open) that operate in excess of 50 volts. The controls shall meet or exceed the requirements of Mil-Std 461C part 9, and IEC Std. 801.2, 801.3 and 801.5 for susceptibility, conducted and radiated electromagnetic emissions. The entire controls shall be tested and meet the requirements of IEEE587 for voltage surge resistance. The generator set mounted controls shall include the following features and functions:
 - 1. The generator control panel shall provide a network interface for the SCADA System. This network interface shall communicate all the generator status, control, display messages, troubleshooting and safety features as described below. Software shall be available for interfacing PLC Software with generator control panel communications. This interface and software development will be performed by another contract.
 - 2. Three position control switch labeled RUN/OFF/AUTO. In the RUN position the generator set shall automatically start, and accelerate to rated speed and voltage. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
 - 3. Red "mushroom-head" push-button EMERGENCY STOP switch. Depressing the emergency stop switch shall cause the generator set to immediately shut down, and be locked out from automatic restarting.
 - 4. Push-button RESET Switch: The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
 - 5. Generator Set AC Output Metering: The generator set shall be provided with a metering set with the following features and functions:
 - a. 2.5-inch, 90 degree scale analog voltmeter, ammeter, frequency meter, and kilowatt (KW) meter. These meters shall be provided with a phase select switch and an indicating lamp for upper and lower scale on the meters. Ammeter and KW meter scales shall be color coded in the following fashion: readings from 0-90% of generator set standby rating: green; readings from 90-100% of standby rating: amber; readings in excess of 100%: red.
 - b. Digital metering set, 0.5% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three phase voltages (line to neutral or line to line) simultaneously.
 - c. Generator Set Alarm and Status Message Display: The generator set shall be provided with alarm and status indicating lamps to indicate non-automatic generator status, and existing alarm and shutdown conditions. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room

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lighting conditions. The generator set control shall indicate the existence of the following alarm and shutdown conditions on a digital display panel:

- 1) Low Oil Pressure (alarm)
 - 2) Low Oil Pressure (shutdown)
 - 3) Oil Pressure Sender Failure (alarm)
 - 4) Low Coolant Temperature (alarm)
 - 5) High Coolant Temperature (alarm)
 - 6) High Coolant Temperature (shutdown)
 - 7) Engine Temperature Sender Failure (alarm)
 - 8) Fail to Crank (shutdown)
 - 9) Overcrank (shutdown)
 - 10) Overspeed (shutdown)
 - 11) Low DC Voltage (alarm)
 - 12) Low Coolant Level (alarm or shutdown-selectable)
 - 13) High DC Voltage (alarm)
 - 14) Weak Battery (alarm)
 - 15) Low Fuel-Daytank (alarm)
 - 16) High AC Voltage (shutdown)
 - 17) Low AC Voltage (shutdown)
 - 18) Under Frequency (shutdown)
 - 19) Over Current (warning)
 - 20) Over Current (shutdown)
 - 21) Short Circuit (shutdown)
 - 22) Ground Fault (alarm)
 - 23) Over Load (alarm)
 - 24) Emergency Stop (shutdown)
 - 25) In addition, provisions shall be made for indication of two customer-specified or future alarm or shutdown conditions. These two alarm conditions shall be interfaced with leak detection/overfill alarm panel for overfill and leak detection. Labeling of the customer specified or future alarm or shutdown conditions shall be of the same type and quality as the above specified conditions. The non-automatic indicating lamp shall be red, and shall flash to indicate the generator set is not able to automatically respond to a command to start from a remote location.
- d. Engine Status Monitoring: The following information shall be available from a digital status panel on the generator set control:
- 1) Engine Oil Pressure (psi or kPA)
 - 2) Engine Coolant Temperature for left and right block temperatures (degrees F or C; both)
 - 3) Engine Oil Temperature (degrees F or C)
 - 4) Engine Speed (rpm)
 - 5) Number of Hours of Operation (hours)
 - 6) Number of Start Attempts
 - 7) Battery Voltage (DC volts)
- e. Control Functions: The control system shall provide for the following functions:
- 1) The control system provided shall include a cycle cranking system, which allows for user selected crank time, reset time, and number of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15 second rest period between cranking periods.
 - 2) The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled.
 - 3) The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this

- specification. The governor control shall include adjustments for gain, damping, and ramping function to control engine speed and limit exhaust smoke while the unit is starting. The governor control shall be suitable for use in paralleling applications without component changes.
- 4) The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.
 - 5) The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components, and an actual failure condition.
- f. Alternator Control Functions: The generator set control shall include the following alternator control functions:
- 1) The generator set shall include an automatic voltage regulation system which is matched and prototype tested with the governing system provided. It shall be immune from mis-operation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The systems shall include a torque-matched characteristic, which shall reduce output voltage in proportion to frequency below a threshold of [58-59] HZ. The voltage regulator shall include adjustments for gain, damping and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alpha-numeric LED readout to indicate setting level.
 - 2) The voltage regulation system shall include provisions for reactive load sharing and electronic voltage matching for paralleling applications. Motorized voltage adjust pot is not acceptable for voltage matching.
 - 3) Controls shall be provided to monitor the output current of the generator set and initiate an alarm when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator.
 - 4) Controls shall be provided to monitor the KW load on the generator set, and initiate an alarm condition when total load on the generator set exceeds the generator set rating for in excess of 5 seconds.
 - 5) Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.
 - 6) An AC over/under voltage monitoring system which responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.
 - 7) A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage is less than 25VDC or more than 32VDC. During engine starting, the low voltage limit shall be disabled, and if DC voltage drops to less than 14.4 volts for more than two seconds a “weak battery” alarm shall be initiated.
 - 8) The control system shall include a ground fault monitoring relay. The relay shall be adjustable from 100-1200 amps, and include an adjustable time delay of 0-1.0 seconds. The relay shall be for indication only, and not trip or shut down the generator set. Note bonding and grounding requirements for the generator set, and provide relay which will function correctly in system as installed.
- g. Control Interfaces for Remote Monitoring: All control and interconnection points from the generator set to remote components shall be brought to a separate connection box. No field connections shall be made in the control enclosure or in the AC power output enclosure. Provide the following features in the control system:

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- 1) Form "C" dry common alarm contact set rated 2A @ 30VDC to indicate existence of any alarm or shutdown condition on the generator set.
- 2) One set of contacts rated 2A @ 30VDC to indicate generator set is ready to load. The contacts shall operate when voltage and frequency are greater than 90% of rated condition.
- 3) A fused 10 amp switched 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit whenever the generator set is running.
- 4) A fused 20 amp 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit at all times from the engine starting/control batteries.
- 5) The control shall be provided with provisions for connection of remote monitoring equipment as described herein or shown on the drawings.

2.06 ENGINES

- A. The diesel engine shall be manufactured by Cummins Engine Company and designed specifically for generator set duty. The diesel engine shall be 4 cycle, diesel fueled, direct injection, 1800 RPM, with forged steel crankshaft and connecting rods. The cylinder blocks shall be cast iron with replaceable wet liners and have four valves per cylinder. The engines shall be turbocharged and aftercooled.
- B. Two cycle engines will not be acceptable.
- C. Electronic governor systems shall provide automatic isochronous frequency regulation. The engine governing systems shall not utilize any exposed operating linkage.
- D. The engines shall be cooled by a unit-mounted closed loop radiator system including belt-driven pusher fan, coolant pump and thermostat temperature control. The cooling systems shall be rated for full rated load operation in 104 degrees F (40 degrees C) ambient condition. The cooling capability of the generator sets shall be demonstrated by prototype tests on a representative generator set model conducted by the generator set manufacturer; calculated data from the radiator manufacturer only is not sufficient. Radiators shall be provided with a duct adapter flange permitting the attachment of an air discharge duct to direct the radiator air outside according to the manufacturer's instructions.
- E. Rotating parts shall be guarded against accidental contact per OSHA requirements.
- F. Engine Schedule:

PARAMETER	KNOTT DRIVE
Radiator Cooling System Air Flow	1385 SCFM
Combustion Air	46 CFM
Maximum Allowable static Restriction	0.5 inches of water
Engine Displacement	100.5 Cubic inches
Minimum number of cylinders	4

- G. The entire cooling air system is based on the above data. All costs incurred if an alternate manufacturer is purchased shall be the responsibility of the Contractor. These costs shall include costs to all other trades as well as any associated engineering fees.

2.07 ENGINE ACCESSORY EQUIPMENT

- A. The engine generator sets shall include the following accessories:
 - 1. Electric starters capable of three complete cranking attempts without overheating, before overcrank shutdown (75 seconds).
 - 2. Positive displacement, mechanical, full pressure, lubrication oil pumps. Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicators. Provide bypass oil filters.
 - 3. Engine driven, mechanical, positive displacement fuel pumps. Fuel filters with replaceable spin-on canister elements. Replaceable heavy-duty dry element air cleaners with restriction indicators and safety element. Flexible fire rated supply and return fuel lines.
 - 4. Engine mounted battery charging alternators, 70 ampere and solid-state voltage regulators.
 - 5. Fuel water separators.
 - 6. Anti-condensation heater for alternator.

2.08 BASES

- A. The engine-generator set shall be mounted on a heavy-duty steel base to maintain proper alignment between components. The engine-generator set shall incorporate battery trays with battery hold-down clamps on the base rails. Provisions for stub up of electrical connections shall be within the footprint of the generator set base rails and within the base tanks as specified in the housing section of the specification. Vibration isolators, spring type, shall be provided to be mounted under the generator set base.

2.09 GENERATOR SETS CIRCUIT BREAKERS

- A. Generator main circuit breaker shall be solid state UL listed, molded case type, rated as listed below. Circuit breakers shall be mounted in a separate NEMA 1 enclosure and be shipped completely wired to the gensets. No exceptions. Enclosures shall include neutral blocks for field connection.
- B. Solid State circuit breakers shall be 100% rated: Refer to drawings for sizes.
- C. Circuit breaker (CB) shall be long time current and instantaneous pickup with solid state trip unit. CB shall have visible mechanical fault indicator and push button trip.
- D. Circuit breakers shall be rated at 65,000 AIC.
- E. Provide auxiliary contacts on breaker position.

2.10 ACCESSORIES

- A. Vibration isolators: Spring type with vertical restraint, painted steel housing and neoprene base pad rated for Seismic Zone 2, Ace Mountings Co., Inc. Type 821.
- B. Starting and Control Batteries: Two (2) 12 volt starting batteries each genset, lead acid type, 12 volt DC, sized to accommodate 45 seconds of cranking at an ambient of 0 degrees F without being recharged.
- C. Battery Chargers: One 15 amp voltage regulated battery charger shall be provided for each engine-generator set. Input AC voltage and DC output voltage shall be as required. Chargers shall be equipped with float, taper and equalize charge settings. Operational monitors shall provide visual output along with individual form C contacts rated at 4 amps, 120 VAC, 30 VDC for remote indication of:
 - 1. Loss of AC Power - red light.
 - 2. Low Battery Voltage - red light.
 - 3. High Battery Voltage - red light.
 - 4. Power ON - green light (no relay contact).
 - 5. Block Heaters: Thermostatically controlled jacket water heater shall be supplied for each genset with a minimum size shall be 2500 watts. Input voltage of heaters shall be 208 VAC 1 phase.
 - 6. Electrical Matting: Dielectric strength 30,000 volts, 2 feet wide, 1/4 inch thick corrugated ASTM D 178 Type 2, Class II.

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7. Fuel Oil: Fuel Oil shall not contain dirt or sediment, or be of a structure to cause clogging of piping and nozzles, and prevent proper operation of the equipment. The ultra-low sulfur diesel (ULSD) fuel supplied under this contract shall meet the following specifications:
 - a. Viscosity: 1.3 to 4.1 cenistrokes at 104 degrees F.
 - b. Cetane Number: 42 minimum above 32 degrees F; 45 minimum below 32 degrees F.
 - c. Sulfur Content: not to exceed .0015 mass percent (15 ppm) sulfur content.
 - d. Active Sulfur: Copper Strip Corrosion not to exceed Number 3 rating after 3 hours at 122 degrees F.
 - e. Water Sediment: not to exceed 0.05 volume percent
 - f. Carbon residue: Not to exceed 0.35 mass percent on 10 volume-percent residuum
 - g. Density: 0.816 to 0.876 grams per cubic centimeter at 59 degrees F.
 - h. Cloud Point: 11 degrees F below lowest ambient temperature at which fuel is expected to operate.
 - i. Ash: Not to exceed 0.02 mass-percent
 - j. Distillation: 10 volume-percent at 540 degrees F maximum, 90 volume-percent at 680 degrees F maximum, 100 volume-percent at 725 degrees F maximum. The distillation curve must be smooth and continuance.
 - k. Lubricity: HFFR – maximum of 0.20 inches Wear Scar Diameter (WSD) at 140 degrees F: SLBOCLE – minimum of 3100 grams.
8. Provide generator 20 light remote annunciator located on the transfer switch cubicle. Interface generator set controls with battery charger and fuel tank alarms for all status conditions. Provide all power, control wiring including conduits.

2.11 EXHAUST SYSTEMS

- A. One exhaust silencer shall be provided for the generator set. The silencer shall be super critical grade. The silencer shall reduce total noise to a maximum dBA level of 85 at 7 meters.
- B. Exhaust silencer within buildings shall be GT Exhaust Slim Line Silencer super critical bottom inlet/side outlet hung from the building ceiling. Provide all fittings, reducers, couplings elbows, spool pieces and supports.
- C. All fittings, accessories, bolts, nuts and hardware shall be type 304 stainless steel. Provide heat resistant gaskets between all flanged connections to serve as dielectric protectors.
- D. The exhaust gas temperature shall not exceed 1074 degrees F. The maximum back pressure shall not exceed 40 inches of water. The design of the entire exhaust system is based on the above data. If a substitution of model specified is made, all costs incurred to redesign as well as costs to other trades to modify the layout shall be the complete responsibility of the Contractor.
- E. Provide stainless steel flexible exhaust connections for the engine as required for connection between the engine exhaust manifolds and exhaust lines in compliance with applicable codes and standards.
- F. Provide an exhaust system condensation trap with manual drain valve to trap and drain off exhaust condensation and to prevent condensation from enter-ing the engine.
- G. Provide a suitable weather cap at the stack outlet with all necessary flanges and fittings for proper installa-tion. The weather cap shall have the proper counter weights attached to prevent banging while generator is unloaded.
- H. Thermal jacket for interior exhaust lines and silencer by FIRWIN CORP. or engineered approved equal. Jacket thickness shall be sufficient to maintain a surface temperature of less than 200 degrees F.
- I. Exhaust mufflers shall be installed by enclosure manufacturer so their weight is not supported by the engines.

2.12 FUEL TANKS

- A. The diesel oil base tank shall be rated at 106 gallons and shall be placed in a rupture basin of 110% capacity for secondary containment, in accordance with Nassau County requirements.

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- B. Minimum 12 gauge steel shall be used for tank body, and minimum 3/16-inch steel shall be used for rupture basin. Tanks shall be UL 142 listed and labeled, have vent, emergency vent, lockable fill, fuel level gauge, and fuel level contacts. Rupture basin shall have contacts to indicate a leak in the fuel tank. Tanks shall be factory tested for leaks under pressure prior to shipment. Submit report on leak test results to the Engineer prior to shipment. Bottom of rupture basin shall be raised 1-3/4 inch minimum off concrete pad on stainless steel channels so bottom does not rest on concrete pad. Exterior of tank and rupture basin and base rails shall be painted with coal tar epoxy primer and exterior epoxy paint to prevent corrosion.
1. There shall be separation between the dike/sub-base and the mounting pad, to prevent the accumulation of moisture.
 2. Provide a five (5) gallon fill containment.
 3. Provide a "scully" type fill connection.
 4. Secondary containment shall be supplied with a removal inspection plate large enough to enable visual inspection of the primary tank.
 5. Tank shall be equipped with an audible/visual high-level alarm/leak detection alarm under Section 16279. The alarm shall be set to indicate when fuel has reached 90% of tank capacity.
 6. A positive fuel shut off shall be installed in the fuel supply line.
 7. The fuel supply and return lines shall be fire rated, U.L listed and labeled.
 8. Fuel connections shall be liquid tight.
 9. Provide 1/4 turn fuel shut off valve.
 10. Check valve shall be installed down stream of liquid tight connection for prevention of blow back.
 11. Tank shall be elevated so that it does not touch the pad.
 12. Tank vents shall terminate outside of building.
 13. Fuel Level Gauge, spiral or mechanical float arm, Rochester Gauges or approved equal.
 14. Overfill Protection Valve: Universal Valve Company, Part No. 49, or approved equal.
 15. Tanks shall be labeled with a plate permanently affixed to the top of the tank near the lifting lug. Plate shall contain year of manufacture of the tank, manufacturer's name, UL identification number, tank model number, capacity and dimensions, design ratings and manufacturer's identification number. A second plate as above, but also containing the date of tank installation, shall be permanently affixed at the fill port.
 16. The tank end shall be stenciled with tank manufacturer, capacity and UL identification number. Letters shall be 1-1/2 inches high minimum.
 17. Tanks shall be provided with a remote fill port within a lockable 5-gallon containment box.

2.13 - ENCLOSURE

- A. The generator set shall be provided with a Level 2 factory-installed sound attenuated housing which allows the generator set to operate at full rated load in the ambient conditions previously specified. The enclosure shall reduce the sound level of the generator set while operating at full rate load to an 8-position average of 69.3 dBA and maximum of 70.6 dBA at any location 7 meters from the generator set in a free field environment. Housing materials used shall be steel and aluminum. Fiberglass and plastic are not acceptable. Acoustical materials used shall be oil and water resistant. No foam materials shall be used.
- B. The enclosure shall include hinged doors for access to both sides of the engine and alternator, and the control equipment and a hinged rear see-through control door. Key-locking and padlockable door latches shall be provided for all doors. Door hinges shall be stainless steel.
- C. The enclosure shall be provided with an exhaust silencer which is mounted on top of the enclosure and allows the generator set package to meet specified sound level requirements. Silencer and exhaust shall include a rain cap and rain shield.
- D. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturers standard color using a two-step electrocoating paint process, or equal meeting the performance requirements specified below. Metal part surfaces shall be prepared, primed

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and painted. The painting process shall result in a coating which meets the following requirements:

1. Primer thickness, 0.5-2.0 mils. Top coat thickness, 0.8-1.2 mils.
2. Gloss, per ASTM D523, 80% plus or minus 5%. Gloss retention after one year shall exceed 50%.
3. Crosshatch adhesion, per ASTM D3359, 4B-5B.
4. Impact resistance, per ASTM D2794, 120-160 inch pounds.
5. Salt spray, per ASTM B117, 1000+ hours.
6. Humidity, per ASTM D2247, 1000+ hours.
7. Water Soak, per ASTM D2247, 1000+ hours.
8. Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts will not be acceptable. Fasteners used shall be corrosion resistant and designed to minimize marring of the painted surface when removed for normal installation or service work. The enclosure shall be built and tested by the engine generator manufacturer.
9. Louver and baffles shall be provided on air inlet to deter entry of rain and snow.
10. Equip with rodent guards.

2.14 SOURCE QUALITY CONTROL

- A. To provide proven reliability of the system, three series of tests shall be performed: prototype model tests, production model tests and field tests. The manufacturer shall provide documentation demonstrating satisfactory prototype and production test results. Generator sets that have not been prototype tested and factory tested at 0.8 PF will not be acceptable.
- B. Generator Set Factory Production Tests and Evaluation: These tests and evaluations must have been performed on a prototype generator set representative of the Model specified. A summary of the generator set testing results shall be submitted for review. The manufacturer's standard series of components development tests on the generator system, engine and other major components shall also be performed and available for review, but shall not be acceptable as a substitute for prototype testing on the complete representative generator set prototype.
- C. Torsiograph Analysis and Test: The manufacturer of the generator set shall verify that the engine generator set, as configured, is free from harmful torsional stresses. The analysis shall include correlation of empirical data from tests on a representative prototype. The empirical data must include spectrum analysis of the torsional transducer output within the operating speed range of the engine generator set. Calculations based on engine and generator separately are not acceptable.
- D. Temperature Rise Test: Complete thermal evaluation of a prototype generator rotor and starter must include actual measurement of internal generator and exciter temperatures by embedded detector method, and measurement of average temperature rise by resistance method. No position measured any place in the windings may exceed the temperature rise limits of NEMA for the particular type of insulation system used. Resistance method temperature rise data shall be confirmed by a full load test on the generator set prototype to include conducted and radiated heat from the engine.
- E. Short Circuit Test: A test on a prototype generator set shall have demonstrated that the generator set is designed to withstand the mechanical forces associated with a short circuit condition. With the generator set operating at rated load and speed, the generator terminals must be short circuited on all three phases for a duration of 20 seconds. At the conclusion of this test, the generator set must be capable of full load operation.
- F. Endurance Run Test: A minimum of 500 continuous hours of endurance testing with a representative generator set prototype operating as defined by the manufacturer's standby rating shall have been performed. Endurance testing shall be used to verify structural soundness and durability.
- G. Maximum Power Test: With the prototype generator set at normal operating temperature and with all power consuming auxiliaries in place, the maximum power available at rated speed shall be determined with the governor set at its fuel stop. The generator set shall maintain this power for a minimum of two minutes.

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- H. Linear Vibration Test: A test for in-line motion of components occurring along a repeatable path shall meet the manufacturer's acceptance criteria.
- I. Cooling System Test: A cooling system test shall demonstrate the ability of the generator set cooling system to maintain normal operating temperature while operating at full rated load and power factor at the highest ambient temperature (122°F) of the system rating. Cooling air requirements, radiator air flow and maximum allowable restriction at radiator discharge, shall be verified by this test.
- J. Maximum Motor Starting KVA: Motor starting KVA shall be determined by test, based on a sustained RMS recovery voltage of at least 90 percent of no load voltage with the specified load KVA at near zero power factor applied to the generator set.
- K. Transient Response, Steady State Speed Control and Voltage Regulation: Prototype generator set tests shall demonstrate consistent performance as follows; stable voltage and frequency at all loads from no load to full rated load, consistent frequency bandwidth with steady state load, maximum voltage and frequency kp on load acceptance and rejection and restoration to steady state after sudden load changes. Transient response is a complete generator set (engine, generator, exciter, and regulator) performance criteria and cannot be established on generator data alone.

2.15 MANUFACTURERS SERVICES

- A. Supply and credit to the Owner field services
- B. Provide the following field services as a minimum at each site:
 - 1. One (1) day for providing installation supervision to the Contractor.
 - 2. One (1) day totaling one (1) trip once the system has been installed to check the completed installations, make all necessary adjustments and otherwise place the system into permanent operation. Electrical wiring shall be verified by the representative. During trip, to be held before substantial completion, provide operation and maintenance instruction to the Owner. A complete review of the Operations and Maintenance Manual shall be presented at this time.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Submit application for installation of generator fuel tank to the Nassau County Department of Health.
- B. Notify the Engineer in writing a minimum of six (6) business days prior to installation to allow for the required minimum five (5) day notification to the Nassau County Department of Health.
- C. Coordinate actions with the Department of Health and the Engineer to allow observation of all significant phases of construction and testing.

3.02 INSTALLATION

- A. Install engine generator and all appurtenances in accordance with manufacturer's recommendations.
- B. Install exhaust components as shown on the drawings and as required to comply with NFPA 37 and local codes and regulations. Components shall be sized to assure full load operation without excessive backpressure sized as per manufacturer's recommendations with actual site dimensions when installed as shown on the drawing. Make provisions as required for pipe expansion and contraction.
- C. Install anchor bolts.
- D. Installation shall comply with applicable State and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.
- E. Fuel tank shall be installed by a Nassau County licensed tank installer and shall conform to compliance with all Nassau County Article III requirements.

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- F. Install leak/overflow panel with individual lights and an alarm horn centered five (5) feet above grade within viewing and hearing distance of the fuel fill.
- G. Provide electrical matting on the floor around the perimeter of the generator. Trim matting to fit.

3.03 FIELD QUALITY CONTROL

- A. Initial startup and field acceptance tests are to be conducted by the authorized rep-representative of the system manufacturer who supplies the equipment.
- B. After approval by Nassau County Department of Health, provide fuel to conduct start-up and acceptance tests.
- C. Test data shall be collected and recorded on the following: time of day, coolant temperature, operating oil pressure, battery charging rate, cranking time, crank-to-rated frequency time, voltage and frequency overshoot, load assumption-to-steady state voltage and frequency stabilization time, operating voltage, frequency, current, kilowatts and power factor. All data shall be taken every fifteen (15) minutes.
- D. Procedure: Generator manufacturer shall conduct a six (6) hour load bank test at 1.0 power factor for each generator set. Provide temporary load bank for testing generator set at 100% load. Load bank test shall test generator at full nameplate KW rating. Generator manufacturer's representative shall record test data, as described in (B) above. Test data shall be tabulated and typed for submission and approval by the Engineer for final acceptance. No handwritten field notes will be allowed.
- E. Conduct a test of the generator and transfer switch to provide power to the facility for a period of 2 hours. At the end of the test period, transfer back to the normal power source.
- F. Follow completion of all tests, provide fuel to fill the fuel tank to 90% of capacity.

END OF SECTION

PART 1 - GENERAL

1.01 - SECTION INCLUDES

- A. Generator Connection Cabinet

1.02 - REFERENCES

- A. NFPA 70 - National Electrical Code.
- B. NEMA ICS 1 - General Standards for Industrial Control and Systems.
- C. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers, and Assemblies.
- D. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

1.03 - SUBMITTALS

- A. Submit product data under provisions of Section 01300.
- B. Submit product data for generator connection cabinets showing overall dimensions, electrical connections, electrical ratings, environmental restrictions, voltage, short circuit ratings, enclosure details and all accessories.
- C. Submit manufacturer's installation instructions. Include instructions for storage, handling, protection, examination, preparation, installation and starting of product.
- D. Submit manufacturer's operation and maintenance manual as part of shop drawing submittal.

1.04 - OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 01730.
- B. Include instructions for operating equipment.
- C. Include instructions for operating equipment under emergency conditions.
- D. Document ratings of equipment and each major component.
- E. Include manufacturer's recommended routine preventative maintenance schedule.
- F. List any special tools, maintenance materials and recommended spare parts.

1.05 - REGULATORY REQUIREMENTS

- A. Conform to all applicable national, state, city or local codes for standby electrical systems.

PART 2 - PRODUCTS

2.01 - MANUFACTURERS

- A. Manufacturer: Trystar, or approved equal.
- B. Generator Connection Cabinet shall comply with the latest NEC 700.3 requirements. Entire cabinet must be listed to ETL or UL 1008 Standards. UL Listing of individual components is not acceptable.
- C. Generator Connection Cabinet shall contain tamper proof 16 series cam-type connections.
- D. Cabinet shall have lockable latches on front door, and independent access panel door. Access panel door shall not open unless main lockable door has been opened.
- E. 4X Two conductor 600-MCM mechanical lugs per phase, neutral, and ground on busbar for permanent load connection.
- F. Construction: All stainless steel construction, silver plated copper busbar, protective caps on all panel mounts to prevent accidental contact, and padlockable swinging front door.
- G. Generator Connection Cabinet shall contain phase rotation monitor.
- H. Generator Connection Cabinet shall include a weatherproof label on the face of the box indicating voltage, phase, and max input rating of 600A.

2.02 - GENERAL REQUIREMENTS

- A. Enclosures:
 - 1. Pad mount, NEMA 3R rain-tight, aluminum enclosure.
 - a) Pad-lockable front door shall include a hinged access plate at the bottom for entry of cables from portable generator or portable load bank. NEMA 3R integrity shall be maintained with access plate open for cable entry.
 - b) Front, side, and bottom through a front access panel shall be accessible for maintenance.

SECTION 16621 – GENERATOR CONNECTION CABINET

- c) Top, side, and bottom through a front access panel shall be accessible for permanent cabling.

2. Finishes:

- a) Paint after fabrication. Powder coated Hammer Gray.

B. Phase, Neutral, and Ground Buses:

- 1. Material: Silver-plated, Tin-plated or Hard-drawn copper, specified upon order.
- 2. Equipment Ground Bus: bonded to box.
- 3. Isolated Ground Bus: insulated from box.
- 4. Ground Bus: 25%, 50%, or 100% of phase size.
- 5. Neutral Bus: Neutral bus rated 100 percent of phase bus.
- 6. Round edges on bus.
- 7. Entire construction shall be Bussing. Cabling between Camlocks or sections shall not be acceptable.

C. Generator Connection Cabinets shall be camlock style mounted on gland plate.

- 1. An additional set of mechanical lugs, accessible from the front of the generator connection cabinet, shall also be required for temporary generator connection on pad mount units.
- 2. Camlocks are required to have phase color identification paint at their mounting point to the generator connection cabinet. Camlock phase paint shall be as follows.
 - a) A phase – Brown
 - b) B Phase – Yellow
 - c) C Phase – Purple or Orange
 - d) N Neutral – White
 - e) G Ground – Green

SECTION 16621 – GENERATOR CONNECTION CABINET

3. Permanent connectors shall be broad range set-screw type, located behind an aluminum barrier.
4. Voltage & Phase shall be as shown on project single line diagram. Camlocks shall be color coded as appropriate for the specified for the specified voltage.
5. Amperage rating shall be as shown on project single line diagram.
6. A remote start terminal shall be provided, so that a temporary generator can be remotely started and stopped in a identical manner as the permanent generator set.

2.03 - RATINGS

- A. Ratings shall be as follows:
 1. Voltage: 277/480VAC, three phase, four wire, 60 Hz.
 2. Amperage: As indicated in drawings.
 3. Enclosure Rating: NEMA 3R

PART 3 – EXECUTION

3.01 - EXAMINATION

- A. Examine elements and surfaces to receive Generator Connection Cabinet for compliance with installation tolerances and other conditions affecting performance of the work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 - INSTALLATION

- C. Installation of generator connection cabinet shall be in accordance with manufacturer requirements. Provide applicable U.L. labeling for installed system.

3.03 - POWER OUTAGE

- A. After the generator connection cabinet is installed, the Contractor shall be responsible to inspect the installation and field verify that the generator connection cabinet has been installed per manufacturer's recommendations. Owner's operating personnel shall be instructed on the use and service requirements of the generator connection cabinet by the manufacturer. A minimum of two (2) hours manufacturers training is required.

SECTION 16621 – GENERATOR CONNECTION CABINET

3.04 - DEMONSTRATION

- A. Demonstrate operation of generator connection cabinet under provisions.

+ + END OF SECTION + +

SECTION 16621 – GENERATOR CONNECTION CABINET

+ + NO TEXT ON THIS PAGE + +

SECTION 16680 – SURGE PROTECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Requirements for providing surge protection on electric service. Provide system in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.

1.02 RELATED SECTIONS

- A. Section 16076 - Labeling and Identification

1.03 PAYMENT FOR WORK FURNISHED AND INSTALLED UNDER THIS SECTION SHALL BE INCLUDED IN THE LUMP SUM PRICE BID FOR THE CONTRACT, AS DESCRIBED IN SECTION 01150 – MEASUREMENT AND PAYMENT.

1.04 REFERENCES

- A. Equipment shall comply with the latest applicable provisions and recommendations of the following:
 - 1. American National Standards Institute and Institute of Electrical and Electronic Engineers (ANSI/IEEE C62.11, C62.41 and C62.45).
 - 2. Federal Information Processing Standards Publication 94 (FIP PUB 94).
 - 3. National Electrical Manufacturer Association (NEMA LS-1).
 - 4. National Fire Protection Association (NFPA 20, 70, 75 and 78).
 - 5. Underwriters Laboratories (UL 1449).
 - 6. CAN/C22.2 No. 8-M1986; CSA Electrical Certification Notice No. 516.
 - 7. The system individual units shall be UL listed under UL 1449 3rd Edition Standard for Transient Voltage Surge Suppressions (TVSS) and the surge ratings shall be permanently affixed to the TVSS.

1.05 SUBMITTALS

- A. Submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions and as specified under Division 1 of the Specifications.
- B. Working Drawings:
 - 1. Manufacturer's technical information.
 - 2. Dimensional drawings.
 - 3. Wiring Diagrams.
 - 4. Mounting details.
 - 5. Submit Operations and Maintenance Manuals in accordance with the Specifications.

1.06 WARRANTY

- A. Provide manufacturers' twenty (20) year warranty to cover repair or replacement with a new device. Manufacturer to provide no cost replacement of protection modules and fuses for the life of the suppressor.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle system components in accordance with the Specifications and the manufacturer's recommendations.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Coordinate installation of surge protection with motor control center manufacturer.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. MCG ELECTRONICS, INC., Deer Park, New York or approved equal.
- B. Approved equal.

2.02 MANUFACTURED UNITS

- A. Surge suppression:
1. Surge Free Model No. 400LS

2.03 SYSTEM REQUIREMENTS

- A. The specified surge protective device shall provide effective high energy surge diversion for application ANSI/IEEE C62.41-1991 Location Category C3 environments. Testing per ANSI/IEEE C62.45-1992 using ANSI/IEEE C62.41 Category C3 waveforms and amplitudes. UL 1449 listing. The specified surge protective device shall provide:
1. 400,000 transient amps, per phase of surge protection.
 2. Peak surge current ratings must be independently tested and verified.
 3. All mode protection, L-N, L-G, L-L, N-G.
 4. Integral disconnect with safety dead front.
 5. Each MOV protected from over-current, thermal overload and monitored individually.
 6. Self diagnostics with comprehensive LED bar graph on front panel showing the exact % level of protection available.
 7. Audible fault alarm with silence switch.
 8. Event counter, indication of time and date of last event (battery backup for time and date).
 9. Remote alarm relay contacts (surge protected), Form C.
 10. Micro-Z low impedance installation cable.
- B. Environmental Requirements:
1. Magnetic Fields: Connection shall be made using low impedance Micro-Z cabling provided with the suppressor for maximum magnetic field cancellation. Unit shall be shunt-installed with no series connected elements.
 2. Operating Temperature: Operating temperature range shall be -40° to $+71^{\circ}$ C (-40° to $+160^{\circ}$ F).
 3. Storage Temperature: Storage temperature range shall be -40° to $+85^{\circ}$ C.
 4. Relative Humidity: Operation shall be reliable in an environment with 0% to 95% non-condensing relative humidity.
 5. Operating Altitude: The system shall be capable of operation up to an altitude of 13,000 feet above sea level.
 6. Operating Voltage: Maximum continuous operating voltage shall be no less than 115% and no greater than 140% of the nominal rated line voltage.
 7. Power Frequency: The power frequency range shall be 47 to 440 Hertz.
- C. Electrical Requirements:
1. Unit Operating Voltage Requirements:

Voltage	Description	V _{peak} L-N 20kV, 10kA	V _{peak} L-N 6kV, 500A
240Y	3 phase, 4W + Gnd	1130 V	970 V
240S	1 phase, 2W + Gnd	1070	940 V
480D	3 phase, 4W + Gnd, Delta	1720	1548 V

2. Energy absorption (8/20us) in joules: 24,296-108,000J.
3. Install unit in parallel with the protected equipment. No series connected protective elements shall be used.
4. The maximum surge current capacity per phase of the specified system, based on the standard IEEE 8/20 microsecond waveform, shall be at least: 1 Event at 400 kA. The surge life (8/20us) shall be at least 10,000 @ 15 kA occurrences. The transient

SECTION 16680 – SURGE PROTECTION

- suppression capability shall be bi-directional and suppress both positive and negative impulses.
5. The suppressor shall be capable of interrupting a 200 kA, short circuit current delivered from the AC power line. The interrupt capability must be confirmed and documented by a recognized independent testing laboratory.
 6. The suppressor shall be designed so as to minimize the internal surge path impedance. Direct point-to-point internal wiring is inherently inductive and not acceptable. Connection to the power service shall be constructed for best performance.
- D. Protection System Components:
1. Replaceable modules: The suppressor shall be constructed using field replaceable protection modules. The suppressor shall have individually fused and monitored 40mm Metal Oxide Varistors (MOV's), including neutral to ground protection mode. Each module will provide five times (5X) redundant protection, with three modules per each phase and five fuses per module. The status of each module shall be locally monitored with a green LED that becomes red in a fault condition. The transient I_{peak} rating of the fuse shall be coordinated with the I_{peak} handling capability of the MOV so that the surge path capability is not limited by the series fusing. In addition, each MOV shall incorporate a thermal disconnect means to remove a shorted MOV safely from the protection system.
 2. Self-Diagnostics: Red, green and yellow solid state LED indicators shall be provided on the hinged front cover to indicate protection status. An illuminated green LED indicates power is present at the protector on all phases, and an illuminated red LED shall indicate that one or more of the modules have reduced protection. An illuminated yellow LED shall indicate a suppression event. Both front panel and internal LEDs are required to provide power and fault indications in the event of even the loss of a single fuse or MOV. Relay operation shall be in a fail-safe operating mode (i.e., continuously energized so that power failure, reduced protection, or a break in the remote monitoring line will cause a fault indication at the remote monitor).
 3. Remote Alarm Capability: Relay alarm contacts shall be provided for remote alarm monitoring capability of unit status. Form C normally open and normally closed contacts shall be provided with voltage and current limiting protection.
 4. Audible Alarm: The specified system shall be equipped with an audible alarm which shall be activated when any one or more of the modules has a reduced protection condition. A mute option shall be provided for the audible alarm.
 5. Advanced Diagnostic LED Display: A front panel, microprocessor controlled LED display, in the form of a bar graph, will indicate the protection status of each MOV on each phase including neutral to ground. A event counter will display number of suppressed transient events with a time and date stamp.
 6. Integral Disconnect: Unit shall be provided with dead front disconnect to remove power from protector for maintenance access. The disconnect should not be accessed from the front panel unless the unit meets the minimum clamp voltage requirements.
 7. NEMA 4X Enclosure: powdered coated steel, with stainless steel hardware.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The unit shall be factory installed in the motor control center by the Motor Control Center manufacturer, in accordance with the manufacturer's printed instruction to maintain warranty. Observe local and national codes.
- B. Install units as close as possible to the load side lugs of the transfer switch to which it is connected using low impedance Micro-Z cabling.
- C. Provide a 3-pole disconnect to insure safety of maintenance personnel.

END OF SECTION

+ + NO TEXT ON THIS PAGE + +

SECTION 16729 – FUEL TANK OVERFILL & LEAK ALARM SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Requirements for providing fuel tank overfill and leak alarm system. Provide system in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.

1.02 RELATED SECTIONS

- A. Section 16076 - Labeling and Identification
- B. Section 16620 – Generator Assemblies

1.03 PAYMENT FOR WORK FURNISHED AND INSTALLED UNDER THIS SECTION SHALL BE INCLUDED IN THE LUMP SUM PRICE BID FOR THE CONTRACT, AS DESCRIBED IN SECTION 01150 – MEASUREMENT AND PAYMENT.

1.04 REFERENCES

- A. Equipment shall comply with the latest applicable provisions and recommendations of the following:
 - 1. NFPA 70, National Electrical Code.
 - 2. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 3. Nassau County Department of Health.

1.05 SYSTEM DESCRIPTION

- A. Overfill and Leakage Alarm: System capable of sensing and indicating product overfill and leakage of fuel oil storage tank. System shall be capable of sensing WARNING, low and FULL level conditions.
- B. Level monitoring/leak detection panel, probes and remote audio/visual alarm panel shall be equipment approved by the Nassau County Department of Health.

1.06 SUBMITTALS

- A. Submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions, Article GC-14 – Contractor Submissions; and as specified under Division 1 of the Specifications.
- B. Working Drawings:
 - 1. Manufacturer's technical information proposed for all components.
 - 2. Dimensional drawings.
 - 3. Wiring Diagrams.
 - 4. Mounting details.
 - 5. Submit for record Nassau County Department of Health approved plans.
 - 6. Submit Operations and Maintenance Manuals in accordance with the Specifications.

1.07 QUALITY ASSURANCE

- A. General:
 - 1. All system components shall conform to the applicable NEMA and UL Standards and shall be built by one approved manufacturer who shall use only best commercial materials and processes of manufacture.
 - 2. All components shall be UL listed.
 - 3. The manufacturer shall use a shop test facility that has recently calibrated testing apparatus and qualified, experienced technicians, for all shop tests. Calibration of testing apparatus shall be within one year.
 - 4. All test equipment and instrument calibration shall be in accordance with the latest edition of the accuracy standard of the U.S. National Institute of Standards and Technology.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle system components in accordance with the Specifications and the manufacturer's recommendations.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Coordinate installation of alarm system with generator system manufacturer.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. VEEDER-ROOT, Simsbury, CT, or approved equal.
- B. System from an alternate manufacturer shall be acceptable and approved by the Nassau County Department of Health.

2.02 COMPONENTS

- A. Overfill/Leakage Alarm Panel: Guardian Model AST, for wall mounting; housing the controlling electronic circuitry, including display, cursor keypad and operating keypad; capable of continuously monitoring all sensor circuits; 120 volt, single phase, 60 Hz; with warning indicator.
- B. High & Low Level Alarm Probes: Model TLS, high level dual float probe, capable of transmitting an electric signal to the control panel at tank warning level (90 percent capacity) and full level (95 percent capacity); automatically resetting once tank is less than 90 percent capacity; Part No. 794380-302. Low level probe shall indicate a 10% capacity indication, Part No. 794380-301. Probes compatible with diesel fuel oil.
- C. Warning Alarm: Model TLS, NEMA 4, capable of indicating visual and audible indication of tank warning level (90 percent capacity) and full level (95 percent capacity); noise level adjustable from 78 to 103 dB at 10 feet, with separate enclosure for alarm acknowledgment switch and acknowledgment lamp.
- D. Secondary Containment Alarm Probe: Form No. 794390-460 interstitial non-discriminating, capable of transmitting an electric signal to the control panel during a leakage situation between the walls of the tank and secondary containment; automatically resetting when leaked product is no longer present.
- E. Probe for inventory Management: Part No. 847390.
- F. Generator fuel tank manufacturer shall verify lengths of fuel tank alarm probes.
- G. Provide Modbus TCP gateway accessory in leak detection panel.

2.03 ACCESSORIES

- A. Alarm Panel Guard: Stainless Steel wire mesh construction, sized to fit over and protect the remote alarm from damage.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify all openings in tank are properly located and sized and ready to receive work of this section.

3.02 PREPARATION

- A. Clean all parts and components of the alarm system such that they are free from dirt, water and other debris.

3.03 INSTALLATION

- A. Installation shall comply with the Nassau County Fire Prevention Ordinance Article III (Article III).
- B. Install alarm system in accordance with manufacturer's instructions and approved shop drawings.
- C. Mount the overfill alarm panel on the building interior and remote panels in the exterior locations shown utilizing Type 316 stainless steel hardware.
- D. Overfill/leakage alarm shall be easily accessible for testing and reading of indication lights during an alarm situation.

SECTION 16729 – FUEL TANK OVERFILL & LEAK ALARM SYSTEM

- E. Install alarm condition into generator controls and for remote annunciator. Provide all wiring as required.
- F. Install secondary containment alarm probe between the inner and outer walls of the fuel tank and located 1/4 inch (6 mm) above the bottom inner surface of the outer tank wall.
- G. Obtain approval of the system installation from the Nassau County Department of Health.
- H. Provide programming services and wiring to connect fuel tank alarm system to Owners SCADA system.

END OF SECTION

SECTION 16729 – FUEL TANK OVERFILL & LEAK ALARM SYSTEM

+ + NO TEXT ON THIS PAGE + +

SECTION 16900 - CABLE AND CONDUIT SCHEDULE

PART 1 - GENERAL

1.01 - SECTION INCLUDES

- A. The cable and conduit schedule lists conduit number, size and type, cable quantity and size from/to destinations, circuit purpose and remarks.
- B. All conduits and wiring shall be furnished and installed under this Contract, unless specifically noted otherwise.
- C. The conduit numbering system consists of two parts separated by hyphen. First part is the equipment identification number. The second part is the individual conduit identification number. The individual conduit identification number may be presented in a 2- or 3-digit format (for example, 01 and 001) and represents the same conduit.
- D. The definition of the term conduit shall include all types of raceway provided under this Contract.
- E. In all cases where the word install or installed refers to conduit it shall mean install all conduit, raceways, fittings, supports, boxes and appurtenances. In addition it shall include all grounding and bonding. Drag lines are to be pulled upon completion of each raceway.
- F. Where install or installed refers to cable it shall include pulling the cable and testing the cable for insulation resistance, continuity and absence from grounds, as well as terminating all conductors and testing for proper connection.
- G. In general, the conduit and cable schedules do not indicate lighting and receptacle circuits, as well as some of the other cable and conduit to be provided under this Contract. The Contractor is advised to refer to the Specifications and Drawings for the additional conduit and cable requirements.
- H. Conform to the specifications requirements for Conduit and Cable Sections 16131 and 16131E - Electric Conduit System, and Sections 16121 and 16121E - Electric Wire and Cable.
- I. The conduit and wire schedule begins following this section.
- J. Refer to the Contract Drawings for specific type of conduit installed. Should there be a conflict between the type of conduit indicated on the Drawings and the following specifications schedule type, the Drawings shall take precedence.

SECTION 16900 - CABLE AND CONDUIT SCHEDULE

PART 2 – PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

+ + END OF SECTION + +

CONTROL CONDUIT AND WIRE SCHEDULE										
MORGAN PARK										
Conduit ID	Conduit Type	Conduit Size	No. of Conduit	Wire Type	Wire Size	No. Of Wires	Ground Size	Description	From	To
TS2-MCP-001	RGS	3/4"	1	XHHW-2	#14	20	N/A	ATS TO PLC	TS2	MCP
MTS-MCP-001	RGS	3/4"	1	XHHW-2	#14	4	N/A	MTS TO PLC	MTS	MCP
TP1-MCP-001	RGS	3/4"	1	XHHW-2	#14	10	N/A	FUEL OIL TRANSFER PUMP MONITORING PANEL	TP1	MCP
WWHL-MCP-001	RGS	3/4"	1	XHHW-2	#14	4	N/A	HIGH-HIGH LEVEL FLOAT	WWHL	MCP
WWLL-MCP-001	RGS	3/4"	1	XHHW-2	#14	4	N/A	LOW-LOW LEVEL FLOAT	WWLL	MCP
SP1MS-MCP-001	RGS	3/4"	1	XHHW-2	#14	30	N/A	SEWAGE PUMP 1 MS IN MCC	SP1MS	MCP
SP2MS-MCP-001	RGS	3/4"	1	XHHW-2	#14	30	N/A	SEWAGE PUMP 2 MS IN MCC	SP2MS	MCP
BUB-MCP-001	RGS	3/4"	1	XHHW-2	#14	20	N/A	WET WELL BUBBLER SIGNALS	BUB	MCP
GEN-MCP-001	RGS	3/4"	1	XHHW-2	#14	10	N/A	GENERATOR CP	GENCP	MCP
PT-MCP-001	RGS	3/4"	1	SHIELDED TWISTED PAIR CABLE	N/A	1	N/A	DISCHARGE PRESSURE TRANSMITTER	VALVE CH	MCP
FM-MCP-001	RGS	3/4"	1	SHIELDED TWISTED PAIR CABLE	N/A	1	N/A	FLOW TRANSMITTER	MPFM	MCP
SP1MS-MCP-002	RGS	3/4"	1	CAT 6 CABLE	N/A	N/A	N/A	SEWAGE PUMP 1 MS IN MCC	SP1MS	MCP
SP2MS-MCP-002	RGS	3/4"	1	CAT 6 CABLE	N/A	N/A	N/A	SEWAGE PUMP 2 MS IN MCC	SP2MS	MCP
TS2-GEN-001	RGS	3/4"	1	XHHW-2	#14	20	N/A	GENERATOR CONTROL	TS2	GEN
TS2-GEN-002	RGS	3/4"	1	BELDEN 9729 CABLE	N/A	N/A	N/A	GENERATOR COMMUNICATION	TS2	GEN
TLS-TP1-001	RGS	3/4"	1	MANUFACTURER'S RECOMMENED CABLE	N/A	N/A	N/A	GENERATOR TANK LEVEL SENSOR	TLS	TP1
TLD-TP1-001	RGS	3/4"	1	MANUFACTURER'S RECOMMENED CABLE	N/A	N/A	N/A	GENERATOR TANK LEAK DETECTION	TLD	TP1

VIOLA										
SPCP-VIO-001	RGS	3/4"	1	THWN	#14	30	N/A	SEWAGE GRINDER CONTROL PANEL	SPCP	PLC-VIO
TS3-VIO-001	RGS	3/4"	1	XHHW-2	#14	20	N/A	TRANSFER SWITCH	TS3	PLC-VIO
WWHL-VIO-001	RGS	3/4"	1	XHHW-2	#14	4	N/A	HIGH-HIGH LEVEL FLOAT	WWHL	PLC-VIO
WWLL-VIO-001	RGS	3/4"	1	XHHW-2	#14	4	N/A	LOW-LOW LEVEL FLOAT	WWLL	PLC-VIO
TGLP-VIO-001	RGS	3/4"	1	XHHW-2	#12	2	N/A	OMTEC FUEL TANK (LEAK DETECTION)	RA	PLC-VIO
MTS3-VIO-001	RGS	3/4"	1	XHHW-2	#14	10	N/A	MTS TO PLC	MTS3	PLC-VIO
WWJB-VIO-001	RGS	3/4"	1	XHHW-2	#14	4	N/A	SEWAGE PUMP SIGNALS	WWJB	PLC-VIO
FM-VIO-001	RGS	3/4"	1	SHIELDED TWISTED PAIR CABLE	N/A	1	N/A	FLOW TRANSMITTER	FM	MCP
PT-VIO-001	RGS	3/4"	1	SHIELDED TWISTED PAIR CABLE	N/A	1	N/A	DISCHARGE PRESSURE TRANSMITTER	VALVE CH	MCP
SP1-CJB-001	RGS	3/4"	1	XHHW-2	#14	20	N/A	SEWAGE PUMP NO. 1 DIGITAL SIGNALS	SP1	CJB
SP1-CJB-002	RGS	3/4"	1	SHIELDED TWISTED PAIR CABLE CAT 6 CABLE	N/A	2 / 1	N/A	SEWAGE PUMP NO. 1 ANALOG SIGNALS AND COMM. SIGNALS	SP1	CJB
SP2-CJB-001	RGS	3/4"	1	XHHW-2	#14	20	N/A	SEWAGE PUMP NO. 2 DIGITAL SIGNALS	SP2	CJB
SP2-CJB-002	RGS	3/4"	0	SHIELDED TWISTED PAIR CABLE CAT 6 CABLE	N/A	2 / 1	N/A	SEWAGE PUMP NO. 2 ANALOG SIGNALS AND COMM. SIGNALS	SP2	CJB

KNOTT DRIVE										
WWHL-CJB-001	RGS	3/4"	1	XHHW-2	#14	4	N/A	WET WELL HIGH LEVEL FLOAT	WWHL	CJB
WWLL-CJB-001	RGS	3/4"	1	XHHW-2	#14	4	N/A	WET WELL LOW LEVEL FLOAT	WWLL	CJB
WWPT-CJB-001	RGS	3/4"	1	SHIELDED TWISTED PAIR	N/A	N/A	N/A	WET WELL PRESSURE TRANSDUCER	WWPT	CJB
TS4-KCP-001	RGS	3/4"	1	XHHW-2	#14	20	N/A	ATS SIGNALS	TS4	PLC-KCP
FM-CJB-001	RGS	3/4"	1	SHIELDED TWISTED PAIR	N/A	1	N/A	MAGNETIC FLOW METER	FM	CJB
VCPT-CJB-001	RGS	3/4"	1	SHIELDED TWISTED PAIR	N/A	1	N/A	VALVE CHAMBER PRESSURE TRANSDUCER	VCPT	CJB
WWEFMS-KCP-001	RGS	3/4"	1	XHHW-2	#14	4	N/A	WET WELL EXHAUST FAN RUN STATUS	WWEF	CJB
CJB-KCP-001	RGS	3"	1	SHIELDED TWISTED PAIR/ CAT 6 CABLE	N/A	4 / 2	N/A	CONTROL JUNCTION BOX	CJB	PLC-KCP
CJB-KCP-002	RGS	3"	1	XHHW-2	#14	60	N/A	CONTROL JUNCTION BOX	CJB	PLC-KCP
RA-KCP-001	RGS	3/4"	1	XHHW-2	#12	10	N/A	OMTEC FUEL TANK (leak detection)	RA	PLC-KCP
MTS2-KCP-001	RGS	3/4"	1	XHHW-2	#14	4	N/A	MTS SIGNALS	MTS2	PLC-KCP
TS4-GDS-001	RGS	3/4"	1	XHHW-2	#14	2	N/A	PORTABLE GENERATOR START/STOP	TS4	GDS
SP1-CJB-001	RGS	3/4"	1	XHHW-2	#14	20	N/A	SEWAGE PUMP NO. 1 DIGITAL SIGNALS	SP1	CJB
SP1-CJB-002	RGS	2	1	SHIELDED TWISTED PAIR / CAT 6 CABLE	N/A	2 / 1	N/A	SEWAGE PUMP NO. 1 ANALOG SIGNALS AND COMM. SIGNALS	SP1	CJB
SP2-CJB-001	RGS	3/4"	1	XHHW-2	#14	20	N/A	SEWAGE PUMP NO. 2 DIGITAL SIGNALS	SP2	CJB
SP2-CJB-002	RGS	2	1	SHIELDED TWISTED PAIR / CAT 6 CABLE	N/A	2 / 1	N/A	SEWAGE PUMP NO. 2 ANALOG SIGNALS AND COMM. SIGNALS	SP2	CJB
TS4-GEN-001	RGS	3/4"	1	XHHW-2	#14	20	N/A	GENERATOR CONTROL	TS4	GEN
TS4-GEN-002	RGS	2	1	BELDEN 9729 CABLE / CAT 6 CABLE	N/A	1 / 1	N/A	GENERATOR COMMUNICATION	TS4	GEN
GEN-MCP-001	RGS	3/4"	1	XHHW-2	#14	2	N/A	PORTABLE GENERATOR START/STOP	GEN	MCP

ROSLYN										
SP1MS-RCP-001	RGS	3/4"	1	THWN	#14	12	N/A	SEWAGE PUMP NO. 1 COMMUNICATION DIGITAL SIGNALS	SP1MS	RCP
SP1MS-RCP-002	RGS	3/4"	1	SHIELDED TWISTED PAIR CABLE	N/A	2	N/A	SEWAGE PUMP NO. 1 COMMUNICATION ANALOG SIGNALS	SP2MS	RCP
SP2MS-RCP-001	RGS	3/4"	1	THWN	#14	12	N/A	SEWAGE PUMP NO. 2 COMMUNICATION DIGITAL SIGNALS	SP3MS	RCP
SP2MS-RCP-002	RGS	3/4"	1	SHIELDED TWISTED PAIR CABLE	N/A	2	N/A	SEWAGE PUMP NO. 2 COMMUNICATION ANALOG SIGNALS	SP1MS	RCP
SP3MS-RCP-001	RGS	3/4"	1	THWN	#14	12	N/A	SEWAGE PUMP NO. 3 COMMUNICATION DIGITAL SIGNALS	SP2MS	RCP
SP3MS-RCP-002	RGS	3/4"	1	SHIELDED TWISTED PAIR CABLE	N/A	2	N/A	SEWAGE PUMP NO. 3 COMMUNICATION ANALOG SIGNALS	SP3MS	RCP
TS1-RCP-001	RGS	3/4"	1	THWN	#14	20	N/A	ATS	TS2	RCP
MV1-RCP-001	RGS	3/4"	1	SHIELDED TWISTED PAIR CABLE	N/A	N/A	N/A	MOTORIZED BUTTERFLY VALVE	MV-2	RCP
WWLT-RCP-001	RGS	3/4"	1	SHIELDED TWISTED PAIR CABLE	N/A	N/A	N/A	WET WELL LEVEL 1	WWLT	RCP
RVP-RCP-001	RGS	3/4"	1	SHIELDED TWISTED PAIR CABLE	N/A	N/A	N/A	VALVE PIT DISCHARGE PRESSURE	RVP	RCP
DWHW-RCP-001	RGS	3/4"	1	SHIELDED TWISTED PAIR CABLE	#14	2	N/A	DRY WELL HIGH WATER	DDHW	RCP
MCCC-SP1-002	RGS	3/4"	1	THWN	#14	6	N/A	SEWAGE PUMP NO. 1 SEAL AND THERMAL SIGNALS	SP1JB	SP1MS
MCCC-SP2-002	RGS	3/4"	1	THWN	#14	6	N/A	SEWAGE PUMP NO. 1 SEAL AND THERMAL SIGNALS	SP2JB	SP2MS
MCCC-SP3-002	RGS	3/4"	1	THWN	#14	6	N/A	SEWAGE PUMP NO. 1 SEAL AND THERMAL SIGNALS	SP3JB	SP3MS

ROSLYN POWER CONDUIT AND WIRE SCHEDULE									
Conduit ID	Conduit Type	Conduit Size	Wire Type	No. Of Wires	Wire Size	Ground Size	Description	From	To
MCCA-MCCB-001	RGS	2"	THWN	4	#2/0	#6	MCCB POWER	MCC-A-4	MCC-B
TS1-MTS-001	RGS	4"	THWN	4	#350	#1	GENERATOR POWER	TS1	MTS
TS1-GDS-001	RGS	3/4"	XHHW-2	3	#14	N/A	PORTABLE GENERATOR START/STOP	TS1	MTS
TS1-BR-001	RGS	3/4"	THWN	2	#10	#10	BATTERY CHARGER	TS1	BATTERY CHARGER
MTS-GEN-001	RGS	4"	THWN	4	#350	#1	Generator	MTS	GEN
TS1-GEN-001	RGS	3/4"	THWN	20	#14	N/A	Generator	TS1	GEN
TS1-GEN-002	RGS	3/4"	BELDEN 9729	N/A	BELDEN 9729	N/A	Generator	TS1	GEN
MCCA-MCCC-001	RGS	2-1/2"	THWN	3	#3/0	3	MCCC Power	MCC-A-5	MCC-C
MCCA-MCCC-002	RGS	2-1/2"	THWN	3	#3/0	3	MCCC Power	MCC-A-5	MCC-C
MCCB-HGCP-001	RGS	3/4"	THWN	3	#12	12	Hydraulic Grinder Control Panel	MCC-B	HG
MCCB-EMCP-001	RGS	3/4"	THWN	3	#12	12	Existing Emergency Storage Control Panel	MCC-B	EMCP
MCCB-MVJB-001	RGS	3/4"	THWN	3	#12	12	Existing MV-1 and MV-2 JB	MCC-B	MVJB
MCCB-SPCP-001	RGS	3/4"	THWN	3	#12	12	Ex. Sump Pump Control Panel	MCC-B	SPCP
MCCB-OC-001	RGS	3/4"	THWN	3	#12	12	Ex. Overhead Crane	MCC-B	OC
MCCA-EUH6-001	RGS	3/4"	THWN	3	#12	#12	ELECTRIC UNIT HEATER MID	MCC-A-5	EUH-6
MCCA-EUH7-001	RGS	3/4"	THWN	3	#12	#12	ELECTRIC UNIT HEATER LOWER	MCC-A-5	EUH-7
MCCA-EUH3-001	RGS	3/4"	THWN	3	#12	#12	ELECTRIC UNIT HEATER GEN RM	MCC-A-57.5 KW	EUH-3
MCCB-EUH4-001	RGS	3/4"	THWN	3	#12	#12	ELECTRIC UNIT HEATER UPPER	MCC-B-2	EUH-4
MCCB-EUH5-001	RGS	3/4"	THWN	3	#12	#12	ELECTRIC UNIT HEATER UPPER	MCC-B-2	EUH-5
RLP-ACC1-001	RGS	3/4"	THWN	2	#12	12	Generator Accesory 1	RLP	ACC1
RLP-ACC2-001	RGS	3/4"	THWN	2	#12	12	Generator Accesory 2	RLP	ACC2
RLP-SP-001	RGS	3/4"	XHHW-2	2	#10	10	Gen. Shore Power	RLP	SP
MCCC-SP1JB-001	RGS	2"	THWN	3	#2/0	6	Sewage Pump No. 1	MCC-C-2	SP1JB
MCCC-SP2JB-001	RGS	2"	THWN	3	#2/0	6	Sewage Pump No. 2	MCC-C-3	SP2JB
MCCC-SP3JB-001	RGS	2"	THWN	3	#2/0	6	Sewage Pump No. 3	MCC-C-4	SP3JB
EF3MS-EF3-001	RGS	3/4"	THWN	2	#12	12	GENERATOR EXHAUST FAN	MCC-A-3	EF-3
UTLY-MAIN-001	RGS	4"	XHHW-2	4	#300	#1/0	MAIN POWER	UTILITY/METER	MCC-A
UTLY-MAIN-002	RGS	4"	XHHW-2	4	#300	#1/0	MAIN POWER	UTILITY/METER	MCC-A
MCCB-WWCP-001	RGS	3/4"	THWN	3	#12	#12	WET WELL FAN CONTROL PANEL	MCC-B-2	WWCP
MCCB-DWCP-001	RGS	3/4"	THWN	3	#12	#12	DRY WELL FAN CONTROL PANEL	MCC-B-2	DWCP
DWCP-EF1-001	RGS	3/4"	THWN	3	#12	#12	DRY WELL EXHAUST FAN	DWCP	EF-1
DWCP-SF1-001	RGS	3/4"	THWN	3	#12	#12	DRY WELL SUPPLY FAN	DWCP	SF-1
RP-SS-001	N/A	N/A	MICRO Z, LOW INDUCTANCE CABLE	N/A	N/A	N/A	SURGE SUPPRESSION	MCC-A-3	SS
RP-T1-001	N/A	N/A	THWN	3	#8	#10	STEP DOWN TRANSFORMER	MCC-A-3	T1
RP-RLP-001	N/A	N/A	THWN	4	#3	#8	PANEL RLP	MCC-A-4	RLP
WWCP-SF2-001	N/A	N/A	THWN	3	#12	#12	WET WELL SUPPLY FAN	MCC-A-3	WWCP
WWCP-EF2-002	RGS	3/4"	THWN	3	#12	#12	WET WELL EXHAUST FAN	EF2MS	WWCP
RP-EF3MS-001	N/A	N/A	THWN	2	#12	#12	EF-3 MOTOR STARTER	RLP	EF3MS

MORGAN PARK POWER CONDUIT AND WIRE SCHEDULE									
Conduit ID	Conduit Type	Conduit Size	Wire Type	No. Of Wires	Wire Size	Ground Size	Description	From	To
MP-MAIN-001	RGS	4"	XHHW-2	4	350	#1	Main	UTILITY	MAIN
MP-MAIN-002	RGS	4"	XHHW-2	4	350	#6	Main	UTILITY	MAIN
MP-SP1MS-001	N/A	N/A	THWN	3	#1	#6	SEWAGE PUMP NO. 1 MS	MP-MCC	SP1MS
MP-SP1MS-002	N/A	N/A	THWN	3	#1	#6	SEWAGE PUMP NO. 2 MS	MP-MCC	SP2MS
SP1MS-SP1DS-001	RGS	1-1/2"	XHHW-2	3	#1	#6	Sewage Pump No. 1 Disconnect Switch	MP-MCC	SP1DS
SP2MS-SP2DS-001	RGS	1-1/2"	XHHW-2	3	#1	#6	Sewage Pump No. 2 Disconnect Switch	MP-MCC	SP2DS
SP1DS-SP1JB-001	RGS	1-1/2"	XHHW-2	3	#1	#6	Sewage Pump No. 1	SP1DS	SP1JB
SP2DS-SP2JB-001	RGS	1-1/2"	XHHW-2	3	#1	#6	Sewage Pump No. 2	SP2DS	SP2JB
SP1JB-SP1-001	RGS	1-1/2"	XHHW-2	3	#1	#6	Sewage Pump No. 1	SP1DS	SP1
SP2JB-SP2-001	RGS	1-1/2"	XHHW-2	3	#1	#12	Sewage Pump No. 2	SP2DS	SP2
MLP-WWEFMS-001	RGS	3/4"	XHHW-2	3	#12	#12	Wet Well EF Motor starter	MLP	WWEFMS
WWEFMS-WWJB-001	RGS	3/4"	XHHW-2	3	#12	#12	Wet Well JB	WWEFMS	WWJB
WWJB-WWEF-001	RGS	3/4"	XHHW-2	3	#12	#12	Wet Well fan	WWJB	WW FAN
MP-SGCP-001	RGS	3/4"	THWN	3	#12	#12	Hydraulic Grinder Control Panel	MP-MCC	SGCP
SGCP-SGJB-001	RGS	3/4"	XHHW-2	3	#12	#12	SEWAGE GRINDER JB	SGCP	SGJB
SGJB-SG-001	RGS	3/4"	MANUFACTURER'S RECOMMENDED CABLE	N/A	N/A	#12	SEWAGE GRINDER	SGJB	SG
MLP-ACC1-001	RGS	3/4"	XHHW-2	2	#12	#12	Generator Accessory 1	MLP	ACC1
MLP-ACC2-001	RGS	3/4"	XHHW-2	2	#12	#12	Generator Accessory 2	MLP	ACC2
MLP-ACC3-001	RGS	3/4"	XHHW-2	2	#12	#12	Generator Accessory 3	MLP	ACC3
TS2-MTS-001	RGS	4"	XHHW-2	4	#350	#1	MTS	TS2	MTS
TS2-MTS-002	RGS	4"	XHHW-2	4	#350	#1	MTS	TS2	MTS
MTS-GEN-001	RGS	4"	XHHW-2	4	#350	#1	GEN	MTS	GEN
MTS-GEN-002	RGS	4"	XHHW-2	4	#350	N/A	GEN	MTS	GEN
TS2-GEN-003	RGS	3/4"	XHHW-2	20	#14	N/A	GEN CONTROL	TS2	GEN
TS2-GEN-004	RGS	2"	9729 BELDEN + CAT 6	N/A	N/A	N/A	GEN COMMUNICATION	TS2	GEN
MP-SS-001	N/A	N/A	MICRO Z, LOW INDUCTANCE CABLE	N/A	N/A	N/A	SURGE SUPPRESSION	MCC	SS
MP-MLP-001	N/A	N/A	THWN	4	#1/0	#6	PANEL MLP	MCC	MLP
MP-PLP-001	N/A	N/A	THWN	4	#3/0	#6	PANEL PLP	MCC	PLP
MP-CS-001	RGS	1-1/4"	XHHW-2	3	#3	#12	CONSESSION STAND	MCC	CS
MLP-EF4MS-001	N/A	N/A	THWN	2	#12	#12	EF-4 MOTOR STARTER	MLP	EF4MS
EF4MS-EF4-001	RGS	3/4"	THWN	2	#12	#12	EF-4	EF4MS	EF4
MLP-EUH1-001	RGS	3/4"	THWN	3	#12	#14	EUH1	MLP	EUH1
MLP-EUH2-001	RGS	3/4"	THWN	3	#12	#12	EUH2	MLP	EUH2
VCCL-MLP-001	RGS	3/4"	XHHW-2	2	#12	#12	VALVE CHAMBER LIGHTING	MLP	VALVE CHAMBER
MLP-FM-001	RGS	3/4"	XHHW-2	2	#12	#12	FLOW METER POWER	MLP	FM POWER

VIOLA POWER CONDUIT AND WIRE SCHEDULE									
Conduit ID	Conduit Type	Conduit Size	Wire Type	No. Of Wires	Wire Size	Ground Size	Description	From	To
VLP-SP-001	RGS	3/4"	THWN	2	#12	#12	SHORE POWER	VLP	SP
VLP-TGLP-001	RGS	3/4"	THWN	3	#12	#12	TANK MONITORING AND LEAK DETECTION PANEL	VDP	TGLP
VDP-SGCP-001	RGS	3/4"	THWN	3	#12	#12	Hydraulic Grinder Control Panel	VDP	SGCP
SGCP-SGJB-001	RGS	3/4"	THWN	3	#12	#12	Hydraulic Grinder JB	SGCP	SGJB
SGJB-SG-001	RGS	3/4"	MANUFACTURER'S RECOMMENDED CABLE	N/A	N/A	N/A	Hydraulic Grinder	SGJB	SG
VLP-ACC1-001	RGS	3/4"	THWN	2	#12	#12	Generator Accessory 1	VLP	ACC1
VLP-ACC2-001	RGS	3/4"	THWN	2	#12	#12	Generator Accessory 2	VLP	ACC2
VLP-BR-001	RGS	3/4"	THWN	2	#10	#12	Generator Battery	VLP	BR
MTS3-GEN-001	RGS	2-1/2"	THWN	4	#3	#8	Generator	MTS3	GEN
TS3-GEN-002	RGS	3/4"	THWN	20	#14	#12	0	TS3	0
TS3-GEN-003	RGS	2"	9729 BELDEN + CAT 6	N/A	N/A	N/A	0	TS3	0
TS3-MTS3-001	RGS	2-1/2"	XHHW-2	4	#3	#8	MANUAL TRANSFER SWITCH/DOCKING STATION	TS3	MTS3
VDP-EUH9-001	RGS	3/4"	THWN	3	#12	#12	EUH-9	VDP	EUH-9
VDP-EUH8-001	RGS	3/4"	THWN	3	#12	#12	EUH-8	VDP	EUH-8
TS3-VDP-001	RGS	1-1/2"	THWN	4	#3	#8	DISTRIBUTION PANEL	MAIN	VDP
VDP-SG-001	RGS	3/4"	MICRO-Z, LOW CONDUCTANCE CABLE	N/A	N/A	N/A	SURGE SUPPRESSION	VDP	SG
MAIN-TS3-001	RGS	2-1/2"	XHHW-2	4	#3/0	#6	TS3	MAIN	TS3
VP-MAIN-001	PVC SCH 80	N/A	XHHW-2	4	#3/0	#6	MAIN	UTILITY	MAIN
VDP-T2-001	RGS	1"	THWN	3	#8	#10	TRANFORMER T2	VDP	T2
T2-VLP-001	RGS	1-1/2"	THWN	4	#3	#8	LIGHTING PANEL	T2	VLP
VDP-SP1DS-001	RGS	3/4"	XHHW-2	3	#10	#10	Sewage Pump no. 1	VDP	SP1DS
VDP-SP2DS-001	RGS	3/4"	XHHW-2	3	#10	#10	Sewage Pump no. 2	VDP	SP2DS
SP1DS-WWJB-001	RGS	3/4"	XHHW-2	3	#10	#10	Sewage Pump NO. 1	SP1DS	WWJB
SP2DS-WWJB-001	RGS	3/4"	XHHW-2	3	#10	#10	Sewage Pump NO. 2	SP2DS	WWJB
WWJB-SP1-001	RGS	3/4"	XHHW-2	3	#10	#10	Sewage Pump WW no. 1	WWJB	SP1
WWJB-SP2-001	RGS	3/4"	XHHW-2	3	#10	#10	Sewage Pump WW no. 2	WWJB	SP2
VLP-WWEFMS-001	RGS	3/4"	XHHW-2	2	#12	#12	WET WELL EFMS	VLP	WWEFMS
WWEFMS-WWJB-001	RGS	3/4"	XHHW-2	2	#12	#12	WWJB	WWEFMS	WWJB
WWJB-WWEF-001	RGS	3/4"	XHHW-2	2	#12	#12	WWEF	WWJB	WWEF
MPLC-MLP-001	RGS	3/4"	XHHW-2	2	#12	#12	METERING PIT LIGHTING CIRCUIT	VLP	MLC
VCLC-MLP-001	RGS	3/4"	XHHW-2	2	#12	#12	VALVE CHAMBER LIGHTING CIRCUIT	VLP	VCLC
WWLC-MLP-001	RGS	3/4"	XHHW-2	2	#12	#12	WET WELL LIGHTING CIRCUIT	VLP	WWLC

KNOTT DRIVE POWER CONDUIT AND WIRE SCHEDULE									
Conduit ID	Conduit Type	Conduit Size	Wire Type	No. Of Wires	Wire Size	Ground Size	Description	From	To
K-MAIN-001	RGS	1-1/2"	XHHW-2	4	#3	N/A	MAIN DISCONNECT	UTILITY	MAIN
TS4-KDP-001	RGS	1-1/2"	XHHW-2	4	#3	#8	DISTRIBUTION PANEL	TS4	KDP
KDP-PC-001	RGS	1"	XHHW-2	2	#6	#10	PHASE CONVERTER	KDP	PHASE CONVERTER
MAIN-TS4-001	RGS	1-1/2"	XHHW-2	4	#3	#8	ATS	UTILITY/GEN	TS4
KDP-SS-001	RGS	3/4"	MICRO-Z, LOW CONDUCTANCE CABLE	N/A	N/A	N/A	SURGE SUPPR.	KDP	SS
MTS2-GEN-001	RGS	1"	XHHW-2	4	#6	#10	GENERATOR	MTS2	GEN
TS4-GEN-002	RGS	3/4"	XHHW-2	20	#14	N/A	GENERATOR	TS4	GEN
TS4-GEN-003	RGS	2"	9729 BELDEN CABLE + CAT 6	N/A	N/A	N/A	GENERATOR	TS4	GEN
TS4-MTS2-001	RGS	1"	XHHW-2	4	#6	#10	MANUAL TRANSFER SWITCH	TS4	MTS2
TS4-MTS2-001	RGS	3/4"	XHHW-2	3	#14	N/A	MANUAL TRANSFER SWITCH	TS4	MTS3
MAIN-KDP-001	RGS	1-1/2"	XHHW-2	4	#3	#8	DISTRIBUTION PANEL	MAIN	KDP
PC-SP1DS-001	RGS	3/4"	XHHW-2	3	#12	#12	SEWAGE PUMPS	PHASE CONVERTER	SP1DS
PC-SP2DS-001	RGS	3/4"	XHHW-2	3	#12	#12	SEWAGE PUMPS	PHASE CONVERTER	SP2DS
SP1DS-WWJB-001	RGS	3/4"	XHHW-2	3	#12	#12	SEWAGE PUMPS	SP1DS	WWJB
SP2DS-WWJB-001	RGS	3/4"	XHHW-2	3	#12	#12	SEWAGE PUMPS	SP2DS	WWJB
WWJB-SP1PC-001	RGS	3/4"	XHHW-2	3	#12	#12	SEWAGE PUMPS	WWJB	SP1PC
WWJB-SP2PC-001	RGS	3/4"	XHHW-2	3	#12	#12	SEWAGE PUMPS	WWJB	SP2PC
SP1PC-SP1-001	RGS	3/4"	XHHW-2	3	#12	#12	SEWAGE PUMPS	PHASE CONVERTER	SP1
SP2PC-SP2-001	RGS	3/4"	XHHW-2	3	#12	#12	SEWAGE PUMPS	PHASE CONVERTER	SP2
KDP-WWEFMS-001	RGS	3/4"	XHHW-2	2	#12	#12	WET WELL FAN MS	KDP	WWEFMS
WWEFMS-WWJB-001	RGS	3/4"	XHHW-2	2	#12	#12	WET WELL FAN	WWEFMS	WWEF
WWJB-WWEF-001	RGS	3/4"	XHHW-2	2	#12	#12	WET WELL FAN	WWJB	WWEF
KDP-LG-001	RGS	3/4"	XHHW-2	2	#12	#12	LIGHTING AND RECEPTACLE	KDP	LIGHTING AND RECEPT.
KDP-KCP-001	RGS	3/4"	XHHW-2	2	#12	#12	SCADA PANEL	KDP	KCP
KDP-ACC-001	RGS	3/4"	XHHW-2	2	#12	#12	GENERATOR ACCESSORIES	KDP	GEN ACCESSORY 1
KDP-ACC-002	RGS	3/4"	XHHW-2	2	#12	#12	GENERATOR ACCESSORIES	KDP	GEN ACCESSORY 2
KDP-SP-001	RGS	3/4"	XHHW-2	2	#12	#12	SHORE POWER RECEPTACLE	KDP	SP
MPLC-KDP-001	RGS	3/4"	XHHW-2	2	#12	#12	METERING PIT LIGHTING	KDP	METERING PIT
VCCLC-KDP-001	RGS	3/4"	XHHW-2	2	#12	#12	VALVE CHAMBER LIGHTING	KDP	VALVE CHAMBER
WWLC-KDP-001	RGS	3/4"	XHHW-2	2	#12	#12	WET WELL LIGHTING	KDP	WET WELL
KDP-FM-001	RGS	3/4"	XHHW-2	2	#12	#12	FLOW METER POWER	KDP	FLOW METER



September 6th, 2022

Gregory Levasseur, PE
H2M Architects + Engineers
538 Broad Hollow Road
Melville, NY 11747

**Re: Subsurface Exploratory Investigation
Nassau County Department of Public Works
Knott, Morgan, Viola, and Roslyn Village Pump Station Improvements
H2M Project No.: NCDP 2102**

P.W. Grosser Consulting (PWGC) has conducted a subsurface investigation at the Knott, Morgan, Viola, and Roslyn Village Pump Station sites in Nassau County. The drilling contractor, Land Air Water Environmental Services, performed eight (8) soil borings under the supervision of PWGC with the purpose of determining the nature and extent of the underlying strata and its engineering properties. This report presents the results of the geotechnical investigation for the six (6) sites to support the proposed improvements, consisting of precast concrete wetwell structures and bulkheading.

EXPLORATION SCOPE AND PROCEDURE

The soil borings were initially advanced to 20' or 30' below grade surface (bgs). Standard Penetration Testing (SPT) was conducted per ASTM 1586 with a 2" diameter, 2'0" long split spoon sampler. SPT blow counts and soil samples were taken continuously from the surface down to 16' below grade surface. Final boring depths were extended as necessary to establish a minimum of 20 feet of suitable bearing material.

The borings were conducted using a Geoprobe rig equipped with a DH-100 Auto Drop Hammer pneumatic hammer with a split-spoon sampling unit. The drill rig was contracted from Land Air Water Environmental Services (LAWES) based in Center Moriches, New York.

The standard penetration value (N) is defined as the number of blows of a 140-pound hammer, falling 30 inches, required to advance the split-spoon sampler one foot into the soil (ASTM D1586). The sampler is lowered to the bottom of the drill hole and the number of blows is recorded for each of the four successive increments of six inches of penetration. The "N" value is the sum of the number of blows required to advance the sampler through the second and third six-inch increment. The results of the standard penetration test indicate the relative density and comparative consistency of the soils and thereby provides a basis for estimating the relative strength of the soil profile.

The borehole locations can be found in the attached Boring Location Plans. Field test results and soil descriptions can be found in the attached boring logs. Elevations in the boring logs were obtained from Google Earth as site surveys were not available. Soil was classified based on the Unified Soil Classification System (USCS) per ASTM D2488.

Laboratory testing for additional characterization was performed on select samples. Laboratory test results can be found in the attached lab report sheets and were incorporated into the recommended properties in the Recommendations section.

The borings were located as follows:

Table 1 – Borings by Site Location

Site Name, Location	Borings	Proposed Improvements
Morgan Memorial Park Pump Station Glen Cove, NY Report Tables 1A, 1B	B-1	Wetwell work
Knott Drive Pump Station Glen Cove, NY Report Tables 2A, 2B	B-2	Wetwell work
Viola Drive Pump Station Glen Cove, NY Report Tables 3A, 3B	B-3	Wetwell work
Whitewood Drive Pump Station Massapequa Park, NY Report Tables 4A, 4B	B-4, B-5	Bulkheading
Roosevelt Boulevard Pump Station East Massapequa, NY Report Tables 5A, 5B	B-6, B-7	Bulkheading
East Avenue Pump Station Lawrence, NY Report Tables 6A, 6B	B-8	Bulkheading

Locations of the exploratory soil borings were based on a site plan package provided by the Engineer of Record. The tables in the next section describe the general findings for each of the sites. Groundwater levels are known to fluctuate with seasonal climatic variations, tidal patterns and changes in the land use.

The bearing capacity of the soil encountered during the geotechnical exploration is calculated using the results of the SPT. The blow counts recorded in the boring log were corrected based on the effective overburden pressure of the soil strata and the driving energy of the drill rig equipment. The recommended soil bearing capacity includes a factor of safety of at least two against shear failure.

FINDINGS AND RESULTS - SUBSURFACE CONDITIONS

Table 1A – Generalized Stratigraphy, For Morgan Memorial Park Pump Station (B-1)

Stratum	Approximate Depth to Bottom of Stratum (feet)	Soil Encountered	Consistency/Density
<u>Stratum 1:</u> Silty Sand SM	4'	Dark brown silty sand, trace amount of gravel, trace brick fragments, possible fill	Very loose to loose
<u>Stratum 2:</u> Lt Br/Grey Silty Clay CL, CL-ML	32'+	Light brown and grey, lean clay and silty lean clay, trace gravel.	Very soft: 4'-8' Firm: 8'-10' Stiff: 10'-32'
Groundwater Encountered at 4' bgs.			

Table 1B – Recommended Soil Parameters, For Morgan Memorial Park Pump Station (B-1)

Stratum	Approx. Depth to Bottom of Stratum (feet)	Allowable Bearing Capacity* (tsf)	Subgrade Modulus (pci)	Unit Weight, Moist (pcf)	Soil Friction Angle, (degrees)	Active Earth Coefficient	Lateral Equivalent Pressures (pcf)
<u>Stratum 1:</u> Silty Sand SM	4'	0.25	150	100	28	0.361	36 (Active) 280 (Pass.) 55 (At Rest)
<u>Stratum 2:</u> Lt Br/Grey Silty Clay CL, CL-ML	32'+	4'-8': 0.25 8'-10': 0.75 10'-32': 1.5	75	118	-	-	-

*Unconfined Compressive strength, q_u , for cohesive soils (Stratum 2).

Table 2A – Generalized Stratigraphy, For Knott Drive Pump Station (B-2)

Stratum	Approximate Depth to Bottom of Stratum (feet)	Soil Encountered	Consistency/Density
<u>Stratum 1:</u> Dark Brown Sand, Fill SP	6'	Dark brown fine-grained sand, trace gravel & mica, possible fill	Loose to medium dense
<u>Stratum 2:</u> Dark Brown Sand with Silt, Fill SP-SM	14'	Dark brown, medium to fine grained sand, trace glass fragments at 6'-8', likely urban fill at 6'-8' bgs	Loose to medium dense
<u>Stratum 3:</u> Yellow-Orange Sand SP	32'	Yellowish orange, medium to fine grained sand, trace gravel. Little silt at 30' bgs	Medium dense
Groundwater Not Encountered			

Table 2B – Recommended Soil Parameters, For Knott Drive Pump Station (B-2)

Stratum	Approx. Depth to Bottom of Stratum (feet)	Allowable Bearing Capacity (tsf)	Subgrade Modulus (pci)	Unit Weight, Moist (pcf)	Soil Friction Angle, (degrees)	Active Earth Coefficient	Lateral Equivalent Pressures (pcf)
<u>Stratum 1:</u> Dark Brown Sand, Fill SP	6'	1.00	200	100	28	0.361	36 (Active) 280 (Pass.) 55 (At Rest)
<u>Stratum 2:</u> Dark Brown Sand with Silt, Fill SP-SM	14'	1.25*	200	100	30	0.333	33 (Active) 300 (Pass.) 50 (At Rest)
<u>Stratum 3:</u> Yellow-Orange Sand SP	32'	2.50	250	120	34	0.283	34 (Active) 425 (Pass.) 53 (At Rest)

*Uncontrolled Fill is unsuitable for direct bearing. Remove and replace if found at foundation bearing depths

Table 3A – Generalized Stratigraphy, For Viola Drive Pump Station (B-3)

Stratum	Approximate Depth to Bottom of Stratum (feet)	Soil Encountered	Consistency/Density
<u>Stratum 1:</u> Light Brown Sand SP	20'	Light brown, medium to fine grained sand, trace gravel and mica. Dense at 14'-20' bgs	Loose to dense
<u>Stratum 2:</u> Light Brown Sand with Silt SP-SM	30'	Light brown, medium to fine grained sand, little silt, trace gravel	medium dense
Groundwater Not Encountered			

Table 3B – Recommended Soil Parameters, For Viola Drive Pump Station (B-3)

Stratum	Approx. Depth to Bottom of Stratum (feet)	Allowable Bearing Capacity (tsf)	Subgrade Modulus (pci)	Unit Weight, Moist (pcf)	Soil Friction Angle, (degrees)	Active Earth Coefficient	Lateral Equivalent Pressures (pcf)
<u>Stratum 1:</u> Light Brown Sand SP	20'	1.25	250	110	32	0.307	33 (Active) 360 (Pass.) 52 (At Rest)
<u>Stratum 2:</u> Light Brown Sand with Silt SP-SM	30'	3.00	250	120	34	0.283	34 (Active) 425 (Pass.) 53 (At Rest)

Table 4A – Generalized Stratigraphy, For Whitewood Drive Pump Station (B-4, 5)

Stratum	Approximate Depth to Bottom of Stratum (feet)	Soil Encountered	Consistency/Density
<u>Stratum 1:</u> Light Brown Sand SP	22'	Light brown to yellow-orange, medium to fine grained sand, trace gravel	Very loose to medium dense
Groundwater Encountered at 3.5'bgs			

Table 4B – Recommended Soil Parameters, For Whitewood Drive Pump Station (B-4, 5)

Stratum	Approx. Depth to Bottom of Stratum (feet)	Allowable Bearing Capacity (tsf)	Subgrade Modulus (pci)	Unit Weight, Moist (pcf)	Soil Friction Angle, (degrees)	Active Earth Coefficient	Lateral Equivalent Pressures (pcf)
<u>Stratum 1:</u> Light Brown Sand SP	22'	0.75	200	120	32	0.307	36 (Active) 390 (Pass.) 56 (At Rest)

Table 5A – Generalized Stratigraphy, For Roosevelt Boulevard Pump Station (B-6, 7)

Stratum	Approximate Depth to Bottom of Stratum (feet)	Soil Encountered	Consistency/Density
<u>Stratum 1:</u> Brown Sand with Silt, Possible Fill SP-SM	5'-10'	Light brown to grey, fine-grained sand, little silt, trace gravel & mica, possible fill (fragments of brick)	Loose
<u>Stratum 2:</u> Peat, Organic Clay Pt	5'-11'	Dark grey to black organics and roots. Interbedded with sand in B-6.	Very soft
<u>Stratum 3:</u> Medium Grained Sand SP	32'+	Light brown to yellowish orange, medium to fine grained sand, trace gravel.	Loose to medium dense
Groundwater Encountered at 5' bgs			

Table 5B – Recommended Soil Parameters, For Roosevelt Boulevard Pump Station (B-6, 7)

Stratum	Approx. Depth to Bottom of Stratum (feet)	Allowable Bearing Capacity (tsf)	Subgrade Modulus (pci)	Unit Weight, Moist (pcf)	Soil Friction Angle, (degrees)	Active Earth Coefficient	Lateral Equivalent Pressures (pcf)
<u>Stratum 1:</u> Brown Sand with Silt, Possible Fill SP-SM	5'-10'	0.50	200	100	28	0.361	36 (Active) 280 (Pass.) 55 (At Rest)
<u>Stratum 2:</u> Peat, Organic Clay Pt	5'-11'	0.00*	0	75	20	0.490	36 (Active) 150 (Pass.) 50 (At Rest)
<u>Stratum 3:</u> Medium Grained Sand SP	32'+	0.50	250	110	32	0.307	34 (Active) 460 (Pass.) 52 (At Rest)

*Peat is unsuitable for direct bearing. Remove and replace if found at foundation bearing depths

Table 6A – Generalized Stratigraphy, For Lawrence Pump Station (B-8)

Stratum	Approximate Depth to Bottom of Stratum (feet)	Soil Encountered	Consistency/Density
<u>Stratum 1:</u> Fine Grained Sand with Silt, Possible Fill SP-SM, SP	20'	Light brown to yellowish orange, fine-grained sand, trace gravel, possible fill (fragments of concrete). Little silt from 0'-4'	Very loose to loose
<u>Stratum 2:</u> Peat, Organic Clay Pt	13'	Dark grey to black organics and roots. Thin layers interbedded with sand in Stratum 1	Very soft
<u>Stratum 3:</u> Grey Sand SP	47'+	Light grey, medium to fine grained sand, trace gravel.	20'-40': Very Loose 40'+: Medium Dense
Groundwater Encountered at 5' bgs			

Table 6B – Recommended Soil Parameters, For Roosevelt Boulevard Pump Station (B-8)

Stratum	Approx. Depth to Bottom of Stratum (feet)	Allowable Bearing Capacity (tsf)	Subgrade Modulus (pci)	Unit Weight, Moist (pcf)	Soil Friction Angle, (degrees)	Active Earth Coefficient	Lateral Equivalent Pressures (pcf)
<u>Stratum 1:</u> Fine Grained Sand with Silt, Possible Fill SP-SM, SP	20'	0.50	200	100	28	0.361	36 (Active) 280 (Pass.) 55(At Rest)
<u>Stratum 2:</u> Peat, Organic Clay Pt	13'	0.00*	0	75	20	0.490	36 (Active) 150 (Pass.) 50(At Rest)
<u>Stratum 3:</u> Grey Sand SP	47'+	20'-40': 0.25 40'+: 2.00	250	110	30	0.333	36 (Active) 330 (Pass.) 55(At Rest)

*Peat is unsuitable for direct bearing. Remove and replace if found at foundation bearing depths



RECOMMENDATIONS - DEWATERING

Dewatering may be required for construction based on the nature and depth of the proposed improvements and the shallow groundwater table at some of the sites.

Controlling groundwater levels may be critical to allow for subgrade preparation and foundation construction. PWGC expects that groundwater can be controlled during excavation by installing well-points and localized gravel-lined sumps and pumps. The contractor's dewatering system should be adequate for maintaining a "dry" site during normal operating conditions and water should be maintained at least two (2) feet below subgrade elevations. Design and implementation of dewatering systems should be the responsibility of the contractor.

Temporary dewatering should remain active until adequate means of providing uplift resistance (i.e. anchors or dead load) is in place to resist hydrostatic pressures. Disposal of pumped groundwater should be performed in accordance with all applicable local, state and federal regulations. The contractor's dewatering designer should design the dewatering system to properly address the various locations and depths of the excavations within this site. All permit requirements must be adhered to as specified by the agency providing the permit.

RECOMMENDATIONS – EXCAVATION SUPPORT

The method of excavation and design of trench support are the responsibility of the contractor and subject to applicable local, state, and federal safety regulations, including the current Occupational Safety and Health Administration (OSHA) excavation and trench safety standards. The means, methods, and sequencing of construction operations and site safety are the responsibility of the contractor.

According to the most recent OSHA regulations, the soils encountered in the borings may be classified as Type C. Excavations extending more than 4 ft deep should be laterally supported or alternatively provided with stable side slopes of 1 1/2H:1V or flatter. In PWGC's opinion, adequate lateral support may be provided by common methods, such as sloping the sides of the excavation, the use of a trench shield, or hydraulic shoring systems.

RECOMMENDATIONS – SEISMIC SITE CLASS

Based on the properties of the soils encountered in the test borings (average N <15) and PWGC's knowledge of geologic conditions in the area of the site, a site class of 'E' ("Soft Soil" profile) is considered appropriate as determined from Table 1613.5.5 of International Building code (IBC).

According to the USGS Seismic Design Maps Tool, ASCE 7 and the Building Code of New York State Section 1613.3.2, the suggested ground motion parameters for the project area are presented in the tables below. PWGC assumed a risk category of III.

Table 7A – Seismic Design Parameters, Glen Cove Sites

PARAMETER	S _s	S ₁	S _{MS}	S _{M1}	S _{DS}	S _{D1}
VALUE	0.273g	0.059g	0.638	0.246	0.425	0.164

Table 7B – Seismic Design Parameters, Massapequa & Lawrence Sites

PARAMETER	S _s	S ₁	S _{MS}	S _{M1}	S _{DS}	S _{D1}
VALUE	0.265g	0.057g	0.625	0.239	0.416	0.159

RECOMMENDATIONS – EARTHWORK AND STRUCTURAL FILL

Structural engineered fill should be inorganic, low plastic clay, sand, or gravel. Any existing soils with a high organic content (browns, topsoil) are suitable for reuse as fill in landscaping areas only as common fill.

Laboratory testing should be performed on fill materials to determine the appropriate moisture-density relationship of the fill being placed. Adjustments to the soil moisture by wetting or drying should be made as needed during fill placement.

Suitable fill material should be placed in lifts (lift thickness depends on type of compaction equipment, but in general, lifts of 8-inch maximum loose measurements are recommended for hand operated equipment). Granular fills (sands and gravels) with less than 10% clays and silts should be compacted with a smooth-drum vibratory compactor, vibratory plate or Rammax trench compactor.

The bottom of all footing excavations should be compacted using a minimum of four (4) passes with a vibratory plate, jumping jack, Rammax trench compactor, or similar compactor, and until no further settlement is visible prior to placing structural fill or constructing footings.

Table 8 – Structural Fill Placement Guidelines

AREAS OF FILL PLACEMENT	COMPACTION RECOMMENDATIONS (ASTM D698 – STANDARD PROCTOR)	MOISTURE CONTENT (PERCENT OF OPTIMUM)
STRUCTURAL FILL SUPPORTING FOUNDATION	98%	0 TO MINUS 5%
STRUCTURAL FILL PLACED WITHIN 5 FEET BEYOND THE PERIMETER OF FOUNDATION	95%	0 TO MINUS 5%
STRUCTURAL FILL OVER FOOTINGS	95%	0 TO MINUS 5%

Compaction activities should be conducted under full-time inspection with the Sand Cone Method (ASTM D1556), Nuclear Density Gauge (ASTM D2922 and D3012), or other moisture/density test methods. Compaction testing should be performed by an experienced geotechnical inspector at sufficient regularity to ensure proper compaction.

Table 9 – Structural Fill Gradation Recommendations

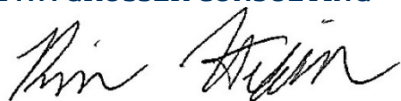
SIEVE SIZE	<u>STRUCTURAL FILL</u> (PERCENT PASSING BY WEIGHT)	<u>COMMON FILL</u> (PERCENT PASSING BY WEIGHT)
3 Inches	100	80-100
½ Inch	50-100	-
No. 4	35-100	20-100
No. 16	20-90	-
No. 50	5-40	-
No. 200 (Fines)	0-10	0-20

After the evaluations and any required remedial measures are performed, concrete should be placed as quickly as possible to avoid exposure of the foundation sub-soils to wetting, drying or freezing. Footings shall not be constructed on frozen or wet subgrade materials. Frozen or saturated subgrade soils should be removed and replaced with compacted structural fill or clean crushed stone.

Should you have any questions or wish to discuss this report in further detail please do not hesitate to call.

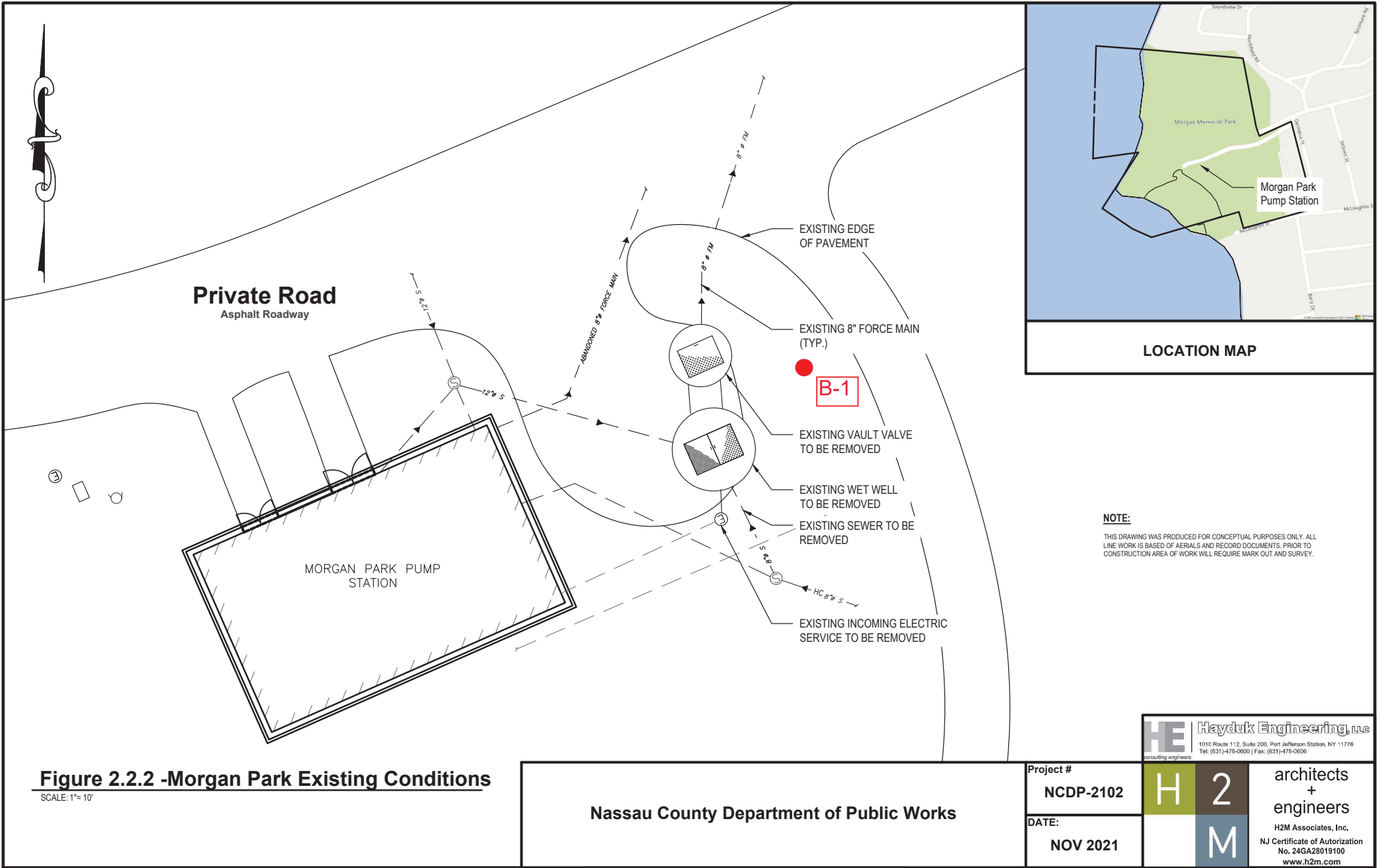
Very truly yours,

P.W. GROSSER CONSULTING

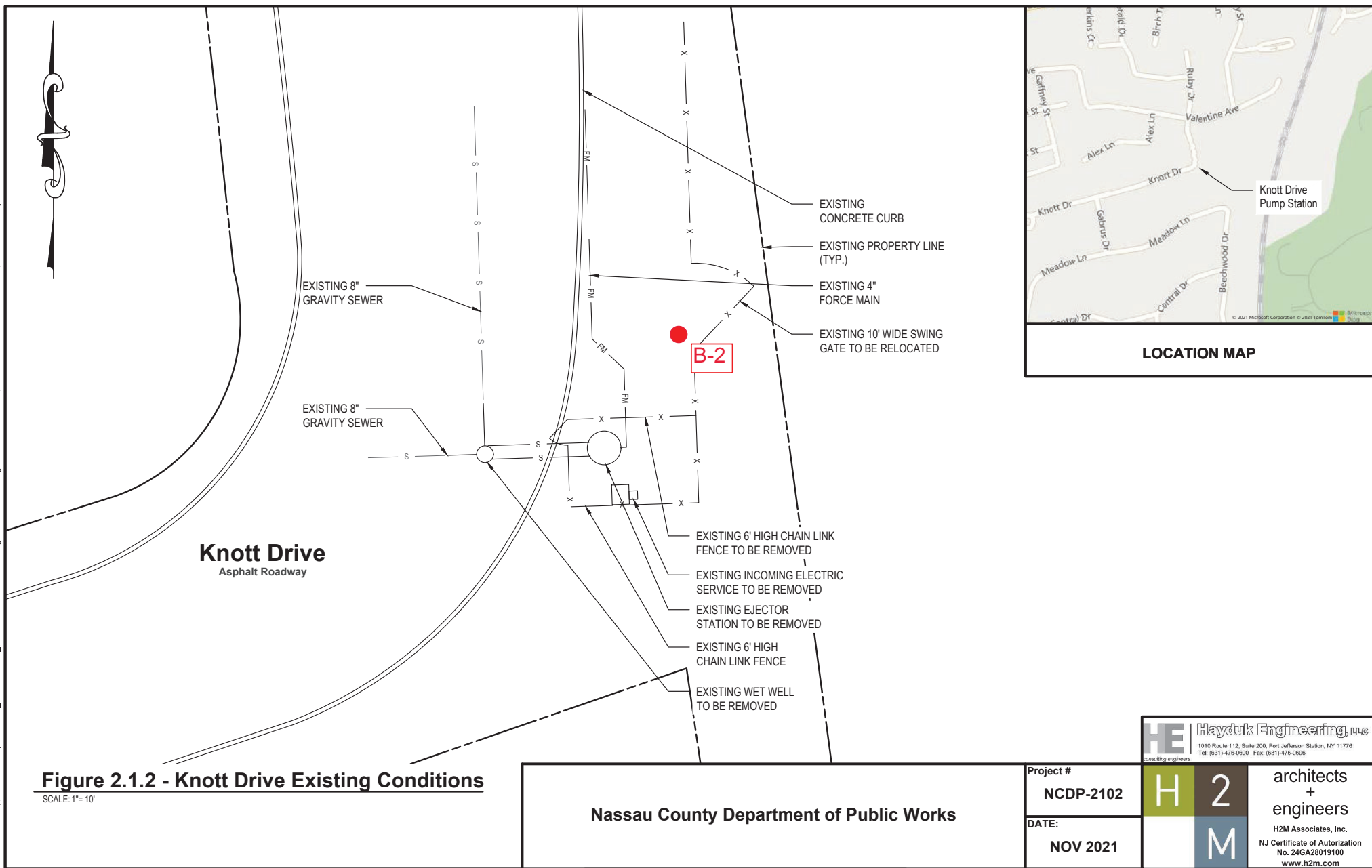


Brian Heflich, P.E.
Project Manager

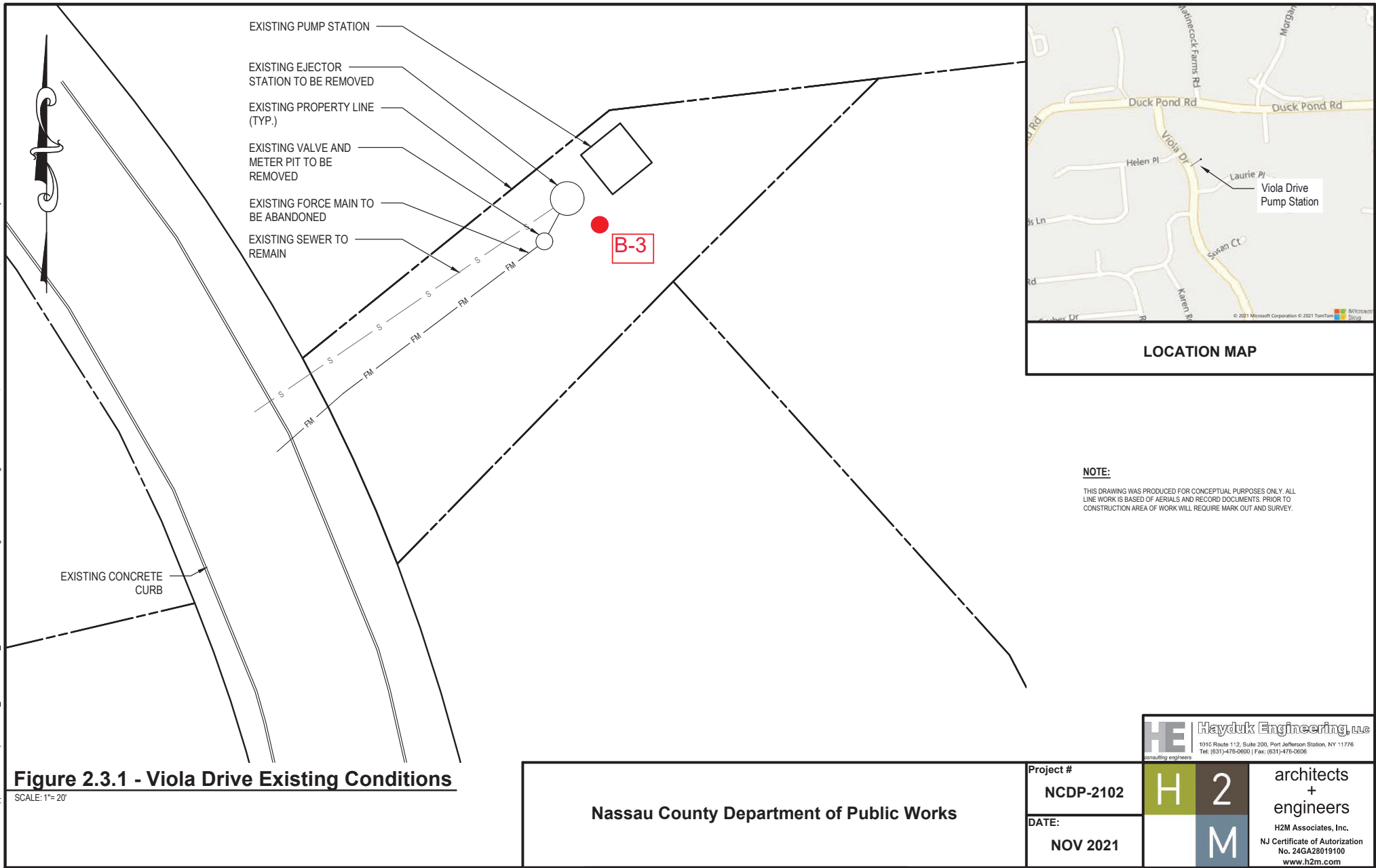
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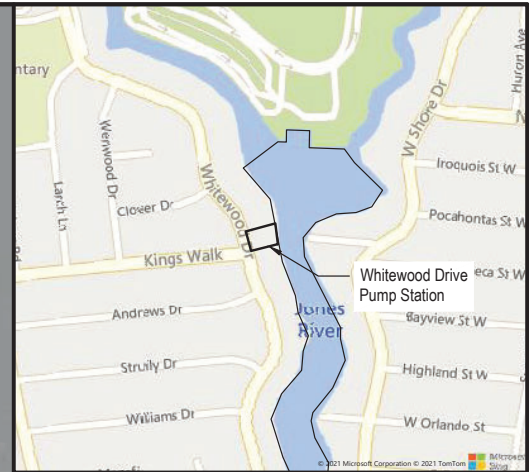
C:\Users\lloesch\appdata\local\temp\AcPublish_L_1220021_0929_SV_100.00-Knott Drive Existing Conditions Plan.dwg Last Modified: Nov 01, 2021 - 11:49am Plotted on: Nov 24, 2021 - 9:01am By Lloesch



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LOCATION MAP

Figure 2.6.1 - Whitewood Drive Existing Conditions

SCALE: 1"= 10'

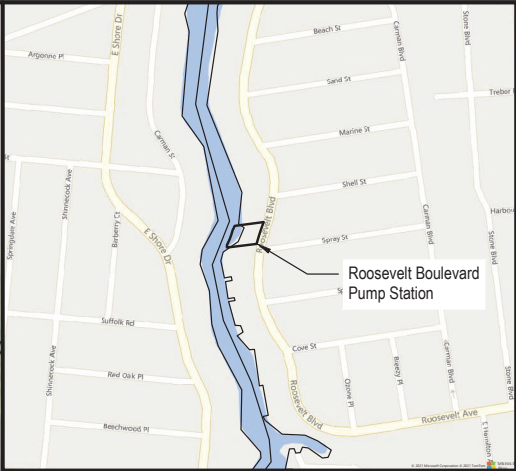
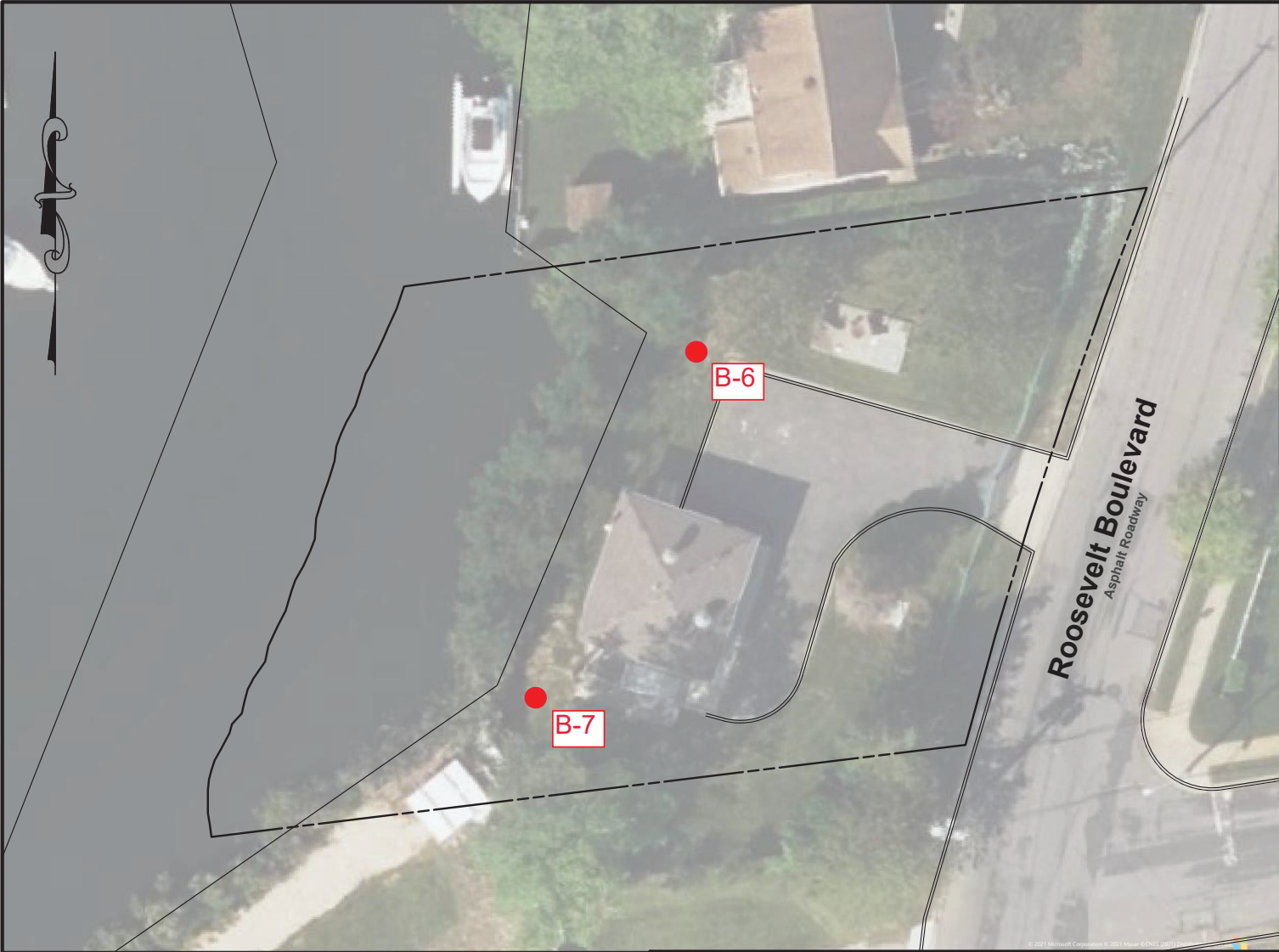
Nassau County Department of Public Works

Project #
NCDP-2102

DATE:
NOV 2021

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LOCATION MAP

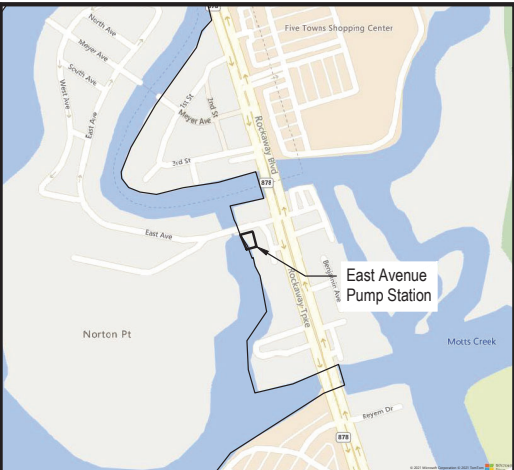
Figure 2.7.1 - Roosevelt Blvd Existing Conditions

SCALE: 1"= 10'

Nassau County Department of Public Works

Project # NCDP-2102		architects + engineers H2M Associates, Inc. NJ Certificate of Authorization No. 24GA28019100 www.h2m.com
DATE: NOV 2021		

C:\Users\lloesch\appdata\local\temp\AcPublish_1220021 0929_SV 500.00- East Avenue Existing Conditions Plan.dwg Last Modified: Nov 01, 2021 - 11:35am Plotted on: Nov 24, 2021 - 9:15am By: Lloesch



LOCATION MAP

Figure 2.5.1 - East Avenue Existing Conditions
SCALE: 1"= 10'

Nassau County Department of Public Works

Project # NCDP-2102		architects + engineers H2M Associates, Inc. NJ Certificate of Authorization No. 24GA28019100 www.h2m.com
DATE: NOV 2021		

USCS SOIL CLASSIFICATION GUIDE

MAJOR DIVISIONS			LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS (MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE)	GRAVEL AND GRAVELLY SOILS (MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE)	CLEAN GRAVELS (LITTLE OR NO FINES)	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS (MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE)	CLEAN SAND (LITTLE OR NO FINES)	SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)	SM	SILTY SANDS, SAND-SILT MIXTURES
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS (MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE)	SILTS AND CLAYS (LIQUID LIMITS LESS THAN 50)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (LIQUID LIMITS GREATER THAN 50)		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS



RELATIVE DENSITY AND CONSISTENCY CLASSIFICATION

For Sands, Gravels:

Non-Cohesive Soils	N Value (Blows/ft)
Very Loose	0 – 4
Loose	4 – 10
Medium Dense	10 – 30
Dense	30 – 50
Very Dense	50+

For Clays, Silts, Organics:

Cohesive Soils	N Value (Blows/ft)
Very Soft	0 – 2
Soft	2 – 4
Medium (Firm)	4 – 8
Stiff	8 – 15
Very Stiff	15 – 30
Hard	30+

DEFINITIONS OF IDENTIFICATION TERMS FOR GRANULAR SOILS

Principal Component (All Capitalized)

- GRAVEL More than 50% of the sample by weight is Gravel
- SAND More than 50% of the sample by weight is Sand
- SILT More than 50% of the sample by weight is Silt

Minor Component (Proper Case)

- Gravel Less than 50% of the sample by weight is Gravel
- Sand Less than 50% of the sample by weight is Sand
- Silt Less than 50% of the sample by weight is Silt

Proportion terms, for Minor Components

- and Component ranges from 35% to 50% of the sample by weight
- Some Component ranges from 20% to 35% of the sample by weight
- Little Component ranges from 10% to 20% of the sample by weight
- trace Component ranges from 0% to 10% of the sample by weight

Size of Soil Components

- Gravel
 - Coarse gravel ranges from 3 inches to 1 inch
 - Medium gravel ranges from 1 inch to 3 / 8 inch
 - Fine gravel ranges from 3 / 8 inch to No. 10 sieve
- Sand
 - Coarse sand ranges from No. 10 sieve to No. 30 sieve
 - Medium sand ranges from No. 30 sieve to No. 60 sieve
 - Fine sand ranges from No. 60 sieve to No. 200 sieve
- Silt
 - Material which passes the No. 200 sieve
- Clay
 - Material which passes the No. 200 sieve
 - Exhibits varying degrees of plasticity

Laboratory Test Abbreviation

Laboratory Tests	Abbreviation
Atterberg	ATG
Moisture Content	MC
Sieve Analysis	SA


Gradation Designations


- Coarse to fine (c-f) All fractions greater than 10% of the component
- Coarse to medium (c-m) Less than 10% of the component is fine
- Medium to fine (m-f) Less than 10% of the component is coarse
- Coarse (c) Less than 10% of the component is medium and fine
- Medium (m) Less than 10% of the component is coarse and fine
- Fine (f) Less than 10% of the component is coarse and medium


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PROJECT #:				LAW2205					
SITE ADDRESS:				Morgan Memorial Park, Glen Cove					
BORING ID:				B-1		BORING DEPTH (FT):		BORING DIAMETER (IN):	
						32		3.25	
DRILLING CONTRACTOR:				Land, Air, Water Environmental Services		DATE STARTED:		DATE FINISHED:	
						07/19/2022		07/19/2022	
DRILLING METHOD:				Direct Push		TIME STARTED:		TIME FINISHED:	
						08:30		10:30	
DRILLING EQUIPMENT:				Geoprobe 7822DT		LATITUDE:		LONGITUDE:	
						N/A		N/A	
SAMPLING METHOD:				Split Spoon, Automatic Hammer		PROJECT MANAGER:		LOGGED BY:	
						Brian Heflich		Jay Usmonov	
DEPTH (feet)	RECOVERY INTERVAL	SAMPLE INTERVAL	GRAPHIC LOG	DESCRIPTION NAME (USCS): saturation, color, texture, plasticity, minor components		ELEVATION (feet)	In Situ/ Lab Test	SPT, N-values (blows/ft.)	
0				SILTY SAND (SM): Dark brown, dry, trace gravel, trace brick fragments, loose, possible fill		10	spt=1,4,4,2	◆ 8	
2				SILTY SAND (SM): Dark brown, dry, trace gravel, very loose, possible fill		8	spt=1,1,0,1	◆ 1	
4				SANDY LEAN CLAY (CL): dark grey/light brown, wet, low plasticity, little sand, trace gravel, very soft, groundwater encountered at 4' bgs		6	spt=0,0,0,0	◆ 0	
6				SANDY LEAN CLAY (CL): light grey/brown, wet, low-medium plasticity, trace gravel, very soft		4	spt=1,1,1,3	◆ 2	
8				SILTY LEAN CLAY (CL/ML): light grey/brown, wet, medium plasticity, firm		2	spt=0,2,3,4	◆ 5	
10				SILTY LEAN CLAY (CL/ML): light grey/brown, wet, low plasticity, little sand, trace gravel, stiff		0	spt=1,3,6,10	◆ 9	
12				SILTY LEAN CLAY (CL/ML): light grey/brown, wet, low plasticity, trace gravel, stiff		-2	spt=4,6,7,11	◆ 13	
14				LEAN CLAY (CL): light grey/brown, wet, medium plasticity, stiff		-4	spt=3,5,6,8	◆ 11	
16				SILTY LEAN CLAY (CL/ML): light grey/brown, wet, low plasticity, trace gravel, stiff		-6	spt=4,7,7,9	◆ 14	
18						-8			
20				LEAN CLAY (CL): light grey, wet, medium plasticity, stiiff		-10	spt=2,4,6,7	◆ 10	
22						-12			
24						-14			
26				LEAN CLAY (CL): light grey, wet, medium plasticity, trace gravel, stiff		-16	spt=9,7,6,7	◆ 13	
28						-18			
30				LEAN CLAY (CL/ML): dark grey/black, wet, low-medium plasticity, trace gravel, very stiff, organic odor		-20	spt=5,8,11,13	◆ 19	
32						-22			
P.W. Grosser Consulting				End of Boring Depth (feet): 32 ⁶⁸		Water Table Symbol: ▼		Page 1 of 1	


PROJECT #:				LAW2205					
SITE ADDRESS:				Knott Drive, Glen Cove					
BORING ID:				B-2		BORING DEPTH (FT):		BORING DIAMETER (IN):	
						32		3.25	
DRILLING CONTRACTOR:				Land, Air, Water Environmental Services		DATE STARTED:		DATE FINISHED:	
						07/19/2022		07/19/2022	
DRILLING METHOD:				Direct Push		TIME STARTED:		TIME FINISHED:	
						12:15		14:10	
DRILLING EQUIPMENT:				Geoprobe 7822DT		LATITUDE:		LONGITUDE:	
						N/A		N/A	
SAMPLING METHOD:				Split Spoon, Automatic Hammer		PROJECT MANAGER:		LOGGED BY:	
						Brian Heflich		Jay Usmonov	
DEPTH (feet)	RECOVERY INTERVAL	SAMPLE INTERVAL	GRAPHIC LOG	DESCRIPTION NAME (USCS): saturation, color, texture, plasticity, minor components		ELEVATION (feet)	In Situ/ Lab Test	SPT, N-values (blows/ft.) 0 20 40 60	
0				POORLY GRADED SAND (SP): dark brown, dry, fine grained sand, trace gravel and mica, loose, possible fill		114	spt=2,2,3,4	◆ 5	
2				POORLY GRADED SAND (SP): dark brown, dry, fine grained sand, trace gravel and mica, possible fill		112	spt=8,10,11,12	◆ 21	
4				POORLY GRADED SAND (SP): dark brown, dry, fine grained sand, trace gravel and mica, loose, possible fill		110	spt=12,4,3,2	◆ 7	
6				POORLY GRADED SAND with SILT (SP-SM): dark brown, dry, medium to fine grained sand, little silt, trace gravel, trace glass fragments, trace mica and organics, possible fill		108	spt=2,5,3,4	◆ 8	
8				POORLY GRADED SAND with SILT (SP-SM): dark brown, dry, little silt, medium to fine grained sand, trace gravel		106	spt=6,4,3,5	◆ 7	
10						104	spt=12,36,10,8	◆ 46	
12				POORLY GRADED SAND with SILT (SP-SM): light brown, dry, little silt, trace gravel		102	spt=9,9,8,10	◆ 17	
14				POORLY GRADED SAND (SP): yellowish orange, dry, medium to fine grained sand, trace gravel		100	spt=14,13,13,13	◆ 26	
16						98	spt=11,11,11,10	◆ 22	
18						96			
20						94	spt=20,14,12,13		
22						92		◆ 26	
24						90	spt=16,10,9,10		
26						88		◆ 19	
28						86			
30				POORLY GRADED SAND with SILT (SP-SM): light brown, dry, little silt, trace gravel, groundwater not encountered		84	spt=26,22,46,18	◆ 50	
32									
P.W. Grosser Consulting				End of Boring Depth (feet): 32.69		Water Table Symbol: ▼		Page 1 of 1	


PROJECT #:				LAW2205					
SITE ADDRESS:				Viola Drive, Glen Cove					
BORING ID:				B-3		BORING DEPTH (FT):		BORING DIAMETER (IN):	
						32		3.25	
DRILLING CONTRACTOR:				Land, Air, Water Environmental Services		DATE STARTED:		DATE FINISHED:	
						07/20/2022		07/20/2022	
DRILLING METHOD:				Direct Push		TIME STARTED:		TIME FINISHED:	
						07:50		09:55	
DRILLING EQUIPMENT:				Geoprobe 7822DT		LATITUDE:		LONGITUDE:	
						N/A		N/A	
SAMPLING METHOD:				Split Spoon, Automatic Hammer		PROJECT MANAGER:		LOGGED BY:	
						Brian Heflich		Jay Usmonov	
DEPTH (feet)	RECOVERY INTERVAL	SAMPLE INTERVAL	GRAPHIC LOG	DESCRIPTION NAME (USCS): saturation, color, texture, plasticity, minor components	ELEVATION (feet)	In Situ/ Lab Test	SPT, N-values (blows/ft.) 0 20 40 60		
0				POORLY GRADED SAND (SP): dark brown, dry, medium to fine grained sand, trace gravel and asphalt fragments, possible fill	124	spt=4,6,6,6	◆12		
2				POORLY GRADED SAND (SP): light brown, dry, fine grained sand, trace gravel, loose	122	spt=5,4,4,3	◆8		
4				POORLY GRADED SAND (SP): light brown, dry, medium to fine grained sand, trace gravel and mica	120	spt=5,6,5,4	◆11		
6				POORLY GRADED SAND (SP): light brown, dry, medium to fine grained sand, trace gravel and mica, loose	118	spt=1,2,4,6	◆6		
8					116	spt=9,4,4,3	◆8		
10				POORLY GRADED SAND (SP): light brown, dry, medium to fine grained sand, trace gravel	114	spt=6,5,5,4	◆10		
12					112	spt=3,3,4,8	◆7		
14				POORLY GRADED SAND (SP): light brown, dry, medium to fine grained sand, trace gravel, dense	110	spt=26,41,45,44			◆50
16					108	spt=32,28,25,27			◆50
18					106				◆50
20				POORLY GRADED SAND with SILT (SP-SM): light brown, dry, little silt, trace gravel, dense	104	spt=42,22,19,29			
22					102			◆41	
24					100				
26				POORLY GRADED SAND with SILT (SP-SM): light brown, dry, little silt, trace gravel	98	spt=5,7,8,7			
28					96		◆15		
30				POORLY GRADED SAND (SP): yellowish orange, dry, fine to medium grained sand, trace gravel, dense, groundwater not encountered	94	spt=25,18,16,19			◆34
32					92				
P.W. Grosser Consulting				End of Boring Depth (feet): 32 ⁷⁰		Water Table Symbol: ▼		Page 1 of 1	

PROJECT #:				LAW2205					
SITE ADDRESS:				Whitewood Drive, Massapequa Park					
BORING ID:				B-4		BORING DEPTH (FT): 22		BORING DIAMETER (IN): 3.25	
DRILLING CONTRACTOR:				Land, Air, Water Environmental Services		DATE STARTED: 07/20/2022		DATE FINISHED: 07/20/2022	
DRILLING METHOD:				Direct Push		TIME STARTED: 12:20		TIME FINISHED: 13:25	
DRILLING EQUIPMENT:				Geoprobe 7822DT		LATITUDE: N/A		LONGITUDE: N/A	
SAMPLING METHOD:				Split Spoon, Automatic Hammer		PROJECT MANAGER: Brian Heflich		LOGGED BY: Jay Usmonov	
DEPTH (feet)	RECOVERY INTERVAL	SAMPLE INTERVAL	GRAPHIC LOG	DESCRIPTION NAME (USCS): saturation, color, texture, plasticity, minor components		ELEVATION (feet)	In Situ/ Lab Test	SPT, N-values (blows/ft.) 0 20 40 60	
0				POORLY GRADED SAND (SP): light brown, dry, fine to medium grained sand, trace gravel and roots, loose		2	spt=3,4,3,3	◆ 7	
2				POORLY GRADED SAND (SP): light brown, moist, fine to medium grained sand, trace gravel and organics, very loose, groundwater encountered at 3.5' bgs		0	spt=2,1,2,2	◆ 3	
4				POORLY GRADED SAND (SP): light brown, wet, fine to medium grained sand, trace gravel, very loose		-2	spt=1,2,1,2	◆ 3	
6				POORLY GRADED SAND (SP): yellowish orange, wet, fine to medium grained sand, trace gravel, loose to medium-dense		-4	spt=3,5,6,4	◆ 11	
8						-6	spt=2,3,3,4	◆ 6	
10						-8	spt=4,4,4,4	◆ 8	
12						-10	spt=4,4,5,5	◆ 9	
14				POORLY GRADED SAND (SP): yellowish orange, wet, fine to medium grained sand, trace gravel, very loose		-12	spt=5,6,5,4	◆ 11	
16						-14	spt=2,2,2,3		
18						-16		◆ 4	
20				POORLY GRADED SAND (SP): yellowish orange, wet, fine to medium grained sand, trace gravel, loose		-18	spt=2,3,5,4	◆ 8	
22									
P.W. Grosser Consulting				End of Boring Depth (feet): 22 ¹		Water Table Symbol: ▼		Page 1 of 1	

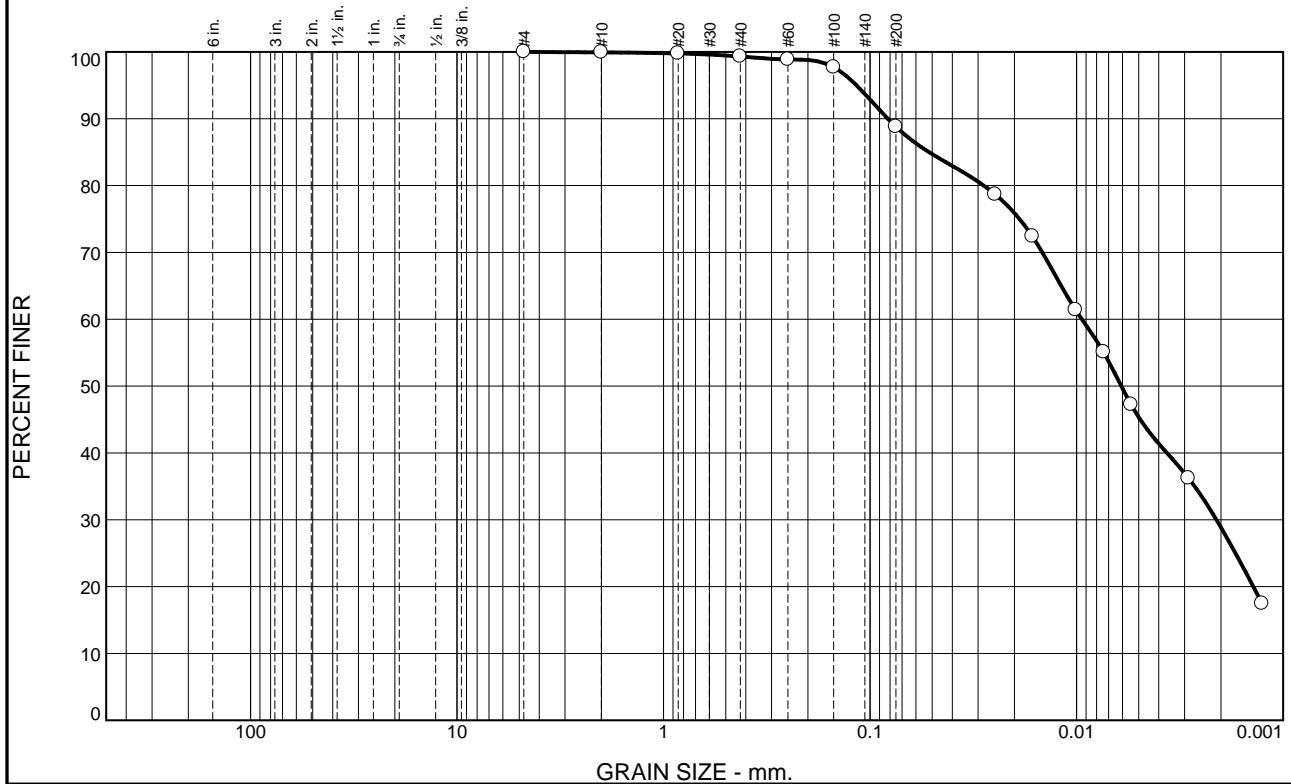
PROJECT #:				LAW2205					
SITE ADDRESS:				Whitewood Drive, Massapequa Park					
BORING ID:				B-5		BORING DEPTH (FT): 22		BORING DIAMETER (IN): 3.25	
DRILLING CONTRACTOR:				Land, Air, Water Environmental Services		DATE STARTED: 07/21/2022		DATE FINISHED: 07/21/2022	
DRILLING METHOD:				Direct Push		TIME STARTED: 08:25		TIME FINISHED: 09:07	
DRILLING EQUIPMENT:				Geoprobe 7822DT		LATITUDE: N/A		LONGITUDE: N/A	
SAMPLING METHOD:				Split Spoon, Automatic Hammer		PROJECT MANAGER: Brian Heflich		LOGGED BY: Jay Usmonov	
DEPTH (feet)	RECOVERY INTERVAL	SAMPLE INTERVAL	GRAPHIC LOG	DESCRIPTION NAME (USCS): saturation, color, texture, plasticity, minor components		ELEVATION (feet)	In Situ/ Lab Test	SPT, N-values (blows/ft.) 0 20 40 60	
0				POORLY GRADED SAND (SP): light brown, dry, fine to medium grained sand, trace gravel and roots, very loose		2	spt=1,2,2,2	◆ 4	
2				POORLY GRADED SAND (SP): light brown, moist, fine to medium grained sand, trace gravel, very loose, groundwater encountered at 3.5' bgs		0	spt=1,1,0,1	◆ 1	
4				POORLY GRADED SAND (SP): Yellowish orange, wet, fine to medium grained sand, trace gravel, very loose		-2	spt=3,2,2,3	◆ 4	
6				POORLY GRADED SAND (SP): Yellowish orange, wet, fine to medium grained sand, trace gravel		-4	spt=4,5,5,5	◆ 10	
8						-6	spt=4,4,5,5	◆ 9	
10						-8	spt=4,5,6,6	◆ 11	
12						-10	spt=5,6,7,6	◆ 13	
14						-12	spt=10,7,7,7	◆ 14	
16						-14	spt=5,6,5,6		
18						-16		◆ 11	
20						-18	spt=2,3,5,5	◆ 8	
22									
P.W. Grosser Consulting				End of Boring Depth (feet): 22 ¹³⁷²		Water Table Symbol: ▼		Page 1 of 1	

PROJECT #:		LAW2205					
SITE ADDRESS:		Roosevelt Blvd, Massapequa					
BORING ID:		B-6		BORING DEPTH (FT):		BORING DIAMETER (IN):	
				32		3.25	
DRILLING CONTRACTOR:		Land, Air, Water Environmental Services		DATE STARTED:		DATE FINISHED:	
				07/21/2022		07/21/2022	
DRILLING METHOD:		Direct Push		TIME STARTED:		TIME FINISHED:	
				10:30		12:35	
DRILLING EQUIPMENT:		Geoprobe 7822DT		LATITUDE:		LONGITUDE:	
				N/A		N/A	
SAMPLING METHOD:		Split Spoon, Automatic Hammer		PROJECT MANAGER:		LOGGED BY:	
				Brian Heflich		Jay Usmonov	
DEPTH (feet)	RECOVERY INTERVAL	SAMPLE INTERVAL	GRAPHIC LOG	DESCRIPTION NAME (USCS): saturation, color, texture, plasticity, minor components	ELEVATION (feet)	In Situ/ Lab Test	SPT, N-values (blows/ft.) 0 20 40 60
0				POORLY GRADED SAND with SILT (SP-SM): light brown, dry, little silt, trace gravel, roots and brick fragments, possible fill	2	spt=1,2,4,4	◆ 6
2				POORLY GRADED SAND with SILT (SP-SM): light brown, dry, little silt, trace gravel and roots, very loose, possible fill	0	spt=4,2,1,1	◆ 3
4				POORLY GRADED SAND with SILT (SP-SM): light brown/grey, dry, little sand, trace gravel, trave roots and brick fragments, loose, possible fill, groundwater encountered at 5' bgs	-2	spt=1,1,0,1	◆ 1
6				PEAT (PT): dark grey/black, wet, high organic contents, trace roots, very soft	-4	spt=0,1,1,4	◆ 2
8				POORLY GRADED SAND with SILT (SP-SM): olive/dark grey, wet, little silt, trace gravel and roots, very loose	-6	spt=1,1,2,3	◆ 3
10				PEAT (PT): dark grey/black, wet, high organic contents, trace roots, very soft	-8	spt=4,10,9,9	◆ 19
12				POORLY GRADED SAND (SP): light brown, wet, medium to fine grained sand, trace gravel	-10	spt=6,9,11,12	◆ 20
14				POORLY GRADED SAND (SP): yellowish orange, wet, medium to fine grained sand, trace gravel and mica	-12	spt=12,7,8,8	◆ 15
16				POORLY GRADED SAND (SP): yellowish orange, wet, medium to fine grained sand, trace gravel and red sand	-14	spt=8,7,8,8	◆ 15
18					-16		
20				POORLY GRADED SAND (SP): yellowish orange, wet, medium to fine grained sand, trace gravel	-18	spt=5,7,8,9	◆ 15
22					-20		
24					-22	spt=6,7,7,9	◆ 14
26					-24		
28					-26		
30					-28	spt=7,8,9,11	◆ 17
32							
P.W. Grosser Consulting		End of Boring Depth (feet): 32 ³		Water Table Symbol: ▼		Page 1 of 1	

PROJECT #:				LAW2205					
SITE ADDRESS:				Roosevelt Blvd, Massapequa					
BORING ID:				B-7		BORING DEPTH (FT):		BORING DIAMETER (IN):	
						32		3.25	
DRILLING CONTRACTOR:				Land, Air, Water Environmental Services		DATE STARTED:		DATE FINISHED:	
						07/21/2022		07/21/2022	
DRILLING METHOD:				Direct Push		TIME STARTED:		TIME FINISHED:	
						13:15		14:40	
DRILLING EQUIPMENT:				Geoprobe 7822DT		LATITUDE:		LONGITUDE:	
						N/A		N/A	
SAMPLING METHOD:				Split Spoon, Automatic Hammer		PROJECT MANAGER:		LOGGED BY:	
						Brian Heflich		Jay Usmonov	
DEPTH (feet)	RECOVERY INTERVAL	SAMPLE INTERVAL	GRAPHIC LOG	DESCRIPTION NAME (USCS): saturation, color, texture, plasticity, minor components		ELEVATION (feet)	In Situ/ Lab Test	SPT, N-values (blows/ft.) 0 20 40 60	
0				POORLY GRADED SAND with SILT (SP-SM): light brown, dry, little silt, trace gravel, trace concrete fragments and roots, loose, possible fill		2	spt=1,2,4,4	◆ 6	
2						0	spt=5,3,3,2	◆ 6	
4				POORLY GRADED SAND with SILT (SP-SM): light brown, dry, little silt, trace gravel and roots, very loose, groundwater encountered at 5' bgs		-2	spt=2,2,1,1	◆ 3	
6				PEAT (PT): dark grey/black, wet, high organic contents, trace roots, very soft		-4	spt=1,0,0,0	◆ 1	
8				PEAT (PT): dark grey/black, wet, high organic contents, trace sand and roots, very soft		-6	spt=0,0,1,3	◆ 1	
10				PEAT (PT): dark grey/black, wet, little gravel, high organic contents, very soft		-8	spt=2,3,3,4	◆ 6	
12				POORLY GRADED SAND (SP): dark/light grey, wet, medium to fine grained sand, little gravel, trace organics, loose		-10	spt=5,5,5,6	◆ 10	
14				POORLY GRADED SAND (SP): dark/light grey/brown, wet, medium to fine grained sand, little gravel, trace organics		-12	spt=7,5,4,5	◆ 9	
16				POORLY GRADED SAND (SP): light brown, wet, medium to fine grained sands, trace gravel and red sands		-14	spt=6,4,4,6	◆ 8	
18				POORLY GRADED SAND (SP): yellowish orange, wet, medium to fine grained sand, trace gravel		-16			
20						-18	spt=2,3,5,5	◆ 10	
22						-20			
24						-22	spt=9,8,8,7	◆ 16	
26						-24			
28						-26			
30						-28	spt=8,7,8,9	◆ 15	
32									
P.W. Grosser Consulting				End of Boring Depth (feet): 32.4		Water Table Symbol: ▼		Page 1 of 1	

PROJECT #:		LAW2205					
SITE ADDRESS:		East Avenue, Lawrence					
BORING ID:		B-8		BORING DEPTH (FT): 47		BORING DIAMETER (IN): 3.25	
DRILLING CONTRACTOR:		Land, Air, Water Environmental Services		DATE STARTED: 08/18/2022		DATE FINISHED: 08/18/2022	
DRILLING METHOD:		Direct Push		TIME STARTED: 07:50		TIME FINISHED: 09:25	
DRILLING EQUIPMENT:		Geoprobe 7822DT		LATITUDE: N/A		LONGITUDE: N/A	
SAMPLING METHOD:		Split Spoon, Automatic Hammer		PROJECT MANAGER: Brian Heflich		LOGGED BY: Jay Usmonov	
DEPTH (feet)	RECOVERY INTERVAL	SAMPLE INTERVAL	GRAPHIC LOG	DESCRIPTION NAME (USCS): saturation, color, texture, plasticity, minor components	ELEVATION (feet)	In Situ/ Lab Test	SPT, N-values (blows/ft.) 0 20 40 60
0				POORLY GRADED SAND with SILT (SP-SM): light brown, dry, medium to fine grained sand, little silt and concrete fragments, trace gravel, trace brick fragments, possible fill		spt=45,8,7,4	◆15
4				POORLY GRADED SAND with SILT (SP-SM): light brown, dry, medium to fine grained sand, little silt, trace gravel, possible fill	112	spt=1,1,2,2	◆3
				POORLY GRADED SAND (SP): yellowish orange, wet, fine grained sand, trace gravel, loose, possible fill, groundwater encountered at 5' bgs		spt=3,2,2,1	◆4
8				POORLY GRADED SAND (SP): yellowish orange, wet, fine grained sand, trace gravel, trace peat, trace red sands, very loose, possible fill	108	spt=1,0,0,0	◆0
				POORLY GRADED SAND (SP): dark brown, wet, medium to fine grained sand, trace gravel, trace roots, very loose		spt=WOH	◆0
12				PEAT (PT): dark grey/black, wet, high organic contents, trace roots, very soft	104	spt=1,0,0,0	◆0
				POORLY GRADED SAND (SP): dark brown, wet, medium to fine grained sand, trace gravel, very loose		spt=WOH,1,0	◆1
16				PEAT (PT): dark grey/black, wet, high organic contents, trace roots, very soft	100	spt=1,0,0,0	◆0
				POORLY GRADED SAND (SP): dark brown, wet, medium to fine grained sand, trace gravel, trace roots, very loose		spt=1,1,1,3	◆2
20				POORLY GRADED SAND with SILT (SP-SM): light brown, wet, medium to fine grained sand, little silt, trace gravel, trace roots	96		
				POORLY GRADED SAND (SP): light brown, wet, medium to fine grained sand, trace gravel, loose		spt=3,3,4,4	◆7
24					92		
				POORLY GRADED SAND (SP): light grey, wet, fine grained sand, trace gravel, very loose		spt=1,2,2,2	◆3
28					88		
					84	spt=2,2,2,2	◆3
32							
					80	spt=1,0,1,0	◆1
36					76		
				POORLY GRADED SAND (SP): light grey, wet, fine grained sand, trace gravel		spt=6,8,13,14	◆21
40					72		
						spt=12,13,17,19	◆30
44							
48					68		
P.W. Grosser Consulting		End of Boring Depth (feet): 47.5		Water Table Symbol: ▼		Page 1 of 1	

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	0.6	10.5	43.5	45.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.9		
#20	99.8		
#40	99.3		
#60	98.9		
#100	97.7		
#200	88.8		

* (no specification provided)

Material Description

Light brown and gray silt

Atterberg Limits

PL= 29

LL= 49

PI= 20

Coefficients

D₉₀= 0.0820

D₈₅= 0.0518

D₆₀= 0.0094

D₅₀= 0.0061

D₃₀= 0.0021

D₁₅=

D₁₀=

C_u=

C_c=

Classification

USCS= ML

AASHTO=

Remarks

Moisture content=34.0%

Unit weights=118 pcf (moist), 88 pcf (dry)

Source of Sample: B-1 Depth: 8-10 ft.

Date: 8-11-2022

SKYLANDS TESTING, LLC

Client: P.W. Grosser Consulting

Project: Nassau County DPW

Sparta, NJ

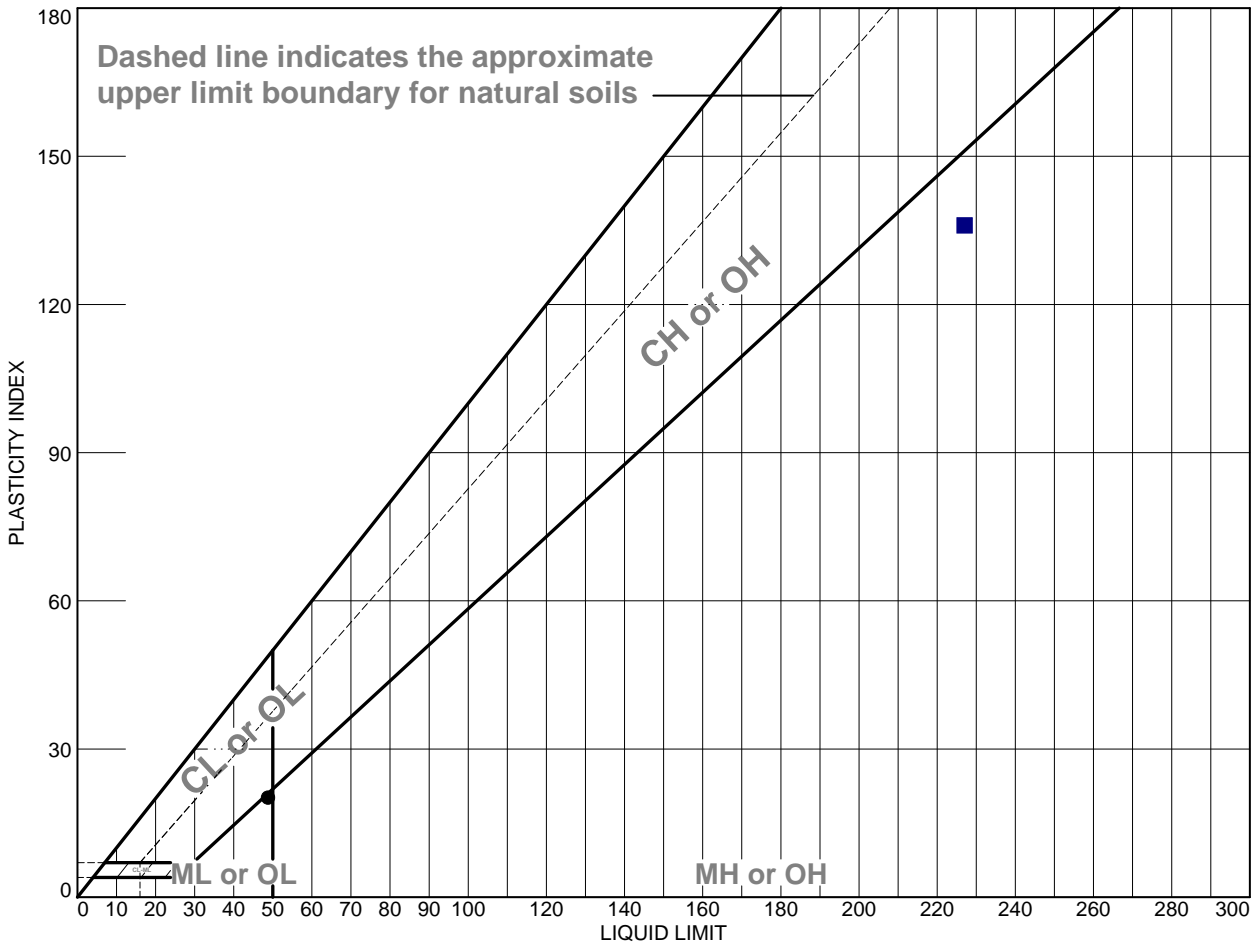
Project No: LAW2205

Figure

Tested By: RS

Checked By: VRS

ATTERBERG LIMITS REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Light brown and gray silt	49	29	20	99.3	88.8	ML
■	Black peat	227	91	136			

Project No. LAW2205 **Client:** P.W. Grosser Consulting

Project: Nassau County DPW

● **Source of Sample:** B-1 **Depth:** 8-10 ft.

■ **Source of Sample:** B-7 **Depth:** 8-10 ft.

Remarks:

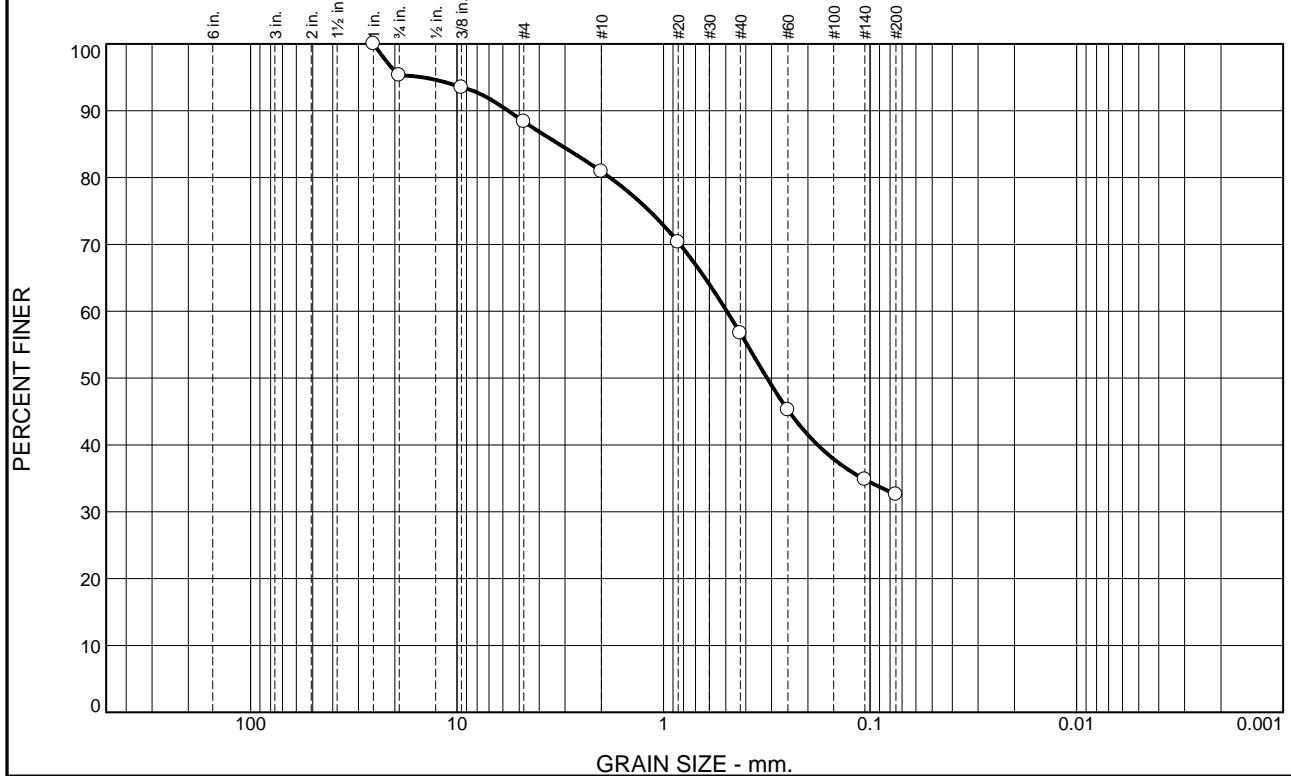
■ B-7 8-10 ft.
Moisture content=162.2%
Unit weights=75 pcf(moist),
29 pcf(dry)

SKYLANDS TESTING, LLC

Sparta, NJ

Figure

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.7	6.9	7.5	24.2	24.1	32.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	95.3		
.375	93.5		
#4	88.4		
#10	80.9		
#20	70.4		
#40	56.7		
#60	45.2		
#140	34.8		
#200	32.6		

* (no specification provided)

Material Description

Dark brown silty sand

Atterberg Limits

PL=

LL=

PI=

Coefficients

D₉₀= 5.6585

D₈₅= 3.2052

D₆₀= 0.4937

D₅₀= 0.3153

D₃₀=

D₁₅=

D₁₀=

C_u=

C_c=

Classification

USCS= SM

AASHTO=

Remarks

Sample washed on #200 sieve

Source of Sample: B-2 Depth: 8-10 ft.

Date: 8-11-2022

SKYLANDS TESTING, LLC

Client: P.W. Grosser Consulting

Project: Nassau County DPW

Sparta, NJ

Project No: LAW2205

Figure

Tested By: RS

Checked By: VRS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	5.4	7.5	59.9	24.2	3.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	94.6		
#10	87.1		
#20	67.0		
#40	27.2		
#60	9.5		
#100	4.3		
#200	3.0		

* (no specification provided)

Material Description

Orange-brown poorly graded sand

Atterberg Limits

PL= LL= PI=

Coefficients

D₉₀= 2.6993 D₈₅= 1.6632 D₆₀= 0.7427
D₅₀= 0.6271 D₃₀= 0.4481 D₁₅= 0.3130
D₁₀= 0.2562 C_u= 2.90 C_c= 1.06

Classification

USCS= SP AASHTO=

Remarks

Moisture content=15.2%
Unit weights=122 pcf (moist), 106 pcf (dry)

Source of Sample: B-4 Depth: 8-10 ft.

Date: 8-11-2022

SKYLANDS TESTING, LLC

Client: P.W. Grosser Consulting

Project: Nassau County DPW

Sparta, NJ

Project No: LAW2205

Figure

Tested By: RS

Checked By: VRS



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