TO BE COMPLETED BY CONTRACTORS SUBMITTING A BID ON S35121-16P						
ITEM NO.	APPROX. QUANTITIES	ITEMS BID WITH PRICE WRITTEN IN WORDS				
1.	Lump Sum	Base Bid for furnishing all Labor, Materials and Equipment required for all Construction work ready for operation. _____	N/A	N/A		
2.	Lump Sum	Add Alternate #1 for furnishing all Labor, Materials and Equipment required for all Construction work associated with piping alignment 'K' ready for operation. _____	N/A	N/A		

DETERMINATION OF LOW BID

Determination of low Bid will be made by comparing the total Bid which shall include the lump sum Base Bid price, and unit price totals, plus the Add Alternate(s), taken in order, or none of them, whichever amount(s) shall be judged by the Commissioner of Public Works to be in the best interest of the County.

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
15510	Pre-Engineered HVAC Piping System	
15705	Pipe Freeze Protection System	

TECHNICAL SPECIFICATIONS INDEX

DIVISION 1 – GENERAL REQUIREMENTS

DIVISION 2 - SITE WORK

DIVISION 14 - CONVEYING SYSTEMS

NO ITEMS IN THIS DIVISION

DIVISION 15 - MECHANICAL

DIVISION 16 – ELECTRICAL

+ + NO TEXT ON THIS PAGE + +

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 for the Bay Park Sewage Treatment Plant, Hot and Chilled Water Lines Replacement, Contract No. S35121-16P located at the Bay Park Sewage Treatment Plant, Nassau County, New York.

B. The broad scope of this project will be to decommission and remove existing temporary high temperature hot water and FRP chilled campus wide distribution systems, and to replace these systems by installing new above and below grade hot water and chilled water piping distribution throughout the site. All above and below grade hot water piping shall be welded steel construction. Above grade chilled water piping shall be steel, and below grade chilled water piping shall be HDPE piping. In general, the piping shall be installed with some sections of piping above grade and some sections below grade, with some piping installed in existing piping access tunnels. Concrete vaults shall be provided to house valves that will allow the buildings to be isolated from the hot/chilled water distribution systems. Air release and drain vents will be provided at all high and low points in the system, with some to be located in underground vaults. Above grade chilled water piping shall be heat traced. All field welds shall be inspected, and subject to approval by, a third party independent testing company using x-ray inspection.

C. 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 for
      a. Excavations for installation of hot and chilled water piping and valve chambers.
      b. De-watering of excavations as required for the proper installation of any underground piping systems below the ground water elevation.
      c. Furnish and install hot and chilled water, above and below grade piping systems.
      d. Welding of above grade and below grade pre-insulated manufactured steel piping systems.
      e. Butt fusion welding of all joints for underground HDPE chilled water lines.
      f. Flushing, filling, pressure testing, and balancing of piping systems as required by phasing. Refer to spec. section 15950 -“Balancing of Hydronic Systems” for details regarding system balancing.
      g. Installation of concrete vault valve chambers for hot and chilled water supply and return connections.
      h. Installation of drains and vents at high and low points, in underground vaults where required.
      i. Electrical work as required for the complete installation of an electric heat trace system for all above grade, exposed, chilled water lines.
      j. Structural work as required to support new piping, including enhancements to existing buildings where shown.
      k. Structural elevated supports for new piping being installed above grade in trafficked or pedestrian pathways.
      l. Decommissioning and disconnection of existing FRP chilled water and temporary hot water lines.
      m. Site restoration.
      n. Replacement of an existing odor control exhaust fan and extension of odor control duct from the existing utility tunnel to the existing odor control system manifold duct.
   2. The foregoing stated in Paragraph 1.1.B.1 is a general description only and shall not be construed as a complete description of the Work to be performed for this Project.

3. The Contractor shall provide parking for work force off site at the Contractor's expense. No on-site parking will be allowed. No staging of vehicles on-site will be allowed.

D. Delays due to lack of available labor, supervision, equipment, etc. will not be acceptable.

E. The existing plant will be maintained in continuous operation by the County during the entire construction period. Work under this Contract shall be so scheduled and conducted by the Contractor that such Work will not impede any treatment process, reduce the quality of the plant effluent or cause odor or other nuisance. In performing the Work shown and specified, the Contractor shall plan and schedule his Work to meet the plant and collection system operating requirements.

F. The construction sequence, as described in Section 01700, Maintenance of Plant Operations, must be maintained so that the County will meet the appropriate State Pollutant Discharge Elimination System Permit.

G. 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 County to perform Work specified herein and to all Contracts derived from said agreements.

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 County 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 01700, Maintenance of Plant 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 County 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 County working hours of 7:00 AM to 3:30 PM, Monday through Friday, or on official County holidays. This written request should be received by the County 24 hours in advance of beginning the work. The Contractor is responsible for coordination with the County Engineer and/or his duly authorized representative, prior to the start of the work to determine the dates of observance of the official County holidays that may occur during the course of the Contract. The official County holidays are:
   1. New Year's Day
   2. Martin Luther King, Jr. Day
   3. Lincoln's Birthday
   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

H. Failure of the Contractor to consider official County holidays during the preparation of their work plans and schedules shall not be cause for a delay claim against the County.

I. Contractor shall obtain permission from Owner, Owner's Representative and/or Plant 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 County's regular working hours (7:00 am to 3:30 pm, or as otherwise established for the project) or on weekends or official County 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 County for the cost of providing inspection and/or plant assistance, at the rate of $175 per hour per staff member. The Owner, Owner's Representative and Plant 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 County.

1.06 WORK BY OTHERS

A. County will perform the following work:
   1. Operate all potable, protected water, effluent water system and all other pertinent existing plant valves and plant functions as deemed necessary
   2. Operate and maintain the existing power generating system which includes four existing primary source engine generators, each rated at 3,600 kW to produce a 2,400 volt, three (3) phase output to meet the power demand of the various treatment processes trains.

1.07 REGULATORY AGENCY ACCESS TO CONSTRUCTION SITE

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

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 01010

PART 1 – GENERAL

1.01 DESCRIPTION

A. General: The Alternates described below shall be included in the Contractor's total bid. Deduction of Alternates shall be in the order that they are listed, and all Alternates deducted from the Contract prior to completion of the Project shall be deducted from final payment made to the Contractor.

B. Documentation of changes to Contract Sum/Price and Contract Time.

1.02 RELATED PROVISIONS SPECIFIED ELSEWHERE

A. Proposal Form.

B. Other sections referencing this section.

C. All contractual requirements outlined in the documents.

1.03 SUBMISSION REQUIREMENTS

A. Bid alternates will be provided on the Proposal Form that will identify the effect on adjacent or related components.

B. Alternates will be reviewed and deducted from the Contract scope at the Owner's option in the order that they are listed.

C. For alternates deducted from the Contract scope, the Contractor will coordinate related work and modify surrounding work to deduct the Work of each Alternate Bid Item.

1.04 SELECTION AND AWARD OF ALTERNATES

A. On the Proposal Form, the Contactor will indicate the variation of Bid Price for Alternate Bid Items as listed. The Proposal Form requests a "difference" in Bid Price by deducting from the Base Bid Price.

B. Alternates quoted on the Proposal Form will be reviewed and accepted at the Owner's option in the order they are listed.

C. Accepted alternates will be identified in the Owner-Contractor Agreement.

D. Bids will be evaluated on the Base Bid Price, less alternate items.

1.05 WORK FOR ALTERNATES

A. Each Alternate shall include all related materials, supplies, labor, equipment and operations necessary to conduct and complete the alternate work and all other affected work or adjacent areas.

B. There shall be no change in time or completion date for selected alternates, unless specified herein or approved in writing by the Architect/Engineer and Owner.

C. Alternates and associated work shall meet all standards and specifications delineated in the Contract Documents.

D. Contractor shall coordinate pertinent related Work and modify surrounding Work as required to complete the project under each alternate selected by the Owner.

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

A. Work for each alternate, related items and collateral work shall be completed in their entirety.

B. If alternate items are not deducted from the Contract scope, then all work for the Base Bid and collateral work shall be completed in their entirety.

END OF SECTION 01030

PART 1 – GENERAL

1.01 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 09900, 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. The Contractor shall 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, the Contractor shall 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.

1.4 SHORING, UNDERPINNING AND BRACING

A. When necessary and required, the Contractor shall 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.

1.5 WORK PREPARATION AND TEMPORARY ACCESS

A. The Contractor, before commencing Work shall prepare a Progress Schedule in accordance with the requirements of Section 01300, Additional Submittals and Section 01700, Maintenance of Plant Operations, in order to coordinate the Work of all trades and to insure completion on or before the completion date. The County 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 County 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 01700, Maintenance of Plant Operations, but may be modified by the Contractor, upon authorization by the County and Engineer as the Work progresses.

D. The General Construction Contractor shall 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, the Contractor will be required to notify the Engineer in writing and shall 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, the Contractor shall notify the County to determine if the conduit can be abandoned. If the conduit connects to equipment or lighting that must be maintained in service, the County 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 County prior to core drilling. Prior to core drilling, the Contractor shall 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. The Contractor and/or his Subcontractors shall 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 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 01031

+ + 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 Contract Drawings and as specified hereinafter. The Contractor shall 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.

B. Scheduling:
   1. Prior to commencement of work, the Contractor shall conduct a hazardous materials survey of all structures, and equipment to be demolished, removed and disposed, as shown on the Contract Drawings, in addition to the hazardous materials survey report provided in the Contract Documents. The survey shall include the identification, quantification, sample collection, and laboratory analytical testing of the following types of hazardous materials:
      a. Asbestos: An asbestos survey shall be performed by a New York State Department of Labor (NYSDOL)-certified Asbestos Inspector. The survey shall include suspect material sample collection and the subsequent laboratory analysis of these samples by a New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP)-certified laboratory. The asbestos survey will be performed in accordance with current federal and state asbestos regulations.
      b. Paint: A paint survey shall be performed by an Environmental Protection Agency (EPA)-certified Lead Inspector. The survey shall include paint chip sample collection and/or the use of an X-Ray Fluorescence (XRF) analyzer to determine the presence of lead and polychlorinated biphenyls (PCBs) in paints. Paint chip sample analysis shall be performed by a NYSDOH ELAP-certified laboratory.
      c. PCB-containing building materials: A survey of potential PCB-containing building materials (e.g., caulking and bitumastic coatings) shall be conducted by the Contractor. The survey shall include suspect material sample collection and the subsequent laboratory analysis of these samples by a NYSDOH ELAP-certified laboratory.
      d. Mercury/PCB-containing fixtures and equipment: An inventory of potential mercury and PCB-containing fixtures and equipment shall be performed by the Contractor.
      e. Survey Report: At the completion of the hazardous materials survey, the Contractor shall develop a survey report and submit it to the Engineer for review and approval prior to the commencement of work. The survey report shall include sample collection protocols and descriptions and estimated quantities of all materials that were sampled. In addition, the survey report shall include sample location drawings and laboratory analytical results for all samples collected.
   2. The Contractor shall submit detailed description of methods and equipment and sequence for demolition and removal for the Engineer's review.

3. The Contractor shall proceed with the removal of the equipment, piping and appurtenances in a sequence designed to maintain the plant in continuous operation as described in Section 01700, Maintenance of Plant Operations, and shall proceed only after approval of the Engineer.
4. Any equipment, piping and appurtenances removed without prior authorization, which are necessary for the operation of the existing plant or of the plant expansion, shall be replaced to the satisfaction of the Engineer at no cost to the County.

C. Related Sections:
1. Section 01355, Hazardous Materials Control.
2. Section 01700, Maintenance of Plant Operations.
3. Section 02050, Demolition, Removals and Modifications.

1.02 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 County 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, all governing codes and as hereinafter specified.
3. The Contractor shall make such investigations, explorations and probes as are necessary to ascertain any required protective measures before proceeding with demolition and removal. The Contractor shall give particular attention to shoring and bracing requirements so as to prevent any damage to new or existing construction.

B. Execution:
1. The Contractor shall 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. The Contractor shall 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. The Contractor shall 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. The Contractor shall take necessary precautions to prevent dust from rising by wetting demolished masonry, concrete, plaster and similar debris. Unaltered portions of the existing structures affected by the operations under this Section shall be protected by dustproof partitions and other adequate means.
5. The Contractor shall provide adequate fire protection in accordance with local Fire Department requirements.
6. The Contractor shall not close or obstruct walkways, passageways, or stairways and shall not store or place materials in passageways, stairs or other means of egress. The Contractor shall 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.

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. The Contractor shall 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, the Contractor shall 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, 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.

D. Materials or items to be demolished and not designated in Section 02050, Demolitions, Removals and Modifications, to become the property of the County or to be reinstalled shall become the property of the Contractor and shall be removed from the property and legally disposed of.

E. The Contractor shall 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, the Contractor shall 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 Contract Drawing or specified, shall comply with that of the various respective trades which normally perform the particular items of work.

G. The Contractor shall finish adjacent existing surfaces of new Work to match the specified finish for new Work. The Contractor shall clean existing surfaces of dirt, grease, loose paint, etc., before refinishing.

H. Where existing equipment are indicated to be reused, the Contractor shall 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. The Contractor shall 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.

1.04 CONDITION OF STRUCTURES AND EQUIPMENT

A. The County 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 County 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 County will be responsible for interpretations or conclusions drawn therefrom by the Contractor.

1.05 MAINTENANCE

A. The Contractor shall maintain the structures and public properties free from accumulations of waste, debris and rubbish, caused by the demolition and removal operations.

B. The Contractor shall 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, the Contractor shall 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 01039

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, County's 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.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 01045

PART 1 – GENERAL

1.01 GENERAL

A. The General Construction Contractor shall 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. The Contractor shall 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.

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 01050

SECTION 01072

REFERENCE STANDARDS

PART 1 – GENERAL

1.01 GENERAL

A. 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:
   1. AMCA- Air Moving and Conditioning Association, Inc.
   2. AASHTO - American Association of State Highway and Transportation Officials.
   3. ABMA- American Boiler Manufacturers' Association
   4. ACI - American Concrete Institute.
   5. ACIFS- American Cast Iron Flange Standards.
   6. AFBMA- Anti-Friction Bearing Manufacturers Association.
   7. AGA- American Gas Association.
   8. AGMA- American Gear Manufacturers Association.
   9. AIA- American Institute of Architects.
   10. AISC- American Institute of Steel Construction.
   11. AISI- American Iron and Steel Institute.
   12. ANSI - American National Standards Institute.
   13. APA- American Plywood Association.
   14. API- American Petroleum Institute.
   15. ASCE- American Society of Civil Engineers.
   16. ASME- American Society of Mechanical Engineers.
   17. ASTM- American Society for Testing and Materials.
   18. AWPA- American Wood Preservers Association.
   19. AWS- American Welding Society.
   20. AWWA- American Water Works Association.
   21. CGA- Compressed Gas Association.
   22. CRSI- Concrete Reinforcing Steel Institute.
   23. CMAA- Crane Manufacturers' Association of America.
   24. DIPRA- Ductile Iron Pipe Research Association.
   25. EEI- Edison Electric Institute.
   26. EJMA- Expansion Joint Manufacturers' Association.
   27. Fed Spec - Federal Specifications.
   28. FM- Factory Mutual.
   29. HMI- Hoist Manufacturers' Institute.
   30. IEEE- Institute of Electrical and Electronic Engineers.
   31. IPCEA- Insulated Power Cable Engineers Association.
   32. NACE- National Association of Corrosion Engineers.
   33. NB- National Board of Boiler Pressure Vessels.
   34. NBS- National Bureau of Standards.
   35. NEC- National Electric Code.
   36. NEMA- National Electrical Manufacturers Association.
   37. NFPA- National Fire Protection Association.
   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
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 01072

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 01141

+ + NO TEXT ON THIS PAGE + +

PART 1 – GENERAL

1.01 DESCRIPTION

A. Payment of the Work of the Contract will be made on the basis of the bid prices, as agreed upon and stipulated in the signed Contract Agreement. Payments include the furnishing of all labor, materials equipment and incidentals required to complete the work of the Contract as shown on the Contract Drawings and as specified.

B. A schedule outlining the procedures for measurement and payment for the contractor is included below. The schedule includes measurement and payment for the lump sum bid item and various unit price items only. For measurement and payment of Allowance items, the Contractor's attention is directed to Section 01020.

1.02 RELATED PROVISIONS SPECIFIED ELSEWHERE

A. Lump Sum Bid - Item No.1: Hot Water/Chilled Water Piping Systems:
   1. Measurement for payment of the Lump Sum Bid Item No. 1 shall be made in accordance with the Construction Agreement. The measurement shall be the percentage of work performed and in place as of the date of the payment request and shall be determined for each item included on the schedule of values. The measurement shall be documented by calculation of costs incurred, quantities in place, and invoices of materials and equipment supplied, as well as certification of the Contractor as to the accuracy of the measurement.
   2. Payment shall fully compensate the Contractor for furnishing all labor, materials, equipment and incidentals required to complete the work, as specified and shown in the Contract Documents, except for the allowance items listed in Section 01020 and unit price items, all as contained in the Bid Proposal and agreed upon in the Construction Contract.
   3. Payment of the lump sum shall also compensate the Contractor for insurance, bonds, furnishing and removing the temporary facilities as specified in Sections 01700 and 01500 and as shown on the drawings, and all other services required for the satisfactory completion of the work of this contract.

1.03 ALTERNATES

A. Alternates will be paid in accordance with the provisions of Section 01030.

1.04 RELATED PROVISIONS ELSEWHERE

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

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 01150

+ + NO TEXT ON THIS PAGE + +

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, Mock Ups, 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 13 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
1. 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
1. 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
   3. Catalog numbers and similar data
   4. Conformance with related Sections

B. Each shop drawing, sample and product data submitted by the Contractor 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. The Contractor shall 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.

1.04 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 1.05 below.
   2. Product Data: See Article 1.05 below.
   3. Samples: Submit the number stated in the respective Sections.

D. Submittals shall contain:
   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
   5. Identification of the product, with the section number, page and paragraph(s).
   6. Field dimensions, clearly identified as such.
   7. Relation to adjacent or critical features of the work or materials.
   8. Applicable standards, such as ASTM or Federal Standards numbers.
   9. Identification of deviations from Contract Documents.
   10. Identification of revisions on resubmittals.
   11. A blank space suitably sized for Contractor and Engineer stamps as defined in the General Conditions.
   12. 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.

1.05 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:

E. PDF (Portable Document Format): .pdf, Adobe PDF documents; created through electronic conversion rather than optically scanned whenever possible.

1.06 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 remains 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.

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 the Contractor shall 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, the Contractor shall 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.
   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, the Contractor shall 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.

1.07 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.

1.08 MOCK UPS

A. Mock Up 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.

1.09 CONSTRUCTION PHOTOGRAPHS

A. The General Contractor shall have a total 300 color photographs made of the work during its progress and color photographs of the completed work. The photographs shall be of such views and taken at such times as the Engineer directs.

B. All photographic work shall be done by a qualified, established commercial photographer acceptable to the Engineer. Three prints of each photograph shall be furnished promptly to the Engineer, and each print shall have a glossy finish and be mounted in plastic sleeving on a substantial backing. The overall dimensions of each mounted print shall be 8-in by 10-inc by 1-1/4-inch flexible binding margin on the long top side to storage in standard 3-ring binders.

C. The film negative shall be retained in the files of the photographer until the completion of the project and shall then be turned over to the Owner Engineer.

D. Each photograph shall have attached to the backing a paper label, approximately 1-1/4-in wise by 1-3/4-inch high containing thereon in neat lettering:
   1. Contractor’s name
   2. Short Description of View
   3. Photo Number and Date Taken
   4. Photographer’s Firm Name

E. Requirements for job photographs are provided in Article GC-37 of the General Conditions.

F. If photographer takes digital pictures then all such pictures shall be provided, to the County, electronically on portable hard drive. Two (2) copies shall be provided.

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, in 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.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 01300

SUBMITTAL REVIEW 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

_____
(Name of Contractor)

to design _____
(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

+ + NO TEXT ON THIS PAGE + +

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 the contract has been awarded. 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 Contractors 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 sixty (60) workdays following the Notice to Proceed, the Contractor shall 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

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 Diagraming 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.
         e. Any project specifics as required by the Engineer.
         f. 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 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. The Contractor shall 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.
   c. Constraint Activity Sort - Listing of Constrained Activities and type of constraint.
   d. Listing of Calendars and Activity Coding incorporated in the Schedule
3. Electronic copies of the Initial CPM Construction Schedule shall be provided 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

   The Contractor shall 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. Any 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.
   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. The Monthly Progress Updates shall be submitted 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 meetings 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
   a. 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 in Work. The forecasted construction Activities shall be logically tied to the appropriate predecessor and successor base Contract Activities and contain all of the required Logic, Duration, Coding and Resource/Cost Loading specified for the detailed CPM schedule activities.
   b. 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 accurately forecast completion of the identified Extra Work Activity. This will allow for accurate forecasting of the successor Work Activities and completion Milestones.
   c. Default progress data provided from the scheduling system is not be 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 Reports is the sole basis for schedule updating shall result in the disapproval of the Contractor's submittal.
   d. 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.
   e. 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

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

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

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

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

In the event a notice of a change to the contract is received the Contractor shall 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

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

1.06 BASIS OF PAYMENT

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.

Payment will be made as follows:

A. Upon submission of the Initial Baseline CPM Construction Schedule……20%

B. Upon acceptance of the Baseline CPM Construction Schedule……20%

C. 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%

D. 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 + +

PART 1 – GENERAL

1.01 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 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 01342

+ + 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. Contractor shall 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. The Contractor shall 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, ACGLH
   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 County 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 County and applicable state agency to accept such waste. The Contractor shall 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. The Contractor shall 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. The Contractor shall 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 County within seven (7) days of disposal.

PART 2 – PRODUCTS

2.01 HEALTH AND SAFETY PLAN

A. The Contractor shall 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 County 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. The Contractor will abide by the work specific Health and Safety requirements as directed by the County.
   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 County 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. The Contractor shall identify an 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): The Contractor shall identify an 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.
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.

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 section and use of respirators, instructions on proper cleaning, storage, and inspection of respirators.

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, the Contractor shall provide a minimum of two Class ABC fire extinguishers (minimum 10 pounds) in the work area. The Contractor shall 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:
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 Plant Chief. 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 Plant Chief 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 hazard. In the event of an accident/injury, the Contractor shall immediately notify the Engineer. Within two working days of any reportable accident, the Contractor shall complete and submit to the Engineer an Accident Report.

T. The Unforeseen Hazardous Material Remediation allowance provided in Section 01020, Allowances is intended to cover only those extra costs incurred by the Contractor in meeting County directed health and safety or remedial action requirements. It is not intended to fund the Contractor for the hiring of his own consultants nor to fund the costs of the Contractor's meeting obligations under OSHA.

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 County to Contractor personnel, the Contractor shall 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. "Payment for disposal of the decontamination wastes shall be made from the Hazardous Materials Remediation Allowance item as described in Section 01020, Allowances.

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. The Contractor shall 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 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 points posted the Contractor's site. A route map detailing the directions to the nearest hospital also shall be posted.

3.05 HEAT AND COLD STRESS

A. The Contractor shall monitor all 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. The Contractor shall 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. Work areas shall be illuminated 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. Portable lights used outside the Final Settling Tanks 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, the Contractor shall 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 fifteen (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. All demolition and excavating work shall be conducted 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) barricades shall be placed around the excavation in such a manner to alert personnel to the danger and prevent them from falling into the trench (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 can enter 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 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. The Contractor shall ensure that all onsite personnel have ready access to soap and clean water for washing and portable toilet facilities. The treatment plant washroom facilities usage is not permissible to the Contractor and crew.

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, the Contractor shall 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 01355

+ + NO TEXT ON THIS PAGE + +

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, the Contractor shall 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; and the Contractor shall 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. The Contractor shall 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. The Contractor shall 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, material safety data sheets, and the site safety plan including information concerning foreseeable emergency conditions, location of emergency and telephone contacts for supportive actions.

E. The Contractor shall stop work whenever a work procedure or a condition at a work site is deemed unsafe by the safety staff.

F. The Contractor and subcontractors shall be required to 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. The Contractor shall submit a Health and Safety Plan (HASP) as described in Section 01355, Hazardous Materials Control.

B. Within thirty (30) days of receiving a Notice to Proceed, the Contractor shall 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. A resume, along with other qualifications, of the safety person or the safety professional and the safety representative(s), must be submitted to the Engineer for review and approval. The resume shall 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.

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 thirty (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. The Contractor shall 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. The Contractor shall 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. The Contractor must submit a preliminary accident report to the Resident 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, the Contractor shall furnish 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 Workmen's Compensation Law, he shall 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, 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 (G) or safety person (E) 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. The Contractor shall have proper safety and rescue equipment, adequately maintained and readily available, for any foreseeable contingency. This equipment shall include such applicable items as: proper 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 or his subcontractors or any visitors whenever entering the job site shall be required to wear appropriate personal protection equipment required for that area. The Contractor shall continuously provide all necessary personal protective equipment as requested by the Engineer for his designated representatives.

2.05 IDENTIFICATION BADGES

A. The Contractor shall 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.

B. The Contractor shall complete and submit the Nassau County Hot Work Permit included in this Section as Attachment 01356-A, located after the "End of Section" designation.

PART 3 – EXECUTION

3.01 SAFETY STAFF DUTIES

A. The safety professional shall visit and audit all work areas as frequently as necessary (a minimum of once a week) and shall be available for consultation whenever necessary. The safety staff shall have full authority to implement and enforce the health and safety plan to take immediate action to correct unsafe, hazardous or unhealthful conditions.

B. A member of the safety staff must be at the job site full time (a minimum of 8 hours per working day) whenever work is in progress. When multiple shift work is in progress more than one safety representative may be required.

C. The safety staff shall as a minimum:
   1. Schedule and conduct safety meetings and safety training programs as required by law, the safety plan, and good safety practice. A specific schedule of dates of these meetings and an outline of materials to be covered shall be provided with the safety plan. The Engineer shall be advised in advance of the time and place of such meetings. County personnel shall be invited to attend the meetings. All employees shall be instructed on the recognition of hazards, observance of precautions, of the contents of the safety plan and the use of protective and emergency equipment.
   2. Determine that operators of specific equipment are qualified by training and/or experience before they are allowed to operate such equipment.
   3. Develop and implement emergency response procedures. Post the name, address and hours of the nearest medical doctor, name and address of nearby clinics and hospitals, and the telephone numbers of the appropriate ambulance service, fire, and the police department.
   4. Post all appropriate notices regarding safety and health regulations at locations, which afford maximum exposure to all personnel at the job site.
   5. Post appropriate instructions and warning signs in regard to all hazardous areas or conditions, which cannot be eliminated. Identification of these areas shall be based on experience, on site surveillance, and severity of hazard. Such signs shall not be used in place of appropriate workplace controls.
   6. Ascertain by personal inspection that all safety rules and regulations are enforced. Make inspections at least once a shift to ensure that all machines, tools and equipment are in a safe operating condition; and that all work areas are free of hazards. Take necessary and timely corrective actions to eliminate all unsafe acts and/or conditions, and submit to the Engineer each day a copy of his findings on the inspection check list report forms established in the safety plan.
   7. Submit to the Engineer, copies of all safety inspection reports and citations from regulating agencies and insurance companies within one working day of receipt of such reports.
   8. Provide safety training and orientation to authorized visitors to ensure their safety while occupying the job site.
   9. Perform all related tasks necessary to achieve the highest degree of safety that the nature of the work permits.

3.02 VISITORS

A. All non-County personnel visitors that visit and tour the site shall sign the Visitors Log at the Plant's Administration Building, and sign waivers as directed by the County. The Resident Engineer must be aware of all tours/visits in conjunction with the Safety Evacuation Plan

Protocol notification. All efforts should be made not to schedule site tours/visits at the time of scheduled evacuation drills.

3.03 ATTACHMENTS

A. The attachments listed below, following the "End of Section" designation, are a part of this Specification section.
   1. Attachment 01356-A, Hot Work Permit.

END OF SECTION 01356

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Nassau County Sewage Treatment Plant
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.

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 hr.?

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

A. Submit a Schedule of Values allocated to the various portions of the work, within twenty (21) days after the effective date of the Agreement.

B. Upon request of the Engineer, support the values with data which will substantiate their correctness.

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 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.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 01370

PART 1 – GENERAL

1.01 WORK 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. The Contractor is specifically directed to become 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 County and operators of utilities may make changes in their facilities.

E. The Contractor shall 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. The Contractor shall cooperate with the County 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. The Contractor shall conduct operations in such a way as to delay or interfere as little as practicable with the work of utility corporations.

I. The Contractor shall give the County 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. The Contractor shall 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.
   1. 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.

K. The Contractor shall take these conditions into consideration in making up the bid.

L. 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. The Contractor shall be required to provide utility mark outs for all private and public utilities. The limits for these mark outs shall be the project limit shown on the Engineering Drawings. The Contractor shall submit the proposed utility subcontractor for approval.

1.03 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 01400

PART 1 – GENERAL

1.01 DESCRIPTION

A. Scope of Work:
   1. The Contractor shall engage the services of an experienced photographer, approved by the County, to take color job photographs and video as detailed under these specifications.
   2. The photographer will be required to take preliminary photographs of the site prior to the commencement of work as directed by the Engineer.
   3. Subsequent photographs as determined by the Engineer shall be taken during the construction phase.
   4. The photographer shall visit the site prior to the start of construction, then every other week as the work progresses, additional visits may be required.
   5. The quantities of job photographs specified herein supersede the quantities specified in the General Conditions, Article GC-37, Photographs.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment for the item "Job Photographs" will be made. The costs of same shall be included in the Base Bid.

B. If less than one thousand (1,000) photographs are required, the Contractor shall credit the County fifteen dollars ($15.0) for each photograph under one thousand (1,000) photographs; should more than one thousand (1,000) photographs be required, the Contractor will be paid fifteen dollars ($15.0) for each photographs over one thousand (1,000) photographs.

PART 2 – PRODUCTS

2.01 PHOTOGRAPHS

A. A photograph shall be defined as one exposure.

B. A total of one thousand (1,000) photographs at the site shall be taken.

C. The County shall reserve the right to reject any photograph that is not clear or definitive. Any photograph so rejected shall be subtracted from the total exposures before computations for payment or credit under this section.

D. The prints, slides and negatives shall be suitably mounted and labeled in loose-leaf type binders, which have protective covers for the prints, slides, and negatives.

E. The prints shall have indelibly printed on their reverse side of the following:
   1. Project Number
   2. Project Name
   3. Contract Number and Description
   4. Job Number
   5. Photo Number
   6. View and description indicating location of camera, general description of what photograph represents, and indicate this is a preliminary photograph. (A plot plan shall be submitted by the Contractor indicating location and photo number of all preliminary photographs.)
   7. Date picture was taken.
   8. Name of photographer and photographer’s firm.

9. Contractor's name.

F. An electronic copy containing all photos taken at the site shall be supplied on thumb drive and submitted to the Engineer for approval. Provide 2 USB thumb drives with copies of the photos.

PART 3 – EXECUTION (NOT USED)

END OF SECTION 01410

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 cooperate with the Coordinating Special Inspector and individual special inspectors employed by County, and to perform required testing and inspections. County 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 County, 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. County 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 County / 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.

E. Notify testing agencies, Special Inspector, and County sufficiently in advance of the Work for the testing agencies, Special Inspector, and County 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.

1.06 SPECIAL INSPECTOR's RESPONSIBILITIES

A. 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, County.
   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.

1.07 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, County, and Contractor of irregularities or deficiencies in the Work observed during Special Inspections. Corrective action, if required, will be determined by County.

C. Promptly submit two copies each of reports of inspections and tests to Special Inspector, County, 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 01416

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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)

_____
Signature Date

Design Professional Seal

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:

- ☐ Soils and Foundations
- ☐ Cast-in-Place Concrete
- ☐ Precast Concrete
- ☐ Masonry
- ☐ Structural Steel
- ☐ Cold-Formed Steel Framing
- ☐ Spray Fire Resistant Material
- ☐ Wood Construction
- ☐ Exterior Insulation and Finish System
- ☐ Mechanical & Electrical Systems
- ☐ Architectural Systems
- ☐ 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.

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

Other

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

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:		

Precast Concrete Page of

Item	Agency # (Qualif.)	Scope
1. Plant Certification / Quality Control Procedures ☐ 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:		

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

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:		

Structural Steel Page of

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

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:		

Mechanical & Electrical Systems Page of

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

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

Special Cases

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.

PART 1 – GENERAL

1.01 DESCRIPTION

A. Scope:
   1. 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. The Contractor shall 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: The Contractor shall provide 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:
   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, the Contractor shall provide 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. The Contractor shall notify the New York State Department of Environmental Conversation, 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: The Contractor shall 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. Evacuation Routes shall be marked 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 01495

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

A. Temporary facilities and controls shall be provided in the manner designated hereinafter. These temporary facilities shall be provided at the Bay Park STP for this project.

B. Contractor shall 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 County, the temporary facilities and controls shall be removed and the facilities restored to their original conditions by the Contractor.

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 WATER FACILTIIES

A. The Contractor shall provide and pay all costs for all toilet facilities in sufficient numbers, for the Contractor’s and Subcontractor’ 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 the 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 periodically and disposed of in a satisfactory manner, as the occasion requires.

C. The Contractor is rigorously prohibit the nuisances within, on, or about the Work.

D. County Sanitary Facilities and Locker rooms are strictly prohibited from Contractors’ and subcontractors’ use.

E. County Sanitary Facilities and Locker rooms are prohibited from Contractor and subcontractors’ use.

1.03 TEMPORARY SANITARY FACILITIES

A. The Contractor shall 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. The Contractor shall 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. The Contractor shall furnish, install, and maintain a temporary power distribution point local to the work area.
   2. At the temporary power distribution point, the Contractor shall furnish and install an overcurrent protection device. The overcurrent protection device shall be rated for 480 volts, three-phase, and shall be sized for Contractor's temporary electric requirements.
   3. The Contractor shall utilize an existing temporary service point located at USS-3 for serving the temporary electrical requirements. The Contractor shall modify the identified temporary distribution point as required to provide temporary electric service for the Work shown and specified. The Contractor shall provide a temporary transformer, a 100 Amp circuit breaker and any other equipment necessary and required to provide the temporary electric system with the specified capacity. The Contractor shall provide separate distribution circuit breakers or fused switches for 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. The Contractor shall 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.
   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.

E. Temporary General Lighting System:
   1. The Contractor shall 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 County.
   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.
   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. The Contractor shall 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 OWNER'S Operations: One 300-watt lamp at intervals of 15 feet on centers.
   7. The Contractor shall maintain the temporary general lighting system in safe
   8. working order.

9. The Contractor shall arrange and install the lamps in a manner to provide an even distribution of illumination as necessary and required over the work areas.
10. If necessary and required, the Contractor shall install the 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.
11. In case of overloading of circuits, the County will restrict the use of tools as required for the correct loading.
12. The temporary general lighting system shall be used for small power purposes only.
13. Hand tools 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.
14. No Contractor will be permitted to proceed with any portion of his work which in the opinion of the Engineer, is not adequately illuminated. If any Work by any other Contractor requires special lighting other than what is provided, the Contractor shall arrange for same.
15. The Contractor shall 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.
16. 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.
17. Temporary general lighting system shall be removed in its entirety at the
18. completion of the project.

F. Security Lighting System:
1. The Contractor shall 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. 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 always be properly maintained and energized 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. The Contractor shall 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. The Contractor shall extend the temporary electric service from the tie-in to the service point specified in Paragraph I.3.D.3 to the Contractor's field office within the Staging Area.
   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 Plant. The Contractor shall coordinate with the Plants for the power source (motor control center in local building) and shall install the electrical service as required to each Field Office.

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, he shall furnish, install and maintain such additional temporary lighting and power facilities at his 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 in-stalled so as not to interfere with the work of other Contractors.
   3. Upon completion of the work under his contract, the Contractor responsible shall remove all additional facilities installed by him.

1.04 TEMPORARY HEATING FACILITIES

A. Temporary construction heating shall be provided by the Contractor responsible for the Work involved for all cold weather protection of his own equipment, Work, and his employee's comfort at all the times.

B. The Contractor shall provide all 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 his employees or his Subcontractor's employees, after the building or structure is temporarily enclosed. Hot water or steam from the existing plant system 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 County 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 by Contractor responsible for the Work involved. "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. "Cold weather protection" shall be provided 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. The Contractor is to 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. All fuel oil tanks shall be provided with adequate secondary containment and the fuel oil systems shall comply with Nassau County Fire Prevention Ordinance-Article III. Special notice is given to the Contractor that the 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 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 tarpaulins 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. 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. The Contractor shall provide and pay for all electric wiring and electrical accessories required for the temporary heating system.

I. Temporary heating equipment shall not be located 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. Temporary construction ventilation shall be provided by the Contractor for the protection of his equipment, Work and his employees' comfort and safety always.

B. The Contractor shall 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 his employees, his Subcontractor's employees, or the employees of the other Contractors, 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 responsible for the Work involved. The following additional requirements shall apply:

1. All temporary ventilation methods proposed by the Contractor shall be submitted to the County 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 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. Where dehumidification is required to prevent mildew or moisture forming on equipment, Work or structures in areas being ventilated, it shall be provided by the Contractor.

D. The Contractor shall 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. The Contractor shall provide and pay for all electric wiring and electrical accessories required for the temporary ventilation system.

F. Temporary ventilation equipment shall not be located 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:
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. 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 always 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. The Contractor shall protect the existing Work and material from damage by his workmen and shall be responsible for repairing any such damage at no additional cost to the County.
3. The Contractor shall 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 Bay Park STP.
c. Within the limits of the Work, water trees and plants that are to remain, 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. All Work and materials shall be protected 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 the course of demolition and construction Work of this Project, the Contractor shall 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. The Contractor in his area of Work shall maintain egress as herein specified.
3. In active process areas, the Contractor shall not be permitted to store or stockpile material. Debris or other material shall be removed daily which may obstruct plant personnel from operating or maintaining active equipment and piping.

C. Temporary Construction Fencing:
1. The Work areas of the Project Site shall always be enclosed by temporary fencing to ensure security.
2. 2Temporary 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. The Contractor shall 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. The Contractor shall explore ahead of his trenching and excavation Work and shall 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, he shall restore it to original condition at his 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:

a. 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. The Contractor shall 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 by the Contractor 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 County.

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. The Contractor shall repair immediately all damage caused by his 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. The Contractor shall 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 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 more than 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 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. The Contractor shall 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:
1. The Contractor shall not allow any areas turned over to him for commencement of Work, to flood. The Contractor shall keep all existing and new facilities within his Work area free of any accumulations of water. The Contractor shall provide, install, and operate sufficient pumps for this purpose. Continuous monitoring for floods and protection of structures from damage and flotation shall be provided. The Contractor shall 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. The Contractor shall take all protective measures to the satisfaction of the County necessary 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
1. In case the Contractor's operations disrupt plant operations, the treatment process or the operating facilities herein before described, at any time, he shall at his own cost immediately make all repairs or replacements and do all work necessary to restore the plant to operation to the satisfaction of the County. Such work shall progress continuously to completion on a 24-hour/day, 7-workday/week basis. 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 construct a Contractor's Staging Area as shown on the Contract Drawings. 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. The Contractor shall erect six-foot high galvanized chain link fencing and gates around the Staging Area as specified in Paragraph 1.6.C.
4. The Contractor shall provide pavement and utilities in the Staging Area and shall maintain all sections of the Staging Area in a suitable manner, including the cutting of grass, weeding, and preventing the accumulation of debris. The Contractor shall provide electrical utilities in the Staging Area.
5. At the completion of the project, the Contractor shall remove all debris not limited to gravel, grout, wood, etc., from the Staging Area off-site. The Contractor shall also 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. Access roads will be provided by the Contractor 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. The Contractor shall 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. The Contractor shall always post speed limit signs to be adhered to in the vicinity of the staging and work areas.

C. Parking, Storage and Work Areas:
1. No on-site parking is permitted.
2. The Contractor shall construct and maintain suitable storage areas for his use within the staging area designated on the Drawings.
3. The Contractor will be required to arrange his Work and dispose of his materials in such manner as to cause the least interference with the Work of other Contractors working within the same area.
4. No Contractor shall claim exclusive occupancy of areas within or adjacent to the limits of his Work under this Contract. The County and its employees and the Contractors for other contracts shall also have access to these areas.
5. The Contractor shall modify any storage areas to cause minimum damage to the landscape and shall comply with the directions of the County. 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 County and the Engineer.

1.08 CONTRACTOR'S FIELD OFFICE

A. The Contractor shall 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 in the Staging Area.

C. The Contractor shall 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 building, or trailer with lockable door.
   b. Telephone service.
   c. Six protective helmets for visitor's use.
   d. Exterior identifying sign.
   e. Company sign no larger than four (4)-feet by eight (8)- feet.
2. Remove office and sheds upon Final Acceptance unless otherwise approved by the Engineer.

1.09 SECURITY

A. It shall be the responsibility of the Contractor to make whatever provisions he deems 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 County's property and other private property from injury or loss in connection with the performance of the Contract.

B. The Contractor may make no claim against the County for damage resulting from trespassing.

C. The Contractor shall repair all damage to the property of the County and others arising from failure to provide adequate security.

D. If existing fencing or barriers are breached or removed for purposes of obstruction, the Contractor shall provide and maintain temporary security fencing equal to the existing one, in a manner satisfactory to the Engineer and the County.

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 always be displayed, as per Section 01356, Safe and Healthful Working Conditions, Paragraph 1.5.F.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 01500

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PART 1 - GENERAL

1.01 - SECTION INCLUDES

A. Furnishing of the Contractor's and Engineer's Field Office (Trailer).

B. The Engineer's Field Office shall be furnished by the General Construction Contractor within the time 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 shall be installed to the Engineer's trailer within two (2) days from the date that the trailer is on-site and 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 offices shall be placed 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. The Contractor shall 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. 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.

C. Install, maintain, and repair if necessary, temporary electric and telephone to their own field office.

D. The Contractor shall 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 building or trailer with lockable door.
      b. Telephone service.
      c. Six protective helmets for visitor's use.
      d. Exterior identifying sign.
      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.

2.02 - ENGINEER’S FIELD OFFICE

A. It shall be the Contractor’s Responsibility to furnish the following equipment items and maintenance services for the contract period or for a period not to exceed two months after the work has received final acceptance by the Department.

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 shall be delivered prior to the first application for payment, but no later than the day the Engineer’s Trailer is delivered.

D. 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.

E. No Construction shall commence until the trailer is provided, furnished as herein specified and made available to the Engineer. The Engineer's field office shall be separate from any office used by the Contractors.

F. The office shall be 36’ long (including hitch), 10’ wide, a minimum ceiling height of 8 feet, 2 exterior doors and 7 windows. All windows and the door shall be equipped with adequate locking devices, alarmed and be weatherproof and screened to provide adequate ventilation. All windows shall be equipped with security grilles.
   1. Door with hasp and padlock and five keys for Owner/Engineer’s use. All doors shall be equipped with locking bars. Provide two (2) commercial grade foot mats at each door.
   2. 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.
   3. 110 volts, 100-amp electric service with sufficient receptacles spaced around the room.

G. Windows shall be the type that will open and close as required. A flush type toilet shall be provided and shall be in an enclosed separate room, in compliance with applicable sanitary codes. The field office shall be equipped with a lavatory with hot and cold running water and venetian blinds. Adequate electric lighting and heating shall always be provided. The sanitary facilities shall be connected by the Contractor to an approved location and in accordance with the site utilization requirements.

H. The Contractor shall provide door switches on all doors with terminals for intrusion alarm indication. Water services, electric and sanitary services shall be provided and shall be maintained in proper order by the Contractor throughout construction.

I. The Contractor shall provide telephone service to the field office, including all Verizon coordination.

J. 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:
   1. Four (4) Office chairs. (Stackable type)
   2. Four (4) Folding chairs
   3. One (1) 30-inch x 72-inch folding table.
   4. One (1) Bracketed wall table (3 feet by 5 feet)
   5. One (1) Draftsman's stool.
   6. Two (2) 30-inch x 60-inch desks with 4 side drawers and a locking center drawer.
   7. Two (2) new swivel task chairs for use with desk equal to order no. SUP-12223643 by Superior Chair (Huntington Business Products).
   8. Chair mat for each desk area.
   9. One (1) new rolling stand with top, Model No. 76MR/76TP from Plan Hold, catalog #27, or equal.
   10. One (1) adjustable, heavy-duty three-hole punch, by Master, order no. MAT-1340PB (Huntington Business Products or equal).
   11. One (1) 40 sheet capacity heavy-duty two-hole punch, by Master, order no. MAT-327B or equal.
   12. One (1) 3-foot x 5-foot cork bulletin board with wall mounting hardware.
   13. One (1) 3-foot x 5-foot white board with wall mounting hardware and dry erase marker set
   14. One (1) 3-foot x 6-foot metal book shelf
   15. One (1) Each hand operated fire extinguisher, Class ABC.
   16. One (1) Telephone set with 1 dedicated telephone line for the exclusive use of the Engineer and his authorized representatives.
   17. One (1) Two Mbit/s down/1Mbit/s up or greater internet connection (Verizon FIOS, Optimum Online or equal).
   18. One (1) First aid kit (#25 kit as manufactured by Acme Cotton Products or equal).
   19. One (1) Rechargeable lantern type light (Flashlight).
   20. Thermometer, with indoor and outdoor sensing bulbs, and high, low instantaneous reading, with magnetic reset function by Radio Shack or equal.
   21. Infrared thermometer, Extech Model #42509.
   22. Two (2) 23-gallon plastic wastepaper basket.
   23. Boot brush at each trailer staircases.
   24. Mud mat at each trailer doorway.
   25. Three (3) legal size clipboards.
   26. Five (5) coat hooks or coat rack.
   27. One (1) 12-inch diameter battery operated wall clock.
   28. Five (5) extension cords, minimum three plug each, three prong type, 50' minimum each
   29. One large set of triangles, an engineer's scale and an architect's scale.
   30. Digital Camera and two 4 GB memory cards.
   31. Tablet Computer.
   32. Three (3) Surge protection power strips, five receptacles minimum each.

33. Two (2) battery back-up units for desk top computer system: CyberPower Intelligent LCD Battery Backup, 825VA/450 Watts
34. 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. A dedicated telephone line (separate from telephone set line) with supplies and maintenance service for the machine for the duration of the project shall be provided.
35. Two (2) laptop computer systems, Dell or equal. The Contractor shall provide the following items at a minimum as provided by Dell or equal.
    a. Processor: 10th gen Intel® Core™ i7-10850H Processor (2.7GHz, 12M cache)
    b. Operating System: Windows 10 Professional English/French 64bit
    c. Office Productivity Software: Microsoft® Office Professional 2019, English, French and Spanish
    d. Dell Data Protection |Encryption Security SW: 1 Year ProSupport Plus with Next Business Day Onsite Service
    e. Adobe Creativity and Productivity Software: Adobe® Acrobat® Professional 2020
    f. Video Card: Nvidia GeFroce MX250 Discrete Graphics with Thunderbolt for Intel 10th Gen Core i7-10850HIntel® Integrated HD Graphics 4400
    g. Hard Drive: 500GB Solid State Hybrid DriveM.2 512GB PCIe NVMe Class 40 Solid State Drive
    h. Latitude 15 5000 SeriesChassis Options: Latitude 15 5000 5511 SeriesBottom Door L10
    i. Memory: 4GB (1x4GB) 1600MHz DDR3L Memory16GB, 1x16GB, DDR4 Non-ECC
    j. Internal Keyboard: Internal English Single Pointing Keyboard Dual Pointing US English Keyboard Backlit with 10 Key Numeric Keypad
    k. Optical Drive: 8X DVD+/-RW
    l. Wireless Driver: Intel® Dual Band Wireless-AC 7260 + BT 4.0 DriverIntel Wi-Fi 6AX201 2x2 802.11ax 160MHz + Bluetooth 5.1
    m. Wireless: Intel® Dual Band Wireless-AC 7260 802.11AC Wi-Fi + BT 4.0LE Half Mini Card
        1) Non-Microsoft Application Software: Additional Software for Window 7 Downgrade
        2) Power Supply: 65W A/C Adapter (3-pin)
        3) Camera: Light Sensitive Webcam and Noise Cancelling Digital Array Mic
        4) LCDDisplay: 15.6" FHD (1366x768)1920 x 1080) Wide View Anti-Glare WLED-backlit Non-Touch, RGB Cam & Mic, WLAN/WWAN Capable
        5) Palmrest: No Fingerprint Reader (Single Pointing) Palmrest
        6) FGA Module: Alpine15_R1_106/US/BTS
        7) Provide for each laptop G-data total protection for duration of project.
36. One (1) 10/100 Ethernet router with at least 4 Smith Ports.
37. One (1) microwave oven, 1250W minimum.
38. One (1) refrigerator.
39. Bottled drinking water supplied by a service to the site; provide refrigerated drinking fountains with a spigot. Disposable drinking cups shall always be furnished and supplied.
40. Fire-Resistant File Cabinets:
    a. Description: Four drawer, legal size, UL Class D label.
    b. Number Required: 2.
    c. Product and Manufacturer: Provide one of the following:
        1) Model 4 CFD by Schwab Safe Company.
        2) Fireking International, Incorporated.
        3) Or equal.

K. All facilities, equipment and utilities furnished under this section shall always be provided and maintained in good working order. In addition, the Contractor shall furnish all necessary washroom supplies. All utility costs for telephone, DSL, etc. shall be paid for by the Contractor for the duration of the project.

L. Two months after final acceptance of the work or when ordered by the Engineer, whichever is sooner, the trailer and the field office equipment and facilities furnished by the Contractor limited to the chairs, tables, stool, telephone set, fax machine, copy machine, computer system, microwave oven, refrigerator, bottled water system and file cabinets shall revert to the Contractor who shall remove them and leave the site in a satisfactory condition, as approved by the Engineer.

2.03 - TELEPHONE SERVICE

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

2.04 - INTERNET SERVICE

A. Provide high-speed internet access (minimum 50 mbps) to computer to be used by Owner and Engineer.

2.05 – WATER SERVICE

A. Provide a water service with backflow prevention and freeze 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 01512

+ + NO TEXT ON THIS PAGE + +

PART 1 – GENERAL

1.01 DESCRIPTION

A. Scope:
   1. The Contractor shall provide temporary fire protection at the Bay Park STP, for all areas where work under this contract is being performed and throughout the Project, until the Nassau County takes occupancy. Remove temporary fire protection when the Nassau County takes occupancy.
   2. The Contractor shall comply with Section 901.7 and 1404.5 of the Fire Code of New York State (2010).
   3. The Contractor shall pay all costs associated with temporary fire protection, including installation, maintenance, and removal.
   4. The Contractor shall 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 Extinguishers.
      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 County'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 01516

+ + NO TEXT ON THIS PAGE + +

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 in no case will noise levels be permitted which interfere with the Work of the County or others.

1.03 DUST CONTROL

A. The Contractor shall be responsible for controlling objectionable dust caused by his 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 must conform to the Storm Water Pollution 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. Contractor's 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.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 01560

PART 1 – GENERAL

1.01 GENERAL

A. Furnish and Install:
   1. Where the words "furnish", "provide", "supply", "replace" or "install" are used, whether singly or in combination, they shall mean to furnish and install, unless specifically stated otherwise.
   2. In the interest of brevity, the explicit direction "to furnish and install" has sometimes been omitted in specifying materials and/or equipment. Unless specifically noted otherwise, it shall be understood that all equipment and/or materials specified or shown on the Drawings shall be furnished and installed under the Contract as designated on the Drawings.

B. Concrete Work
   1. Contractor, unless specifically noted otherwise, shall provide all concrete shown, specified, or required under this Contract.

C. Concrete Maintenance Pads for Equipment:
   1. The Contractor shall provide all concrete maintenance pads shown, specified, or required within the building, for all equipment furnished under this Contracts.
   2. Anchor bolts and templates for equipment maintenance pads shall be furnished under the respective Contracts for installation by the Contractor. The General Construction Expansion, epoxy resin and grouted anchor bolts will be permitted unless shown or specified otherwise. The equipment manufacturer should show a normal equipment installation including the anchoring system in their shop drawing submittal. The anchoring system shall exhibit pertinent design criteria such as bolt diameter, embedment depth, pull out strength, spacing, type of anchor, edge distance, bolt patterns and certifications that the anchoring system will function properly with the equipment selected. The anchor system will be subject to additional requirements and testing called for in Section 05051 on these Contract Documents.
   3. All concrete maintenance pads for equipment shall be treated, by the Contractor, with a sealer, approved by the Engineer, to prevent oil from seeping into the concrete.

D. Contractor's Title to Materials:
   1. No materials or supplies for the Work shall be purchased by the Contractor or by any Subcontractor subject to any chattel mortgage or under a conditional sale contract or other agreement by which an interest is retained by the seller. The Contractor warrants that he has good title to all materials and supplies used by him in the Work, free from all liens, claims or encumbrances.

E. "Buy American" Requirements of Financing Entity:
   1. The Project is financed by the New York State Environmental Facilities Corporation under the New York State Clean Water Revolving Fund. Contractor shall comply with requirements of the financing entity relative to the Project, including submitting all required documentation.
   2. Project financing is under the FY 2014 federal appropriations for the Clean Water State Revolving Fund (CWSRF). Comply with applicable requirements of the financing entity, including compliance with the FY 2014 CWSRF's "buy American" provisions.
   3. All the iron and steel products incorporated into the Work shall be produced in the United States, in accordance with the FY 2014 CWSRF provisions of H.R. 3547, "Consolidated Appropriations Act, 2014" (Appropriations Act), enacted on January 17, 2014.
   4. Under the Appropriations Act:

a. "Iron and steel products" are defined as the following products made primarily of iron or steel: lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, and construction materials.
b. The word, "steel" means an alloy that includes at least 50 percent iron, between 0.02 and two percent carbon, and may include other elements. Production in the United States of the iron or steel used in the Project requires that all manufacturing processes take place in the United States, except metallurgical processes involving refinement of steel additives. This requirement does not apply to iron or steel used as components or subcomponents of manufactured goods used in the Project.
c. The words, "reasonably available quantity" mean that the quantity of iron, steel, or the relevant manufactured good is available or will be available at the time required on a schedule consistent with complying with the Contract Times and at the location place required, and in the proper form and quality as shown or indicated in the Contract Documents.
d. The words, "satisfactory quality" mean the quality of iron, steel, or the relevant manufactured good as shown or indicated in the Contract Documents.

5. Requirements for using United States iron and steel will not apply in any case or category of cases in which the Administrator of the U.S. Environmental Protection Agency (in this section referred to as the "Administrator") finds that:
   a. applying the "buy American" provision for iron and steel would be inconsistent with the public interest
   b. iron and steel products are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality; or
   c. inclusion of iron and steel products produced in the United States will increase the cost of the Project by more than 25 percent.
6. Contractor shall submit information verifying compliance with the buy American requirements, certification of compliance with the buy American requirements, and when required information necessary to support applying for a waiver of the buy American requirements, as required by the Owner or the financing entity, under the provisions of the Appropriations Act and related guidance by authorities having jurisdiction over such funds and use thereof.
7. Contractor shall pay damages incurred by Owner for Contractor's failure to comply with provisions of the financing entity's requirements, including "buy American" provisions. Notwithstanding other provisions of the Contract Documents, failure to comply with the buy American requirements allows Owner to recover as special damages against Contractor, and Contractor shall pay, costs for all claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred by Owner resulting from such failure by Contractor, including without limitation impairment or loss of Project funding or financing, whether in whole or in part, from the financing entity, and damages incurred by Owner by Owner's obligations to the financing entity regarding Project funding or financing.

1.02 TRANSPORTATION AND HANDLING OF MATERIALS AND EQUIPMENT

A. The Contractor shall make all arrangements for transportation, delivery and handling of equipment and materials required for prosecution and completion of the Work in accordance with Section 01610, Transportation and Handling of Materials and Equipment.

1.03 STORAGE OF EQUIPMENT AND MATERIALS

A. The Contractor shall store his equipment and materials at the job Site in accordance with the requirements of the General Conditions, Article GC-17, "Materials and Equipment, Approvals Substitutions and Deviations", and as hereinafter specified. All equipment and materials shall be stored in accordance with manufacturer's recommendations and as directed by the

Engineer, and in conformity to applicable statues, ordinances, regulations, and rulings of the public authority having jurisdiction.

B. The Contractor shall enforce the instructions of the County and the Engineer regarding the posting of regulatory signs for loading on structures, fire safety and smoking areas.

C. The Contractor shall not store materials or encroach upon private property without the written consent of the owners of such private property.

1.04 INSTALLATION OF EQUIPMENT

A. Equipment and materials shall be installed in accordance with the requirements of the General Conditions, Article GC-17, "Materials and Equipment, Approvals, Substitutions and Deviations".

B. Concrete maintenance pads for equipment shall be of approved design and shall be adequate in size, suitable for the equipment erected thereon, properly reinforced, and tied into floor slabs by means of reinforcing bars or dowels. Maintenance pads bolts of ample size and strength shall be provided and properly positioned by means of suitable templates and secured during placement of concrete. Maintenance pads shall be built, and bolts shall be installed in accordance with the manufacturer's approved shop drawings.

C. Before mounting equipment on a maintenance pad, the Contractor shall clean the top surface; if necessary, rough it with a star chisel and clean again; and clean out all maintenance pads bolt sleeves. The Contractor shall provide sufficient steel plate shims (about 2 inches wide and 4 inches long), and of a varying thickness (from 1/8 to 1/2 inch). A combination of these shims shall be placed next to each maintenance pads bolt to bring the bottom of the bedplate or frame about 1/8 inch above the final setting. The equipment shall be lowered by changing the combination of shims. Using brass shim stock of various thicknesses, continue to level the equipment a little at a time and in rotation until it is at the correct elevation in both directions. When the equipment is level, tighten down on the maintenance pads bolts a little at a time in rotation to make certain the equipment remains level and does not shift on the shims. A preliminary alignment check shall be made before grout is placed.

D. Equipment shall be set, aligned, and assembled in conformance with manufacturer's drawings or instructions. Runout tolerances by dial indicator method of alignment shall be plus or minus 0.002 inches, unless otherwise directed by the Engineer.

E. Blocking, wedges, shims, filling pieces, or other materials required by the proper support and leveling of equipment during installation shall be furnished by the Contractor. All temporary supports shall be removed, except steel wedges and shims, which may be left in place with the approval of the Engineer. Any grinding necessary to bring parts to proper bearing after erection shall be done at the expense of the Contractor.

F. Each piece of equipment or supporting base, bearing on concrete maintenance pads, shall be bedded in grout. The Contractor shall provide a minimum of 1-1/2-inch thick grouting under the entire baseplate supporting each pump, motor drive unit and other equipment. Mortar shall be non-shrink grout, as specified under Section 03600, Grouting.

G. When motors are shipped separately from driven equipment, the motors shall be received, stored, meggered once a month, and the reports submitted to the Engineer. After driven equipment is set, the motors shall be set, mounted, shimmed, millrighted, coupled and connected complete.
   1. Space heaters shall be supplied in all enclosures being utilized for storage of motors. All areas shall be heated.
   2. Electrical machines being stored shall be turned in accordance with the manufacturer's recommendations to prevent "flat-spotting" of bearings.

H. Anchor and expansion bolts will be furnished by the Contractor, as specified, and required. Expansion bolts shall only be used where permitted by the Engineer. Anchor and expansion bolts shall be of Type 304 stainless steel unless otherwise specified. Anchorage items shall conform to the applicable requirements of Section 05051, Anchor Systems.

I. Workmanship:
   1. The following erection Specifications are not intended to cover all instructions, but only some of the important practices. In all cases, only the best methods known to the trades are to be employed.
   2. Only those mechanics skilled in the handling, setting, alignment, leveling and adjustment of the type of equipment materials supplied shall be employed in the Work.
   3. An oil bath heater shall always be used to expand couplings, gears, etc. They shall not be forced or driven on equipment shafts, nor shall they be subjected to an open flame or torch.
   4. Wedging will not be permitted. Only the least number of flat shims are to be used in leveling equipment (shims are to be clean and free of slag). All shims, filling pieces, keys packing, red or white lead grout, or other materials necessary to properly align, level and secure apparatus in place shall be furnished by the Contractor. All parts intended to be plumb or level must be proven exactly so. Any grinding necessary to bring parts to proper bearing after erection shall be done at the expense of the Contractor.
   5. Proper tools shall be used in the assembly of equipment and materials to prevent marring the surface of shafts, nuts, and/or other parts.
   6. Connections requiring gaskets shall be tightened evenly all around to ensure uniform stress over the entire gasket area.
   7. No equipment and materials shall be altered or repaired, and no burning or welding will be permitted on any parts having machined surfaces, except by written permission of the Engineer.
   8. No rigging shall be done from any structure without the permission of the Engineer, and the Contractor shall be completely responsible for any damage to the structure due to his operations.
   9. Only such equipment and materials that will not damage the structure, equipment, or materials, shall be used on the Work.
   10. The Contractor shall be responsible for the exact alignment of equipment with associated piping and, under no circumstances, will "pipe springing" be allowed.
   11. Misaligned holes shall be reamed, as excessive driving of bolts or keys will not be permitted.
   12. The Contractor shall furnish and install all necessary plugs in lubrication holes to prevent entry of foreign material.

J. Alignment and Leveling:
   1. All couplings shall be aligned while the equipment is free from all external loads.
   2. Both angular and parallel alignment shall be checked, and the degree of misalignment shall be recorded and submitted to the Engineer.
   3. Dial indicators shall be used for the checking of angular and parallel alignment. During rotation of the half couplings in performance of this test, they shall be maintained in the same relative position, and the dial indicator readings shall be taken at the same place on the circumference of the coupling.
   4. Misalignment shall not exceed the manufacturer's tolerances.

K. Threaded Connections:
   1. A molybdenum disulfide anti-seize compound shall be applied to all threads in mechanical connections such as bolts, studs, cap screws, tubing, etc. unless otherwise indicated.

L. Lubrication:

1. All lubrication shall be performed by the Contractor before start-up, in accordance with the lubricant specifications and directions furnished by the manufacturer. The Contractor shall furnish the lubricants.

M. Electrical Connections:
1. Electrical connections shall be provided in accordance with the applicable requirements of Division 16, Electrical.

N. Painting:
1. All equipment and materials, unless specified otherwise, shall be field painted in accordance with the requirements of Section 09900, Painting.

O. Testing:
1. The Contractor shall carry out all checking and/or testing of installed equipment in accordance with manufacturer's specifications, and as required by the Engineer.

P. Maintenance of Installed Equipment:
1. During the time between installation and receipt of the certificate of completion, the Contractor shall maintain all equipment in accordance with the equipment manufacturer's instructions and with the approval of the Engineer.

Q. Services of Manufacturer's Representatives:
1. Equipment furnished under Divisions 2 through 16 shall include the cost of a representative of the manufacturers of all equipment as specified in the General Conditions, Article GC-17, "Materials and Equipment, Approvals, Substitutions and Deviations".
2. Detailed Specifications contain additional requirements for furnishing the services of the manufacturer's representatives.
3. A certificate from the manufacturer stating that the installation of the equipment is satisfactory, that the unit has been satisfactorily tested and is ready for operation, and that the operating personnel have been suitably instructed in the operation, lubrication and care of the unit shall be submitted within thirty days of completion f the performance test.

1.05 CONNECTIONS TO EQUIPMENT

A. Connections to equipment shall follow manufacturer's recommendations as to size and arrangement of connections and/or as shown in detail on the Drawings or approved Shop Drawings. Piping connections shall be made to permit ready disconnection of equipment with minimum disturbance of adjoining piping and equipment. The Contractor shall be responsible for the exact alignment of equipment with associated piping and under no circumstances will pipe springing be allowed.

B. The Contractor shall be responsible for bringing proper electrical service to each item of equipment requiring electrical service as shown on the Drawings or approved Shop Drawings. Electrical connections to equipment requiring electrical service shall be made by the Contractor, unless otherwise indicated on the Drawings or in the Technical Specifications.

1.06 SUBSTITUTIONS

A. Requests for substitutions of equipment or materials shall conform to the requirements of the General Conditions, Article GC-17, "Materials and Equipment, Approvals, Substitutions and Deviations", and as hereinafter specified.
1. The Contractor shall submit for each proposed substitution sufficient details, complete descriptive literature, and performance data together with Samples of the materials, where feasible, to enable the County to determine if the proposed substitution is equal.

2. The Contractor shall submit certified tests, where applicable, by an independent laboratory attesting that the proposed substitution is equal.
3. A list of installations where the proposed substitution is in satisfactory operation.
4. Requests for substitutions shall include full information concerning differences in cost, and any savings in cost resulting from such substitutions shall be passed on to the County.

B. Where the approval of a substitution requires revision or redesign of any part of the Work, all such revision and redesign, and all new Drawings and details required therefore, shall be provided by the Contractor at his own cost and expense, and shall be subject to the approval of the County.

C. In the event that the Engineer or his consultants is required to provide additional services, the charges for such additional services shall be charged to the Contractor by the County in accordance with the requirements of the General Conditions, Article GC-18, "Contractor Costs for Engineering Services".

D. Any modifications in Work required under other Contracts, to accommodate the changed design, will be incorporated in the appropriate Contracts and any resulting increases in Contract prices will be deducted by the County from payments otherwise due by the Contractor who initiated the changed design.

E. In all cases the County shall be the judge as to whether a proposed substitution is to be approved. The Contractor shall abide by their decision when proposed substitute items are judged to be unacceptable and shall in such instances furnish the item specified or indicated. No substitute items shall be used in the Work without written approval of the County.

F. In making request for substitution, the Contractor represents that:
1. The Contractor has investigated proposed substitution, and determined that it is equal to or superior in all respects to the product, manufacturer or method specified.
2. The Contractor has verified that proposed substitution will coordinate with existing design.
3. The Contractor will provide the same or better warranties or bonds for proposed substitution as for product, manufacturer or method specified.
4. The Contractor waives all claims for additional costs or extension of time related to proposed substitution that subsequently may become apparent.

G. Proposed substitutions will not be accepted if:
1. Acceptance will require substantial revision of the Contract Documents.
2. They will change design concepts or Specifications.
3. They will delay completion of the Work, or the work of other contractors.
4. They are indicated or implied on a Shop Drawing and are not accompanied by a formal request for substitution from the Contractor.

H. Approval of a substitution will not relieve the Contractor from the requirement for submission of Shop Drawings as set forth in the Contract Documents.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 01600

PART 1 – GENERAL

1.01 GENERAL

A. The Contractor shall 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 County except where otherwise directed.

C. If necessary to move stored materials and equipment during construction, the Contractor shall 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 County.
   2. Limitations of storage space.
   3. Availability of equipment and personnel for handling products.
   4. County'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 from delivery vehicles. Hand carry or use suitable materials handling equipment.

1.04 REMOVING, HAULING, AND INSTALLING EQUIPMENT AND MATERIALS

A. The Contractor shall 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 may receive while being unloaded, transported, stored or installed. The Contractor shall employ competent mechanics experienced in the installation of the types of equipment and materials to be furnished, and shall ensure that all equipment and materials are installed in accordance with the recommendations of the manufacturer. Bolts, nuts and other fastenings shall be furnished by the Contractor, and shall 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. The Contractor shall coordinate storage and installation of new equipment with construction schedule for existing and new structures.

1.06 CONTRACTOR'S USE OF COUNTY LIFTING EQUIPMENT

A. The Contractor shall not be permitted to use any existing lifting equipment at County facilities unless the following procedure is followed:
   1. Contractor shall 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 County 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 County, the Contractor will 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, the Contractor shall 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 County, the County will resume responsibility for the equipment.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 01610

PART 1 – GENERAL

1.01 GENERAL

A. The Contractor shall initially start up and place all equipment installed by him 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. Also provide filters, chemicals, and other expendables required for initial startup 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.
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.
   1. 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.
   1. 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 startup of the plant facilities, the Contractor shall have prepared and pre tested all equipment to check its ability for sustained operation, including inspections and adjustments by manufacturer's servicemen, as specified in Section 01660 and this Section. Also, all 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, the Contractor shall furnish competent personnel to start up the plant facilities. The Contractor will be responsible for startup of all facilities constructed under this Contract. During the initial startup period the Contractor shall check and provide for satisfactory mechanical operation of the plant facilities. Prior to start up, the Contractor shall prepare a schedule detailing the proposed start up and his plans for manpower and auxiliary facilities to be provided. The startup schedule is subject to

approval of the Engineer. Startup of the plant by the Contractor shall include the operation and maintenance of all mechanical facilities such as pumps, and like equipment, and the ventilating, air conditioning (or heating), and electrical systems. The start-up period shall be a minimum of ten (10) consecutive twenty-four (24)-hour days of satisfactory operation of the facility or the number of days called for in the Technical Specifications. Startup 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 startup period is completed, the County 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 startup period, the Contractor shall continue to operate those facilities that are incomplete or not operating satisfactorily until they are complete and acceptable to the County.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 01650

+ + 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 County. 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 County will perform the tests tabulated in the General Conditions, Article GC 19, "Inspection and Testing".

C. The Contractor shall 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. The Contractor shall 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, the Contractor shall 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. The Contractor shall 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. The Contractor shall furnish all labor, materials, instruments, fuel, incidentals, and expendables required, unless otherwise provided.
   5. The Contractor shall make all changes, adjustments and replacements required to place equipment in service and test it.
   6. The Engineer and the County 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, the Contractor shall perform final field tests of equipment prior to initial startup and operation of the Project. Where this is not practicable, final field tests shall be performed during initial startup 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 County personnel.
   c. In compliance with design conditions, material specifications and all other requirements of the Contract Documents.
4. The Contractor shall submit the test procedure for approval by the Engineer. The procedure shall specify the duration and the parameters of the test.
5. The Contractor shall notify the Engineer at least twenty-four (24) hours prior to beginning of tests. The Contractor shall keep notes and data on tests and submit copy to the Engineer. The Engineer and the County'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, the Contractor shall make all necessary changes, readjustments and replacements at no additional cost to the County.
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 startup 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 01660

PART 1 – GENERAL

1.01 GENERAL

A. The intent of this Section is to have Contractor perform his Work in such a manner that continuous, uninterrupted treatment of the waste flows (air and water) and all essential Plant services and facilities are maintained operational throughout the construction period.

B. Except for the scheduled shutdowns specified in this Section and in other Contracts, the existing plant will be maintained in continuous operation by the County during the entire construction period under all Contracts. Work under this Contract shall be so scheduled and conducted by Contractor such that it will not impede any treatment process, create potential hazards to operating equipment and Plant Personnel, reduce the quality of the plant effluent or cause odor or other nuisance. In performing the Work shown and specified, Contractor shall plan and schedule Work to meet both constraints outlined in this Section and plant operating requirements.

C. The work covered in the following paragraphs may not be all inclusive of all work which may affect plant operations. All operations which involve the demolitions, isolation or tie into existing plant equipment and/or systems will be submitted for approval.

E. Contractor has the option of providing additional temporary facilities that can eliminate a constraint, provided it is done without additional cost to the County, and provided that it does not require any other Contractor to perform additional work, and provided that all requirements of these Specifications are fulfilled.

F. The Contractor shall not shut off or disconnect any operating system of the Plant. All Plant equipment operation and equipment shutdowns shall be executed by the County. The Contractor shall put in place a Lock Out Tag Out (LOTO) system for the safety of their workers in conjunction with Plant's LOTO.

G. The Contractor should 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.

H. 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 County and stored on site, or to become the property of the Contractor and removed from the site.

I. Related Sections:
   1. Section 01031, Additions, Modifications and Alterations to Existing Buildings and Structures.docx
   2. Section 01500, Temporary Facilities and Controls.
   3. Section 02050, Demolition, Removals and Modifications.

1.02 GENERAL CONSTRAINTS

A. Paragraph 1.5 of this Section specifies the sequence and shutdown duration (where applicable) for Plant units which are to be taken out of service. The operational status of new or existing "units", "utility systems", etc., other than the designated "units", "utility systems", etc., shall not be interrupted by the Contractor during the specified time periods. New "units", "utility systems", etc., may only be used after the specified testing and acceptance of the "units", "utility systems", etc.

B. The following constraints shall be applied to all equipment and appurtenant utility systems on the Plant site.
   1. Load limits on Access Roads: Existing and new underground facilities such as electrical duct banks, pipelines, etc., in, under and crossing plant roads have been designed for a maximum wheel load of AASHTO H-20. The Contractor shall not exceed this weight limit.
   2. Access to Plant Site: An unobstructed traffic route through all Plant gates must be maintained at all times.
   3. Internal Roads Access: Vehicular access to all treatment units and buildings must always be maintained.
   4. Personnel Access: Treatment Plant Personnel must have access to all areas that remain in operation throughout the construction period.
   5. Potable Water System: The existing potable water system shall be kept in operation at all times.
   6. Plumbing Facilities: Sanitary facilities in the existing structures shall be operational at all times for Plant operating personnel. All other building plumbing systems such as roof and floor drains, pumping, etc. shall be maintained for all structures.
   7. Storm Drainage: Storm drainage on the site shall be operational at all times.
   8. 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 by the Contractor. Temperatures to be maintained in any area occupied by Plant Personnel such as offices, lunchrooms, locker rooms, toilet rooms, etc., shall be at least 65 °F. Temperatures to be maintained in all other interior Plant areas, whether new, existing or temporary, shall be maintained at a minimum of 55°F as specified in Section 01500, Temporary Facilities and Controls.
   9. Power, Light and Communication Systems: Electric power, lighting service and communication systems shall be maintained in uninterrupted operation in all areas unless otherwise shown or specified.
   10. Draining Process Pipes and Conduits:
      a. Unless otherwise specified, the contents of pipes and conduits undergoing modifications shall be transferred to the Plant 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. All spillage shall be immediately washed down by the Contractor to the floor drains, sumps and sump pump discharge piping flushed out by the Contractor to prevent clogging and septic odors.
   11. Dead End Valves or Pipe: The Contractor shall 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 SHUTDOWNS

A. General:
   1. Shutdown shall be defined to indicate that a portion of the normal operation of a Plant unit has to be suspended or taken out of service in order to perform the specified work. For each shutdown, the Contractor shall compile an inventory of its labor and materials required to perform the tasks, an estimate of the time required, and a written description of steps required to complete the tasks. Contingency time shall be provided where existing shut-off devices do not close tight and supplemental pumping and/or other devices are required to maintain dry conditions. The inventory, the estimate and written procedure shall be submitted to the County for review 60 calendar days prior to the proposed start date of the shutdown. The Contractor shall also request in writing, from the County, approval for each shutdown a minimum of fourteen calendar days prior to the proposed

date. No shutdown shall be initiated until the list of materials and labor is verified on site at least one week prior to the proposed start date.

2. Work required which will interrupt the normal Plant operations shall be accomplished at such times that will be convenient to the County.
3. The Contractor shall also have on hand, located in close proximity to the Work area, all tools, equipment and materials, both temporary and permanent, necessary to complete each work category, without interruption. Adequate numbers of personnel shall be scheduled for each shutdown, so that the work may be accomplished within the specified time frame. Prefabrication of all piping, ductwork and other assemblies shall be completed to greatest degree possible, prior to any shutdowns. The County shall be satisfied that the Contractor has complied with these requirements, to the fullest extent possible, before shutdowns will be authorized.

B. Shutdowns of Mechanical and Electrical Systems: The Contractor and the County shall each lock out and tag circuit breakers and switches operated by the County, and shall check cables and wires to be sure that they are de-energized to ground potential before Work begins and that all mechanical isolation devices are functional. Upon completion of the Work, the Contractor shall remove the locks and tags and advise the County that the facilities are available for use. The County will then remove their locks and place facilities back into use.

1.04 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.

1.05 MAINTENANCE OF PLANT OPERATIONS (MOPO) AND SEQUENCE OF CONSTRUCTION

A. In order to maintain a continuous plant operation during construction, a MOPO Description Section is included after this Section. The category order and item order within each category are not intended as an exact sequence of work or a listing of priorities. However, within each item procedural steps, time constraints and milestone dates may be outlined and are intended to recommend a sequence and timing in order to maintain the continuous operation of the Plant.

B. The Contractor shall note that all necessary shutdowns may not be included in the MOPO Descriptions. As the need for additional shutdowns becomes evident, the Contractor shall notify the Engineer, who with assistance and approval of the County, will arrange for necessary shutdowns.

C. Contractor is advised that work in multiple areas of the Plant performed simultaneously may be required in order to complete the entire scope of the Contract within the allotted time.

D. Refer to "Detailed MOPO Descriptions", located after "End of Section" designation.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 01700

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SEQUENCE OF CONSTRUCTION

GENERAL DESCRIPTION OF WORK

A. Phased, coordinated construction, installation, testing, start-up, and placement into service of hot and chilled water distribution systems, including but not limited to:
   - Excavations for installation of hot and chilled water piping and valve chambers.
   - De-watering of excavations as required for the proper installation of any underground piping systems below the ground water elevation.
   - Furnish and install hot and chilled water, above and below grade piping systems.
   - Welding of above grade and below grade pre-insulated manufactured steel piping systems.
   - Butt fusion welding of all joints for underground HDPE chilled water lines.
   - Installation of concrete vault valve chambers for hot and chilled water supply and return connections.
   - Installation of drains and vents at high and low points, in underground vaults where required.
   - Electrical work as required for the complete installation of an electric heat trace system for all above grade, exposed, chilled water lines.
   - Structural work as required to support new piping, including enhancements to existing buildings where shown.
   - Structural elevated supports for new piping being installed above grade in trafficked or pedestrian pathways.
   - Decommissioning and disconnection of existing FRP chilled water and temporary hot water lines.
   - Site restoration.
   - Replacement of an existing odor control exhaust fan and extension of odor control duct from the existing utility tunnel to the existing odor control system manifold duct.

B. Phasing Requirements (General)
   - The construction of the new hot and chilled water lines may be phased in any number of sections, as required, to facilitate the work with minimal disruption to the existing plant operations.
   - All buildings within the scope of work scheduled to be provide with hot or chilled water, must maintain the ability to provide heating or cooling during their respective heating/cooling season as described in the following schedule:

Item	Item Description	Time Constraints	Processes Out of Service	Procedure:
A	Hot Water Systems	October 2nd to April 30th	High Temperature Hot Water	In order to maintain an indoor temperature of not less than 65°F, hot water must be supplied to all buildings during this time period. The hot water system will be complete and operational at this time or the contractor will supply temporary boilers to back feed the existing buildings. When required, the contractor shall provide a temporary heating system that can meet the minimum requirements as identified in "Building Heating and Cooling Load" spreadsheet.
B	Chilled Water Systems	May 1st to October 1st	Chilled Water	In order to maintain an indoor temperature of not more than 75°F and 50% RH. Chilled water must be supplied to all buildings during this time period. When required the contractor shall provide a temporary cooling system that can meet the minimum requirements as identified in the "Building Heating and Cooling Load" spreadsheet. The existing chilled water system shall remain in service until such time as the new chilled water system is fully installed, tested, commissioned and approved by the county.

- Any area of excavation must be protected from unauthorized entrance to the work area to prevent normal plant maintenance staff, or visitors to the site, from unknowingly entering a construction area. Excavated areas must be protected from vehicular traffic at all times.
- The contractor shall install additional temporary valves, vents and drains to assist in isolating areas to allow for the sequencing of the work.
- Building tie ins will be season dependent. Before performing any building tie ins, contractor shall provide minimum of two weeks advance notice to owner and must have written approval from the owner.
- The contractor shall coordinate final construction sequencing and work restrictions with requirements laid forth in specification section 01311 "Construction Scheduling."
- The contractor shall refer to "GEN-G02 – STAGING SEQUENCING AND WORK RESTRICTIONS PLAN" for work restrictions and suggested phasing in specific areas.

OTHER

A. Working Meeting
A working meeting with the Contractor will be held prior to the start of work at the site to determine the plan of work, schedule, submittal requirements, training, and to review the sequence and constraints for construction, migration of existing loads to new construction, and demolition.

B. Shop Drawings
Within 30 days of the NTP, the Contractor shall submit shop drawings for all materials needed and a sequence of work needed to connect the new work to existing utilities and facilities and to disconnect/demolish existing utilities and facilities.

HOT WATER SYSTEMS

- The contractor shall provide temporary isolation valves in order to connect the temporary hot water piping to the new piping at the West Central Warehouse as indicated on "GEN-

G02 – STAGING, SEQUENCING AND WORK RESTRICTIONS PLAN." If the contractor cannot complete the work on the heating system prior to the start of heating season, October 2nd, the contractor shall provide a means of temporary heating for all buildings until the end of the heating season, April 30th.

- If work on the proposed hot water system cannot be completed by October 2nd, the contractor may, with approval by the County, elect to complete a phase of the work prior to the start of the heating season, and continue the work after the end of that heating season. Any phase of the work that is started will not be considered complete unless it allows for the continued operation of the heating system for all buildings affected under the current or future phases of the work.

CHILLED WATER SYSTEMS

- It is the intention of this contract that the existing chilled water system will remain in service during the construction of the new chilled water distribution system and the buildings that will have chilled water service interrupted have DX cooling capabilities.
- The contractor shall install permanent isolation valves in the utility tunnel between the new chilled water system and the existing system to allow for the existing chilled water piping to remain operational while the new piping system is being installed.
- It is anticipated that final connections to the buildings for the chilled water system will occur during the cooling season and therefore cause an interruption to the existing building. The duration of any such interruption to a building service shall be limited to 24 hours unless approved prior to the shutdown in writing by the county. If the shutdown is to exceed a 24 hour duration, the contractor shall provide a means of temporary cooling to the building. Building tie ins will be season dependent. Before performing any building tie ins, contractor shall provide minimum of two weeks advance notice to owner and must have written approval from the owner.

BUILDING HEATING AND COOLING LOAD SPREADSHEET

Building	Equipment	Heating (MBH)	HW Flow (GPM)	HW Ent. & Lvg. Temp.	Cooling (MBH)	CW Flow (GPM)	CW Ent. & Lvg. Temp.
Sludge Thickening Bldg.	UH 80855	45	3.25	220/190			
	UH 80856	45	3.25	220/190			
	UH 80857	50	3.5	220/190			
	UH 80858	37	2.6	220/190			
	UH 80859	50	3.5	220/190			
	UH 80860	17.5	1.25	220/190			
	UH 80861	22.5	1.75	220/190			
	HV-80815A	1483	102.6	220/190			
	HV-80816A	889.7	61.6	220/190			
	HV-80805A	136.4	9.4	220/190			
	CRAC-80812A	-	-	-	134	29	
	CRAC-80813A	-	-	-	59	13	
Bldg. Totals		**2776.1**	**192.7**		**193**	**42**	
West Central Warehouse	AHU-019810	285	19	215/185	261	52	45/55
	AHU-019811	182	12	215/185	130	26	45/55
	UH-019855	25	1.75	215/185			
	UH-019856	25	1.75	215/185			
	UH-019857	25	1.75	215/185			
	UH-019858	25	1.75	215/185			
	UH-019859	25	1.75	215/185			
	UH-019860	40	3	215/185			
	UH-019861	40	3	215/185			
	UH-019862	40	3	215/185			

Building	Equipment	Heating (MBH)	HW Flow (GPM)	HW Ent. & Lvg. Temp.	Cooling (MBH)	CW Flow (GPM)	CW Ent. & Lvg. Temp.
	UH-019863	40	3	215/185			
	C-019880	8.8	0.5	215/185			
	C-019881	8.8	0.5	215/185			
	C-019882	8.8	0.5	215/185			
	C-019883	8.8	0.5	215/185			
	C-019884	8.8	0.5	215/185			
Bldg. Totals		**796**	**54.25**		**391**	**78**	
East Central Warehouse	AHU-019812	800	53	215/185	336	58	45/55
	AHU-019813	217	15	215/185	185	37	45/55
	UH-019864	45	3.25	215/185			
	UH-019865	45	3.25	215/185			
	UH-019866	50	3.5	215/185			
	UH-019867	50	3.5	215/185			
	C-019885	8.8	0.5	215/185			
	C-019886	8.8	0.5	215/185			
	C-019887	8.8	0.5	215/185			
	C-019888	8.8	0.5	215/185			
Bldg. Totals		**1242.2**	**83.5**		**521**	**95**	
Plant Maintenance	HRU-11801	846	55	210/180	543	107	44/54
	HRU-11802	810	55	210/180	537	107	44/54
	HRU-11803	1024	70	210/180	697	136	44/54
	HRU-11804	1024	70	210/180	697	136	44/54
	UH-11858	84	5.8	210/180			
	UH-11859	84	5.8	210/180			
	UH-11860	84	5.8	210/180			
	UH-11861	84	5.8	210/180			
	UH-11862	84	5.8	210/180			
	UH-11863	84	5.8	210/180			
	UH-11864	84	5.8	210/180			
	UH-11865	84	5.8	210/180			
	UH-11866	84	5.8	210/180			
	UH-11867	84	5.8	210/180			
	UH-11868	84	5.8	210/180			
	UH-11869	84	5.8	210/180			
	UH-11870	50	3.5	210/180			
	UH-11871	50	3.5	210/180			
Bldg. Totals		**4812**	**326.6**		**2474**	**486**	
Effluent Screening	HV-60805	1294.5	89.2	215/185			
	AHU-60810	-	-	-	92.2	18.4	45/55
	UH-60855	25	1.75	215/185			
	UH-60856	50	3.5	215/185			
	UH-60857	50	3.5	215/185			
	UH-60858	35	2.5	215/185			
	UH-60859	35	2.5	215/185			
	UH-60860	35	2.5	215/185			
	UH-60861	30	2.25	215/185			
	UH-60862	30	2.25	215/185			
	UH-60863	30	2.25	215/185			
	UH-60864	50	3.5	215/185			
Bldg. Totals		**1664.5**	**115.7**		**92.2**	**18.4**	
Fire Protection Pump Station	HV-16805	425.8	28.4	215/185	-	-	-
	UH-16850	7	0.5	215/185			
	UH-16851	15	1				
	UH-16852	25	1.75				
	UH-16853	25	1.75				
	UH-16854	25	1.75				
	UH-16855	25	1.75				

Building	Equipment	Heating (MBH)	HW Flow (GPM)	HW Ent. & Lvg. Temp.	Cooling (MBH)	CW Flow (GPM)	CW Ent. & Lvg. Temp.
	MUA-16860	22.8	1.52				
Bldg. Totals		**570.6**	**38.42**				
Substation No. 6 BUILDING NO LONGER IN SERVICE	HRU 80815	415	27.6	220/190			
	HRU 80816	415	27.6	220/190			
	HV 80805	379.8	25.3	220/190			
	AC 06815				217	45	45/55
	AC 80810				164	33	45/55
	UH 06856	40	2.73	220/190			
	UH 06857	40	2.73	220/190			
	UH 80855	45	3.25	220/190			
	UH 80856	45	3.25	220/190			
	UH 80857	50	3.5	220/190			
	UH 80858	37	2.6	220/190			
	UH 80859	50	3.5	220/190			
	UH 80860	17.5	1.25	220/190			
	UH 80861	22.5	1.75	220/190			
Bldg. Totals							**0**
Primary Settling Tank Odor Control Building	HRU 34815	1620	109.3	210/180			
	HV 34805	157	12.5	210/180			
	UH 34857	50	3.5	210/180			
	UH 34858	50	3.5	210/180			
Bldg. Totals		**1877**	**128.8**				
Primary Sludge Pump Station No. 1	HRU 31815	459.5	30.6	210/180			
	HRU 31816	529.3	35.2	210/180			
	PTAC 31800	26	1.8	210/180			
	UH 31855	30	2.25	210/180			
	UH 31856	30	2.25	210/180			
	UH 31857	30	2.25	210/180			
	UH 31858	30	2.25	210/180			
	UH 31859	15	1	210/180			
	UH 31860	15	1	210/180			
	CONV 31880	13.7	0.94	210/180			
	CONV 31881	13.7	0.94	210/180			
Primary Sludge Pump Station No. 2	PTAC 31801	26	1.8	210/180			
	HV 31807	110.2	7.3	210/180			
	UH 31861	15	1	210/180			
Primary Sludge Pump Station No. 3	PTAC 31802	26	1.8	210/180			
	HV 31808	110.2	7.3	210/180			
	UH 31862	15	1	210/180			
Bldg. Totals		**1494.6**	**100.68**				
ROAD MAINTENANCE	UH-10855	50	3.4	210/180			
	UH-10856	50	3.4	210/180			
	UH-10857	50	3.4	210/180			
	UH-10858	50	3.4	210/180			
	UH-10859	50	3.4	210/180			
	UH-10860	50	3.4	210/180			
	UH-10861	50	3.4	210/180			
	UH-10862	50	3.4	210/180			
	UH-10863	50	3.4	210/180			
	UH-10864	50	3.4	210/180			
	UH-10865	50	3.4	210/180			
	UH-10866	50	3.4	210/180			
	UH-10867	30	2	210/180			
	UH-10868	30	2	210/180			
	UH-10869	30	2	210/180			

Building	Equipment	Heating (MBH)	HW Flow (GPM)	HW Ent. & Lvg. Temp.	Cooling (MBH)	CW Flow (GPM)	CW Ent. & Lvg. Temp.
	UH-10870	18	1.2	210/180			
	UH-10871	18	1.2	210/180			
	UH-10872	30	2	210/180			
	UH-10873	30	2	210/180			
	UH-10874	20	1.4	210/180			
	UH-10875	35	2.4	210/180			
	UH-10876	35	2.4	210/180			
	UH-10877	35	2.4	210/180			
	UH-10878	10	0.7	210/180			
	CRAC-10810				164.5	33.1	45/55
	HVAC-1B				350.26	83	44/52.3
	HVAC-2B				335.9	75	44/52.1
Bldg. Totals		**921**	**62.5**		**850.66**	**191.1**	
Sludge Dewatering	HV-1	2132	147	215/185	-	-	-
	HV-2	2027	140	215/185	-	-	-
	HV-3	195	14	215/185	-	-	-
	AHU-1	-	-	-	181	36	45/55
	AHU-2	-	-	-	181	36	45/55
	AHU-3	-	-	-	90	18	45/55
	AHU-4	-	-	-	90	18	45/55
	HUH-1	15	1	215/185			
	HUH-2	15	1	215/185			
	HUH-3	16.8	1.2	215/185			
	HUH-4	16.8	1.2	215/185			
	HUH-5	16.8	1.2	215/185			
	HUH-6	16.8	1.2	215/185			
	HUH-7	16.8	1.2	215/185	-	-	-
	HUH-8	16.8	1.2	215/185	-	-	-
	HUH-9	16.8	1.2	215/185	-	-	-
	HUH-10	16.8	1.2	215/185	-	-	-
	HUH-11	16.8	1.2	215/185	-	-	-
	HUH-12	16.8	1.2	215/185	-	-	-
	HUH-13	16.8	1.2	215/185	-	-	-
	HUH-14	16.8	1.2	215/185	-	-	-
	HUH-15	21.5	1.5	215/185	-	-	-
	HUH-16	15	1	215/185	-	-	-
	HUH-17	15	1	215/185	-	-	-
	HUH-18	16.8	1.2	215/185	-	-	-
	HUH-19	16.8	1.2	215/185	-	-	-
	HUH-20	16.8	1.2	215/185	-	-	-
	HUH-21	16.8	1.2	215/185	-	-	-
	HUH-22	16.8	1.2	215/185	-	-	-
	HUH-23	21.5	1.5	215/185	-	-	-
	HUH-24	16.8	1.2	215/185	-	-	-
	HUH-25	16.8	1.2	215/185	-	-	-
	HUH-26	16.8	1.2	215/185	-	-	-
	HUH-27	16.8	1.2	215/185	-	-	-
	HUH-28	16.8	1.2	215/185	-	-	-
	HUH-29	16.8	1.2	215/185	-	-	-
	HUH-30	16.8	1.2	215/185	-	-	-
	HUH-31	16.8	1.2	215/185	-	-	-
	HUH-32	16.8	1.2	215/185	-	-	-
Bldg. Totals		**4893.8**	**339.2**		**542**	**108**	
Effluent Pump Station	HV-70815	1197	45	200/145.5			
	SCAC-70811	-	-	-	177	30	44/56.4

Building	Equipment	Heating (MBH)	HW Flow (GPM)	HW Ent. & Lvg. Temp.	Cooling (MBH)	CW Flow (GPM)	CW Ent. & Lvg. Temp.
	UH-70855	49.6	3.4	200/170			
	UH-70856	49.6	3.4	200/170			
Bldg. Totals		**1296.2**	**51.8**				
Grit Building	HV-B-1A	828	48	190/150	-	-	-
	HV-B-1B	828	48	190/150	-	-	-
	HV-B-2	245	14	190/154	-	-	-
	UH-B-1	31.4	3.4	190/170	-	-	-
	UH-B-2	28.4	3.8	190/170	-	-	-
	UH-B-3	31.4	3.4	190/170	-	-	-
	UH-B-4	31.4	3.4	190/170	-	-	-
	UH-B-5	31.4	3.4	190/170	-	-	-
	UH-B-6	31.4	3.4	190/170	-	-	-
	UH-B-7	31.4	3.4	190/170	-	-	-
	XP UH-B-8	31.4	3.4	190/170	-	-	-
	XP UH-B-9	31.4	3.4	190/170	-	-	-
	XP UH-B-10A	22.7	2.5	190/170	-	-	-
	XP UH-B-10B	22.7	2.5	190/170	-	-	-
	XP UH-B-10C	22.7	2.5	190/170	-	-	-
	XP UH-B-10D	22.7	2.5	190/170	-	-	-
	UH-B-11	33.6	3.8	190/170	-	-	-
	UH-B-12	33.6	3.8	190/170	-	-	-
	UH-B-13	33.6	3.8	190/170	-	-	-
	UH-B-14	16	1.7	190/170	-	-	-
	UH-B-15	16	1.7	190/170	-	-	-
	UH-B-16	16	1.7	190/170	-	-	-
	UH-B-17	16	1.7	190/170	-	-	-
	UH-B-18	16	1.7	190/170	-	-	-
	UH-B-19	16	1.7	190/170	-	-	-
	PTR-1	16.2	1.6	190/170	-	-	-
Bldg. Totals		**2484.4**	**174.2**		**0**	**0**	
MCC Building	AC-90812	-	-	-	142	29	45/55
	UH-90865	30	2.25	210/180	-	-	-
Bldg. Totals		**30**	**2.25**		**142**	**29**	
Campus Totals		**24858.4**	**1670.6**		**5205.86**	**1047.5**	

END OF SECTION 01700a

+ + NO TEXT ON THIS PAGE + +

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 plant Site.
   2. Do not burn or bury rubbish and waste materials on the plant Site.
   3. Do not dispose of volatile or hazardous wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.
   4. Do not discharge wastes into 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. The Contractor shall 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 01710

+ + NO TEXT ON THIS PAGE + +

PART 1 – GENERAL

1.01 GENERAL

A. The Contractor shall 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 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.

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 media set and on USB thumb drive, (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 the Bay Park Program 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 thirty (30) days after the completion of the Work and prior to Final Payment.
2. At the completion of all electrical Work under this Contract, the Contractor shall furnish to the Engineer, reproducible tracings showing a one-line diagram of the distribution system and the actual in-place grounding system, lighting arrangement , motor control centers, equipment and conduit and cable plans. Tracing shall be furnished not later than thirty (30) days after the completion of the Work and prior to Final payment
3. The Contract Drawings may be used as a starting point in developing these Drawings. The Subcontractor and manufacturer's drawings may be included in this package. The drawing package must be fully integrated and include the necessary cross-references between Drawings. The drawing package shall include interconnection and termination details to the equipment furnished un 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) Substation controls.
   b. Wiring (connection) diagrams: These shall be included for all pre-wired equipment furnished under this Contract.
   c. Interconnection diagrams: These shall include all interconnections to be furnished under this Contract.
   d. Conduit and cable schedules: These shall include all conduit and cable furnished under this Contract.
   e. Dimension of outline drawings: These shall include all equipment furnished under this Contract.
   f. Power and lighting layout drawings: These shall 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 01720

PART 1 – GENERAL

1.01 GENERAL

A. Provide operation and maintenance data in the form of instructional manuals for use by the County's personnel for:
   1. All equipment and systems.
   2. All valves, gates, and related accessories.
   3. All instruments and control devices.
   4. All electrical gear.

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. The Contractor shall supply all lubricants, applicators, and labor for lubricating the equipment, in accordance with manufacturer's recommendations, for field-testing and prior to final acceptance. A supply of required lubricants sufficient for start-up and one year of operation shall also be supplied by the Contractor.

D. Twelve copies of the approved lubrication survey shall be furnished 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, the Contractor shall 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. The Contractor shall also 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.

B. Special Tools:
   1. The Contractor shall furnish at no additional cost to the County 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. The Contractor shall 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, the Contractor shall 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, instructional 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 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 County 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. 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-inch by 11-inch; paper shall be sixty (60) pound and reinforced holes 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 the attached 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. The Contractor shall 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, the Contractor shall submit ten copies of the manual and the itemized listing to the County.

1.05 MAINTENANCE AND LUBRICATION SCHEDULES

A. For all items of equipment furnished, Contractor shall 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**

SAMPLE LUBRICATION SCHEDULE				
Item	**Manufacturer's Recommendations**	**Type Lubricant**	**Quantity Per Tank**	**Frequency**

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.

B. During the equipment start-up period the Contractor shall furnish, at no additional cost to the County, 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 County shall:
   1. Provide the necessary plant personnel for training in the operation and maintenance of the equipment during their regularly assigned work shifts.

D. The Contractor shall 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 to cause minimum disruption to the total plant operation.

F. Upon completion of a minimum of ten consecutive twenty-four (24)-hour days of satisfactory operation, or the number of days called for in the Technical Specifications, the County 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, the Contractor shall 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. Manufacturer shall provide the services of factory trained specialists to instruct the County's 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 County's representative.

3. Manufacturer shall be responsible for coordinating these services at times acceptable to the County, 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 Bay Park Sewage Treatment Plant unless otherwise specified.
5. Manufacturer shall provide the minimum training for each piece of
6. equipment as specified in the attached schedule.
7. The County reserves the right to videotape all manufacturer training sessions.

B. Submittals:
1. Manufacturer shall submit for approval 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. Manufacturer shall submit for approval credentials of their 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. Manufacturer's 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.
2. Manufacturer's proposed 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. The manufacturer shall 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.
      2) Preventive Maintenance (PM):
         a) Define the recommended PM program and schedules for each system and equipment item.
         b) Describe PM procedures.
         c) Describe inspection and test procedures and use of test equipment, if applicable.
         d) Describe routine inspection procedures required to:
            i. Perform an inspection of equipment while it is operating.
            ii. Identify symptoms of potential problems to anticipate breakdowns.
         e) Describe equipment housekeeping procedures,
         f) Equipment Troubleshooting:
         g) Define recommended systematic troubleshooting procedures.
         h) Provide component-specific troubleshooting checklists.
         i) Describe applicable equipment testing and diagnostic procedures to facilitate troubleshooting.

3) Equipment Corrective Maintenance:
   a) Describe recommended equipment preparation requirements.
   b) Identify and describe the use of any special tools required for maintenance of the equipment.
   c) Describe component removal/installation and disassembly/assemb1y procedures.
   d) Perform at least two "hands-on" demonstrations of common corrective maintenance repairs.
   e) Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.
   f) Define recommended torque, mounting, calibration, and/or alignment procedures and settings, as appropriate.
   g) 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.
   2) Operation:
      a) Describe operating principles and practices.
      b) Describe routine operating, startup, and shutdown procedures.
      c) Describe alarm conditions and response to alarms. Identify safety features and control interlocks.
      d) Describe routine monitoring and record keeping procedures.

D. Responsibilities:
   1. 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 County 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: To provide the County with adequate time requirements for manufacturer's training, minimum training times for various pieces of equipment and systems are listed on the attached schedule. Schedule 01730-A also references sections that will require an Operation & Maintenance Manual.
   1. Schedule 01730-A: Schedule of specification sections requiring an Operations and Maintenance Manual:

Training Schedule Specification Sec.	Description of Equipment	Minimum Training Time
15705	Piping Freeze Protection System	XX hours
15831	Exhaust Fans	XX hours

END OF SECTION 01730

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Requirements for construction waste management.

1.02 SUBMITTALS

A. The Contractor shall prepare and submit a Construction Waste Management Plan for' review and approval by the Engineer within fifteen (15) days after receipt of Notice to Proceed and prior to the removal of any construction waste or demolition materials from the Project site.

B. The Construction Waste Management Plan shall contain the following:
   1. Analysis of the proposed job site waste to be generated during the full construction period, including types and anticipated quantities of each. The list of construction waste materials shall include, at a minimum but not limited to, the following materials:
      a. Cardboard
      b. Clean dimensional wood
      c. Demolition debris
      d. Concrete
      e. Bricks
      f. Concrete masonry units (CMU)
      g. Asphalt
      h. Metals from rebar, sheetrock studs, framing, etc.
      i. Steel sheet piling
      j. Steel pipe piles
      k. Structural steel
      l. Paints, solvents, and other hazardous fluids
      m. Glass
      n. Roofing
      o. Wood pallets
      p. Fencing materials
      q. Mercury containing light bulbs/batteries
      r. Recyclable office wastes such as paper and toner and ink cartridges that should be recycled.
   2. Materials Handling Procedures: A description of the means by which any construction waste materials listed above will be appropriately segregated and not mixed in order to prevent cross-contamination as well as a description of the means to be employed in recycling the above materials consistent with requirements of the County.
   3. The Construction Waste Management Plan shall specify a list of waste transporters, transfer stations, disposal facilities and recyclers with addresses, phone numbers, and permits which the Contractor intends to utilize during the construction period for the purpose of complying with the Construction Waste Management Plan. The Plan should list where the non-recyclable materials will be disposed.
   4. Transportation: A description of the means of transportation of the recyclable and non-recyclable materials (whether materials will be site-separated and self- hauled to designated centers, or whether mixed materials will be collected by a waste transporter and removed from the site) and destination of such materials.
   5. Hazardous wastes: The Construction Waste Management Plan shall specifically note the proper method of disposal for anticipated hazardous wastes or potentially hazardous wastes such as resins, epoxies, waterproofing agents, waste paints, solvents, and other hazardous fluids, expended 55 gallon drums, concrete curing compounds, etc. The Plan shall state that the hazardous waste transporter must hold a current DEC Part 364 Waste Transporter Permit. The permit must authorize the transporter to take the hazardous

waste to the Transportation, Storage and Disposal Facility (TSDF) identified in the permit. The Construction Waste Management Plan must state that the hazardous waste will be transported in compliance with USDOT 49 CFR Hazardous Materials Transportation regulations.

6. Universal wastes: The Construction Waste Management Plan shall specifically identify the proper method of handling of universal wastes (e.g., mercury containing bulbs, batteries). Universal wastes must be managed in compliance with 6NYCRR Part 374-3 and with USDOT 49 CFR Hazardous Materials Transportation regulations.
7. Non-hazardous wastes: The Construction Waste Management Plan shall specifically note the proper method of disposal of anticipated non-hazardous waste such as oily rags. The Plan shall state the transporter must hold a current Part 364 Waste Transporter Permit to transport the waste to a TSDF that accepts non-hazardous waste.
8. The Construction Waste Management Plan shall include the method of recycling office materials such as clean white paper, mixed paper, toner cartridges for laser printers, copiers, and fax machines. Each item shall be recycled in accordance with the manufacturer's instructions.
9. The Construction Waste Management Plan shall include the coordination of product deliveries to designated prepared areas in order to minimize site storage time and potential damage to stored materials and the return of packing materials, such as wood pallets, fifty-five (55)-gallon drums, etc., where economically feasible.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 CONSTRUCTION WASTE MANAGEMENT

A. The Contractor shall use construction and demolition methods and processes to ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors. Where economically feasible, as many of the materials from the generated waste shall be salvaged, reused, or recycled.

B. When encountered as part of his work, the Contractor shall dispose of construction and demolition waste by recycling methods in accordance with all relevant State, County and local codes, laws, and regulations.

C. All hazardous waste, universal waste, and used oil must be separated and stored in their own dedicated storage areas and managed in compliance with NYSDEC Hazardous Waste, Universal Waste and Used Oil Regulations and USDOT 49 CFR Hazardous Material Transportation Regulations.

3.02 HANDLING AND STORAGE

A. The Contractor shall designate separate receiving/storage areas for delivered materials and equipment to minimize waste due to excessive materials mishandling, misapplication, weather, and other damage.

B. The requirements herein shall supersede any conflicting statements wherever they may appear in the Contract Documents.

END OF SECTION 01733

PART 1 – GENERAL

1.01 FINAL CLEANING

A. At the completion of the Work, the Contractor shall 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. The Contractor shall broom clean paved surfaces and rake clean other surfaces of grounds.

C. The Contractor shall thoroughly clean all materials, equipment and structures; all marred surfaces shall be touched up to match adjacent surfaces; dirty filters and burned-out lights replaced as required. The Contractor shall clean and polish all interior and exterior glass surfaces so as to leave glass surfaces in a clean and new appearing condition.

D. The Contractor shall 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 nameplates, labels and other identification markings.

F. The Contractor shall maintain cleaning until Project, or portion thereof, is occupied by the County.

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". The Contractor shall also 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 County 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 01760

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PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

A. The Contractor shall comply with all federal, state, and local statutory and constitutional anti-discrimination provisions. In addition, Local law No. 14-2002, entitled "Participation by Minority Group Members and Women in Nassau County Contracts" governs all County Contracts. In accordance with Local law 14-2002:

1. The Contractor shall not discriminate against employees or applicants for employment because of race, creed, color, national origin, sex, age, disability or marital status in recruitment, employment, job assignments, promotions, upgradings, demotions, transfers, layoffs, terminations and rates of pay or other forms of compensation. The Contractor will undertake or continue existing programs related to recruitment, employment, job assignments, promotions, upgradings, transfers, and rates of pay or other forms of compensation to ensure that minority group members and women are afforded equal employment opportunities without discrimination.
2. At the request of the County contracting agency, the Contractor shall request each employment agency, labor union, or authorized representative of worker with which it has a collective bargaining or other agreement or understanding, to furnish a written statement that such employment agency, union, or representative will not discriminate on the basis of race, creed, color, national origin, sex, age, disability, or marital status and that such employment agency, labor union, or representative will affirmatively cooperate in the implementation of the Contractor's obligations herein.
3. The Contractor shall state, in all solicitations or advertisements for employees, that, in the performance of the County Contract, all qualified applicants will be afforded equal employment opportunities without discrimination because of race, creed, color, national origin, sex, age, disability or marital status.
4. The Contractor shall make its' best efforts to solicit active participation by "Certified business enterprises (as defined in Section 101 of Local law No. 14-2002).
5. The Contractor shall be bound by the provisions of Section 109 of Local law No. 14-2002 (entitled "Enforcement").
6. The Contractor shall include the provisions of (a) through (e) above in every subcontract providing for a total expenditure in excess of twenty-five thousand dollars ($25,000) for the construction, demolition, replacement, major repair, renovation, planning or design of real property and improvements thereon (the "Work"), except where the Work is for the beneficial use of the Contractor.
7. The provisions of (a) through (f) above do not apply to: (i) work, goods or services unrelated to the County Contract, or (ii) employment or employment related activities outside of the County.
8. The term "County Contract" means (i) a written agreement or purchase order instrument, providing for a total expenditure in excess of twenty-five thousand dollars ($25,000), whereby a County contracting agency is committed to expend or does expend funds in return for labor, services, supplies, equipment, materials or any combination of the foregoing, to be performed for, or rendered or furnished to the County; or (ii) a written agreement in excess of one hundred thousand dollars ($100,000), whereby a County contracting agency is committed to expend or docs expend funds for the acquisition, construction, demolition, replacement, major repair or renovation of real property and improvement thereon. However, the term "County Contract" does not include agreements or orders for the following services: banking services, insurance policies or contracts, or contracts with a County contracting agency for the sale of bonds, notes or other securities.
9. The term "Contractor" means an individual, business enterprise, including sole proprietorship, partnership, corporation, not-for-profit corporation, or any other person or entity other than the County, whether a contractor licensor, licensee or any other party,

that is (i) a party to a County Contract, (ii) a bidder in connection with the award of a County Contract, or (iii) a proposed party to a County Contract.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 01770

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope:
   1. The Contractor shall 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. The Contractor shall 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. The Contractor shall 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. The Contractor shall make such investigations, explorations and probes as are necessary to ascertain any required protective measures before proceeding with demolition and removal.
   4. The Contractor shall 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. The Contractor shall 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. The Contractor shall 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. The Contractor shall 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. The Contractor shall take necessary precautions to prevent dust from rising by wetting demolished masonry, concrete, plaster and similar debris. Unaltered portions of the existing buildings affected by the operations under this Section shall be protected by dustproof partitions and other adequate means.
5. The Contractor shall provide adequate fire protection in accordance with local Fire Department requirements.
6. The Contractor shall not close or obstruct walkways, passageways, or stairways and shall not store or place materials in passageways, stairs or other means of egress. The Contractor shall 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. The Contractor shall carry out all operations so as 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.
10. 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.

C. Notification:
   1. At least 48 hours prior to commencement of demolition or removal, the Contractor shall 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. The Contractor shall 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. All supports, pedestals and anchors shall be removed 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:

1. The Contractor shall 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, the Contractor shall 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. The Contractor shall 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. The Contractor shall 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 attached 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. Curbs and gutters shall be removed 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.

B. When underground piping is to be altered or removed, the remaining piping shall be properly capped with a minimum of 12 inches of flowable fill. 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. The Contractor shall 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. The Contractor shall 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.

3.09 MAINTENANCE AND CLEAN UP

A. The Contractor shall maintain the buildings, structures and public properties free from accumulations of waste, debris and rubbish, caused by the demolition and removal operations.

B. The Contractor shall 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, the Contractor shall clean the Site and properties (including sweeping roadways with a mechanical sweeper), and dispose of waste materials, debris and rubbish.

END OF SECTION 02050

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PART 1 - GENERAL

1.01 - SECTION INCLUDES

A. Remove and dispose of surface debris as required.

B. Remove and dispose of paving, sidewalk, curbs, etc.

C. Clear site or designated areas of the site of plant life and grass as required and dispose of as required.

D. Remove and dispose of trees and shrubs as required.

E. Remove and dispose of stumps and root system of trees and shrubs as required.

F. Removal and storage of topsoil.

1.02 - RELATED SECTIONS

A. Section 02200 - Earthwork.

B. Section 02485 - Grassing and Plantings.

1.03 - REGULATORY REQUIREMENTS

A. Conform to applicable local code(s) for disposal of debris.

B. Burning of materials on site is prohibited.

C. Coordinate clearing work with utility companies.

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 - PREPARATION

A. Verify existing conditions.

B. Identify existing plant life designated to be removed. Verify with Owner and Engineer prior to removal.

C. Verify limits of clearing.

3.02 - PROTECTION

A. Locate, identify and protect utilities that are to remain from damage.

B. Protect trees, plant growth and features designated to remain as final landscaping.

C. Protect benchmarks and existing structures from damage or displacement. Any damage to existing structures is to be promptly repaired at no additional cost to the Owner.

3.03 - APPLICATION

A. Clear areas required for access to site and execution of work.

B. Remove paving, curbs, debris and sidewalks as required.

C. Remove trees and shrubs designated to be removed. Remove stumps, main root ball, surface rock and perishable debris.

D. Clear undergrowth and dead wood without disturbing subsoil.

E. Remove paving, debris, rock and extracted plant life from site and dispose of in accordance with State and local ordinances.

F. Excavate topsoil from areas to be further excavated, re-landscaped or regraded. Do not excavate wet topsoil.

G. Stockpile topsoil in area designated on site to a height not exceeding 8 feet. Protect from erosion. Remove excess topsoil not being reused from site. Do not remove any topsoil from the site prior to obtaining the approval of the Engineer.

END OF SECTION 02110

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope:
1. The Contractor shall perform all excavating, backfilling and disposing 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 replacement of roads, walks, pavements, grading, structures and other facilities 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 shall be obtained from off-site sources.

C. Related Sections:
1. Section 02050, Demolition, Removals and Modifications.
2. Section 03300, Cast-In-Place Concrete.

1.02 QUALITY ASSURANCE

A. Permits and Regulations:
1. The Contractor shall perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.

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 "Specifications 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 recommendations 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 422, Particle-Size Analysis of Soils.
4. ASTM D 698, Moisture-Density Relations of Soils, using 5.5 lb (2.5 kg) Rammer and 12-inch (304.8 mm) Drop.
5. ASTM D 1556, Density of Soil in Place by the Sand-Cone Method.

D. Tests:

1. The Owner will make tests and determine acceptability of the fill or material as listed below.
2. Required Tests:
   a. Select Fill Samples: Gradation, ASTM D 422.
   b. Compacted Select Fill: Compaction, ASTM D 698 and ASTM D 1556.
3. 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. Contractor shall prepare drawings for the following items:
   1. Sheeting and bracing, or other protective system(s).
   2. Dewatering system.

   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.

B. Shop Drawings: Submit the following:
   1. Sheeting and bracing, or other protective system(s).
   2. 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.

C. Samples: Submit for approval the following:
   1. At least two weeks prior to the date of anticipated use, the Contractor shall submit, to the Owner, for approval, a representative sample of all on-site and off-site material required. The Contractor shall notify the Owner in writing of the source of each sample.

D. 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 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 underground 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. They shall be supported and protected

from injury by the Contractor. If they are broken or injured, they shall be restored immediately by the Contractor at no additional cost to the Owner.

2. Prior to execution of the Work, the Contractor shall 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.
3. The Contractor shall establish benchmarks on all existing structures and submit the benchmark elevations to the Owner. The Contractor shall 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. The Contractor shall 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. The Contractor shall 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, undermining, 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: The Contractor shall conduct all of his operations and maintain the area 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, the Contractor shall 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 backfill and fill, free of organics, clay, rock or gravel larger than 3 inches in any dimension, debris, waste, frozen 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 FILTER FABRIC:

A. Filter fabric shall be placed below or under the drainage material as shown on the Drawings.

B. Filter fabric shall be a non-woven polypropylene material, needle punched or spunbonded fabric.

C. Filter fabric material, of non-woven plastic cloth meeting the following requirements, shall be installed as shown on the Contract Drawings.

Equivalent Opening Size	80-100 (U.S. Standard Sieve)
Open Area (%)	20-40
Pore Size Range (MM)	0.10 To 0.18
Thickness (mils)	30
Grab Strength (lbs)	120 (Minimum)
Grab Elongation (%)	70
Burst Strength (psi)	125
Trapezoid Tear Strength (lbs)	70
Water Permeability	
Coefficient (K-cm/sec)*	0.07
Water Flow Rate (gal/min-ft2)	480
Weight (ms/m2)	140 (Minimum)

*According to CFMC-FFET-2, "Falling-Head Water Permeability of Filter Fabrics".

D. Filter fabric shall be Mirafi 140S as manufactured by the Celanese Fibers Marketing Company, Celanese Corporation, or equal.

2.03 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 A 328. Steel for soldier piles, wales and braces may be new or used and shall conform to ASTM A 36.
   2. Permanent Work: New or used rolled steel sections of the continuous interlocking type, conforming to ASTM A 328.

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. The Contractor shall 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.

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. The Contractor shall stockpile and cover excess-stripped topsoil in an area approved by the Engineer.

3.04 EROSION CONTROL

A. General:
   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. The Contractor shall 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.
6. Straw or salt hay mulches should be immediately anchored using peg and twine netting or a mulch anchoring tool or liquid mulch binders.
7. After stabilization remove all straw bale dikes, debris, etc., from the site.
8. Refer to Section 02485, Grassing and Plantings, for locations and types of permanent turf.

3.05 EXCAVATION

A. General:
1. The Contractor shall perform all excavation required to complete the Work as shown and specified. 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.

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 may 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.
4. Where existing piping or ductbank 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.

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 sub grade.
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:

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 subgrade 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.

F. 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.

G. 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:
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. The Contractor shall thoroughly clean wales, braces and all other items to be embedded in the permanent structure, and shall 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:
1. Acceptance by the Engineer of all Work within the excavation.
2. Inspection, testing approval, and recording of locations of underground utilities, connections, branches, structures and other facilities.
3. Removal of temporary shoring and bracing, and backfilling of voids with satisfactory materials.

4. Removal of trash and debris.

B. Excavation shall be kept dry during backfilling operations. Backfills around piping and structures shall be brought up evenly on all sides.

C. General fill and select fill materials shall be placed in layers not exceeding 8 inches in thickness, and each layer shall be compacted as specified below.

D. 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 8 inches in depth and thoroughly compacted before the next layer is placed. Compaction layers shall be 8 inches up to the pipe spring line and 12 inches thereafter in trenches that are not below other pipes, structures, foundations, or paved areas.

E. 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.

F. 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.

G. 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.

H. 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.

I. Crushed Stone Placement:
   1. Crushed stone shall be placed where shown on the Contract Drawings.
   2. Crushed stone shall be placed in hand tamped lifts not to exceed 6 inches.

J. 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.

K. Compaction Density Requirements:
   1. Unless otherwise noted, the degree of compaction required for all types of fills shall be 95 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. 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.
   3. Owner’s laboratory will perform tests necessary to provide data for selection and control of fill material placement and water content.
   4. 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.
   5. 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 recompaction until acceptable fill is provided, as determined by the Engineer.

L. The Contractor shall repair any damage, at no additional cost to the Owner, after-settlement that occurs. He shall 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. The Contractor shall remove and dispose off site all unsuitable organic and/or inorganic materials. Within thirty (30) consecutive days after Notice to Proceed, the Contractor shall 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. The Contractor shall 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, the Contractor shall leave the disposal site in a condition acceptable to the Owner of the disposal site.

F. The Contractor shall not dump soil onto those areas designated by the Owner as wetlands or waterways. Each Contractor shall not stockpile or store spoil, materials, tools or equipment on wetlands. Stockpiling of unsuitable organic material is not permitted on site.

3.10 RESTORING AND RESURFACING EXISTING ROADWAYS AND FACILITIES

A. The Contractor shall place 1-1/2 inches of temporary bituminous pavement immediately after backfilling excavations in paved roadways. He shall maintain, in good and safe condition during progress of the entire Work, the surface of the paved area over the excavation, and shall promptly fill all depressions over and adjacent to the excavation caused by settlement of backfill. Immediately prior to constructing the permanent paving and base the Contractor shall remove and dispose of temporary pavement.

B. Pavement, gutters, curbs, walks, driveways and roadways disturbed or damaged by the Contractor's operations shall be restored or replaced by him 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.

3.11 DRAINAGE AND DEWATERING

A. Drainage and Dewatering:
   1. Contractor shall 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 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. Contractor shall install drainage ditches and dikes and shall 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. The diversion and removal of surface water shall be performed 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.
   2. Contractor shall 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, Contractor shall 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, Contractor shall submit details of the methods he proposes 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.

b. Dewatering operations shall not be discontinued without the prior authorization of the Engineer.

c. 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.

B. Disposal of Water Removed by Dewatering System:

1. Contractor's Dewatering System shall discharge to location directed by COUNTY, in accordance with State and Federal regulations.
2. 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.
3. Dispose of water in such a manner as to cause no inconvenience to Owner, Engineer, or others involved in Work about the Site.
4. Convey water from the construction Site in a closed conduit. Do not use trench excavations as temporary drainage ditches.

END OF SECTION 02200

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PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Crushed stone aggregate base course.

1.02 RELATED SECTIONS

A. Section 02200 - Earthwork.

1.03 REFERENCES

A. ANSI/ASTM C88 - Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.

B. ANSI/ASTM C136 - Sieve Analysis of Fine and Coarse Aggregates.

C. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb Rammer and 18-inch Drop.

D. ASTM D4318 - Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.04 SUBMITTALS

A. Submit under provisions of Section 01330.

B. Test Reports: Submit a sieve analysis for the aggregate base course used.

1.05 DELIVERY, STORAGE and HANDLING

A. Deliver, store and handle products to the site under provisions of Section 01650.

B. Do not handle aggregate in any manner which will cause segregation of large or fine particles.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Coarse Aggregate: Angular, crushed, natural stone with crushed stone screenings; free of shale, clay, friable materials and debris; graded in accordance with ANSI/ASTM C136 within the following limits:

Sieve Size	% Passing
1-1/2 inches	100
1 inch	90-100
1/2 inch	65-85
3/8 inch	55-75
No. 4	40-55
No. 8	30-45
No. 16	22-36
No. 30	16-27
No. 50	12-19
No. 100	7-13
No. 200	3-7

B. Material retained on the 1/2 inch sieve is coarse aggregate.

C. Coarse aggregate when subjected to 5 cycles of the soundness test in accordance with ANSI/ASTM C88 shall have a weight loss of not more than 5 percent with sodium sulfate or 10 percent with magnesium sulfate.

D. The portion of the aggregate base course which passes the No. 50 screen shall have a plasticity index of zero as tested in accordance with ASTM D4318.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify existing conditions and substrate.

B. Verify elevations of subgrade are as indicated on the plans.

C. Verify that subgrade is properly compacted and ready to receive work of this section.

D. Beginning work of this section means acceptance of existing conditions.

3.02 PREPARATION

A. Fine grade and compact subgrade to 95 percent maximum dry density in accordance with ANSI/ASTM D1557.

3.03 AGGREGATE PLACEMENT

A. Spread course aggregate over prepared subgrade to a total compacted thickness as indicated on the plans.

B. Place aggregate in 3 inch layers and compact by roller.

C. Level and contour surfaces to elevations and gradients indicated.

D. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.

E. Compact placed aggregate materials to 95% maximum dry density in accordance with ANSI/ASTM D1557. Maintain optimum moisture content to attain required density.

F. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.

G. Use mechanical vibrating tamping in areas inaccessible to compaction equipment.

H. New pavement must be placed on the properly compacted aggregate base course within 24 hours of final compaction. If aggregate base course is left open for more than 24 hours, recompact and retest in accordance with ANSI/ASTM D1557.

3.04 TOLERANCES

A. Maximum Variation From Flatness: 1/4 inch measured with 10 foot straight edge.

B. Maximum Variation From Scheduled Compacted Thickness: 1/4 inch.

C. Maximum Variation from True Elevation: 1/4 inch.

3.05 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of Section 01450.

B. Compaction testing will be performed in accordance with ANSI/ASTM D1557.

C. If tests indicate work does not meet specified requirements, remove work, replace and retest at no cost to Owner.

D. Frequency of Tests: One test per 500 sq ft. immediately prior to paving.

END OF SECTION 02231

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PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Work of this Section includes dewatering for structures, tanks, manholes, and all other underground pipelines and utilities.

B. The costs associated with work of this Section shall be included in the price as bid.

C. All costs associated with satisfying the requirements of the NYSDEC shall be solely borne by the Contractor.

D. No time extensions will be granted for the Contractor's failure to obtain the permit in accordance with the Contractor's own schedule and sequence of construction as may have been anticipated prior to the submission of the bid.

1.02 PROJECT CONDITIONS

A. Groundwater Levels: The Bidder shall be solely responsible to ascertain the exact level of groundwater prior to bid. Water levels, if shown on the Plans, solely represent the levels obtained at the time and specific locations of soil borings, monitoring wells, or test holes. They are not intended to be indicative of levels to be found at locations other than that shown. Separate payments will not be made to the Bidder / Contractor for the cost of ascertaining groundwater or surface water levels and for dewatering operations. The Bidder shall contact the Engineer at least ten (10) working days prior to the date set for the bid opening so that access to the site can be arranged allowing the Bidder to conduct explorations and investigations.

B. Subsoil Conditions: The Contractor shall be solely responsible to ascertain the exact nature of soils near the excavation(s), as it affects the design of the dewatering conditions. All costs for preliminary test borings, if any, shall be included in the price as-bid.

C. Noise Control: When dewatering systems utilizing well points or central pumping systems are used, acoustically shield pumping equipment from neighboring buildings. Use Styrofoam or other sound absorbing material on the inside of the enclosure surrounding the pump. Provide an exhaust stack extension when required by the Engineer. The Engineer will not permit the use of loud pumps generating excessive emissions and/or noise. Comply with the requirements of Section 01568 – Environmental Protection.

D. The Contractor shall supply power to all dewatering equipment by use of a suitably sized portable generator. Temporary electric shall be furnished and installed as work of Contract E.

E. Dewatering operations shall be conducted by companies regularly engaged in this type of work, are experienced, and are knowledgeable with governing health, labor, and environmental regulations associated with dewatering operations.

1.03 REGULATORY REQUIREMENTS

A. Apply, obtain, and pay for permits required by regulatory agencies. All associated costs including reports, plans, applications, and engineering fees shall be included in the price as bid.

B. The Contractor shall discharge water removed from trenches and excavations in compliance with the requirements of regulatory agencies and the Owner.

C. The Owner makes no representation that water removed from excavations can be disposed of readily or without expense associated with conveyance and/or treatment prior to discharge. The Contractor, by submitting a bid, has satisfied himself/herself that disposal of water can be discharged (returned to groundwater or surface water) in accordance with all regulatory requirements.

D. Well pointing shall be carried out by registered well drillers in accordance with Section 15-1525 of New York State Environmental Conservation Law.

E. The type of dewatering system shall be selected by the Contractor, as necessary to install the work. The method of dewatering to be used will depend upon subsoil conditions and the depth of water encountered. The method of dewatering and treatment system, if necessary, is at the sole discretion of the Contractor.

F. Conduct dewatering operations and groundwater recharge so as not to cause a harmful effect on adjoining wetlands in compliance with the requirements contained in Section 01568.

1.04 SUBMITTALS

A. Prior to submitting information to the NYSDEC, the Contractor shall submit to the Engineer, for review and comment purposes only, the proposed layout of the dewatering system together with proposed sampling protocols that are to be followed by the Contractor in order to secure the required permits and approvals.

B. Submit to the Engineer, for record purposes only, the proposed layout of the dewatering system together with any subsurface explorations, sampling and testing results, or studies that may have been conducted by the Contractor in order to secure the required permits and approvals.

C. The Contractor shall provide a copy of the dewatering permit as issued by the New York State Department of Environmental Conservation to the Engineer for record purposes.

PART 2 – PRODUCTS (NOT USED)

PART 3- EXECUTION

3.01 INSTALLATION

A. Dewater trenches and excavations when ground or surface water is encountered in the installation of pipe, foundations, structures, or appurtenances.

B. Furnish all piping, pumps, electrical systems and equipment, well pointing equipment, materials and labor required to properly well point or sump excavations in order to eliminate ground and surface water or precipitation from entering the excavation area during construction.

3.02 PERFORMANCE

A. All water removed from the trenches or excavations by pumping, bailing, siphoning, well-points, or other means shall be disposed of in such a manner so as to avoid interference with wetlands, environment, plant operations, pedestrian and vehicular traffic and so to prevent damage to persons or property.

B. Unless otherwise permitted, groundwater encountered within the limits of excavation shall be depressed to an elevation not less than twelve inches below the bottom thereof before pipe laying or concreting is started, and shall be so maintained until concrete and joint material have attained adequate and specified strength. Dewatering operations shall be continuous (24 hours per day, 7 days per week) unless otherwise noted on the Contract Drawings. Dewatering

operations shall be continued until the entire structure is backfilled to the grades required by the Contract Documents.

C. The Contractor shall not discharge water from dewatering operations directly into any live or intermittent stream, channel, wetlands, surface water or storm sewer without the approval of the NYSDEC.

D. Water from dewatering operations shall be treated by chemical treatment, physical treatment, filtration, settling basins, or other NYSDEC approved methods to reduce the amount of contaminates, sediment, and/or pollution contained in the water to allowable levels, as determined by the State.

E. Upon completion of the portion of the work wherein the operations have been performed, the Contractor shall remove from the catch basins, sumps, ditches or water courses, all mud, silt, debris and other accumulations discharged to these various locations. The Contractor is responsible for leaving them in a condition similar to that which existed prior to his operations to the satisfaction of the regulatory agency. Proper control measures shall be employed, to minimize siltation and erosion in and adjacent to the area of the Work at all times.

F. Locate dewatering pumps as far as possible from residential structures. The pumps shall be housed in noise suppression enclosures. If the operation noise levels, as determined by the Engineer, are still excessive, the Contractor shall, at the discretion and direction of the Engineer, apply damping compound to the external portion of the enclosure.

G. The Contractor is hereby advised that during the dewatering process, in some instances, as directed by the Engineer, the quantity of water to be discharged will have to be limited so that flooding will not occur.

H. Dewatering shall continue as required to avoid floatation to structures until completed, unless other positive measures, such as flooding sleeves, can be used.

3.03 PROTECTION

A. Provide adequate protection from the affect of possible uplift due to storm or groundwater where buoyancy might lift installed work or cause joint or structure failure during construction. Provide back-up equipment where pump failure could result in damage to installed work.

B. Protect the interior of installed work from the entering and accumulation of liquids, ice, and snow. Immediately remove and dispose any accumulation that may occur.

3.04 CLEANING

A. Upon completion of all work, remove from the gutters, catch basins, drains, and manholes all debris and other accumulations, leaving them in a condition equal to or better than that, which existed prior to the work. Restore any pavement, shoulder or other areas disturbed or damaged by the installation of the dewatering system.

END OF SECTION 02240

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PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies requirements for the construction and maintenance of various temporary soil erosion and sediment control measures, including relocation as required for staged construction.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM) ASTM C 33 Specification for Concrete Aggregates

1.03 REQUIREMENTS

A. Environmental Requirements
   1. Apply dust retardants other than water only when wind velocity is less than 5 mph and drift hazard is negligible.
   2. Conform to "Seeding Calendar Limitations" of the Section entitled "SEEDING".
   3. Use Dust Retardant or other approved methods for temporary surface stabilization of short duration where establishing grass by seeding is not practical.

B. Construction Requirements
   1. The Contractor shall employ soil erosion and sedimentation control measures during the duration of the contract to control erosion and minimize the sedimentation of water courses on the construction site.
   2. The Contract Drawings do not include borrow pits or storage areas that the Contractor utilizes or establishes outside of the site in order to perform the Work. If the land disturbance for this Work is five thousand square feet (5,000 SF) or greater, the Contractor shall provide the Engineer with documentation that a soil erosion and sediment control plan has been approved for this Work by the appropriate Soil Conservation District of the New York State Department of Environmental Conversation.
   3. The Contractor shall incorporate all permanent pollution control features into the project at the earliest practicable time. Temporary soil erosion and sediment control measures shall be coordinated with the permanent pollution control features and with the construction of pavement, drainage facilities such as pipes, culverts, headwalls, channels, ditches, etc., to the maximum extent practical to assure economical, effective and continuous erosion control throughout the duration of the Contract, as outlined in the approved progress schedule.
   4. Prior to all grubbing operations, soil erosion and sediment control measures shall be installed. When unstabilized areas caused by site development, grading, or other earth disturbing activities exist beyond 14 calendar days, the areas disturbed shall be seeded and mulched. These requirements pertain to perimeter controls, berms, dams, swales, ditches and slopes. Upon completion of the grading or construction, disturbed areas shall be permanently stabilized in accordance with the Contract Drawings within 7 calendar days.
   5. When excavation or embankment construction reaches the finished subgrade, those areas on which paving is to be placed are exempt from the above stabilization requirements. Roadways and haul roads actively being used for daily conveyance of equipment as well as areas between temporary berms, except median areas, are also exempt unless otherwise shown on the Contract Drawings.
   7. The turbid discharge from dewatering construction activities shall be contained in a dewatering basin in order to control sediment and provide filtration of water prior to it being released into adjacent streams or other watercourses.

8. Soil being stockpiled shall be placed in well-drained areas no closer than 50 feet from streams, wetlands, floodplains and other watercourses, unless otherwise directed by the Engineer. The stockpiles shall be seeded and mulched in accordance with the Contract Drawings. Temporary soil erosion and sediment controls shall be provided around the stockpiles until such time as vegetation is established on the piles.
9. Temporary soil erosion and sediment control measures shall be used to correct conditions that develop during construction.
10. In the event that temporary soil erosion and sediment control measures are required due to the Contractor's failure, for any reason, to install or maintain soil erosion and sediment controls, either as part of the work or as directed by the Engineer, such Work shall be performed by the Contractor at no additional cost to the Authority.
11. If the Contractor is not in compliance with soil erosion and sediment control provisions, corrective actions shall be taken immediately. The Engineer may suspend the Work, wholly or in part, until such time as the Contractor is fully in compliance. All corrective and remedial work required to bring the Contractor into compliance shall be performed at no additional cost to the Authority.
12. Temporary soil erosion and sediment control measures shall be removed when necessary to allow for the installation of permanent control features or as permanent controls become functional. Before issuance of a Certificate of Final Completion, all items used for temporary soil erosion and sediment control shall be removed unless otherwise shown on the Contract Drawings.

1.04 QUALITY ASSURANCE

A. Progress Schedule
1. The Contractor shall prepare a progress schedule for the Engineer's approval in accordance with Division 1 of the Specifications.
2. The progress schedule shall clearly outline the intended maintenance of traffic, the locations where temporary and permanent soil erosion and sediment control measures shall be installed, and such other information as required. The progress schedule shall give special consideration to sensitive areas such as wetlands, waterways, etc. Appropriate staging and seasonal constraints shall be used to maximize the effectiveness of the soil erosion and sediment controls. The progress schedule shall also indicate when Work is restricted in these sensitive areas as outlined in permits issued by regulatory agencies.

B. Soil Erosion and Sediment Control Manager
1. The Contractor shall assign to the project a supervisory-level employee to serve in the capacity of Soil Erosion and Sediment Control Manager. This employee shall be thoroughly experienced in all aspects of soil erosion and sediment control and construction. The Contractor shall submit the name and experience of this employee to the Engineer for approval at least 10 working days prior to commencing any Work on the project. Replacement of the Soil Erosion and Sediment Control Manager during the Contract shall be made only after approval of a written request for such replacement.
2. The Soil Erosion and Sediment Control Manager shall implement approved soil erosion and sediment control schedules and methods of operations. He shall coordinate his operations with the Engineer and shall oversee and supervise all aspects of soil erosion and sediment control work for the project. He will attend all soil erosion and sediment control meetings during the Contract.

1.05 SUBMITTALS

A. Submit catalog cuts for the following:
1. Geotextiles
2. Pipe for Slope Drains

3. Topsoil Stabilization Matting
4. Dust Retardant

B. Submitcertificatefromgeotextilemanufacturersthatgeotextilescomplywiththe requirements specified in this Section.

C. Submit design computations for sizing of Dewatering Basins prepared by a Professional Engineer, licensed in the State in which the Work will be performed.

E. Submit a Progress Schedule reflecting the requirements of Section 1.04 A.

F. Submit name and applicable experience of Soil Erosion and Sediment Control Manager in accordance with Section 1.04B.

G. Submit alternate methods for stabilizing disturbed areas when seeding calendar limitations apply.

H. Submit documentation of approval of soil erosion and sediment control plan for offsite land disturbance greater than 5000 square feet.

1.06 DELIVERY, HANDLING AND STORAGE

A. Protect materials against damage prior to installation.

1.07 SPARE MATERIALS

A. During construction, the Contractor shall have on hand sufficient spare materials and appurtenances as are necessary to repair damage to permanent and temporary installations.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Geotextiles shall conform to the Section entitled "Geotextiles". Unless otherwise shown on the Contract Drawings, geotextiles shall have a maximum Apparent Opening Size of 0.6 mm. and minimum permeability of 1 x 10-3 cm/sec.
   1. Silt Fences and Inlet Filter Sediment Control shall be "Self Supported".
   2. Geotextiles for other Soil Erosion and Sedimentation Control items shall be "Erosion Control - Class A".

B. Wood stakes, posts and boards shall be solid, reasonably knot-free lumber conforming to the nominal size specified on the Contract Drawings.

C. Hay bales shall consist of timothy, red top or native grasses securely bound with wire or baling twine. The twine shall be an ultra-violet light stabilized polypropylene which has a knot strength of 170 pounds and straight break strength of 300 pounds.

D. Riprap shall be broken stone (argillite, calcite, dolomite, gneiss, granite, quartzite, traprock). Unless otherwise shown on the Contract Drawings, riprap shall have a designated median stone (D50) size in the range of 6 to 9 inches maximum dimension, weighing not more than 150 pounds, with at least 90% weighing more than 25 pounds but not more than 40% exceeding 100 pounds, having the following characteristics:

Characteristic	Max. %
Weathered decomposed stone	5
Other than that classification approved	5
Absorption in cold water	1.8
Sodium sulfate soundness, loss by weight	10

E. Coarse aggregate shall be broken stone or washed crushed gravel meeting the specification for rip rap except for size and weight requirements. Size and gradation shall be as shown on the Contract Drawings.

F. Welded wire fabric shall conform to AASHTO M55 flat sheets or rolls.

G. Pipe for temporary slope drains shall be minimum 8-inch diameter of type shown on the Contract Drawings.

H. Seed and mulch shall be as specified in the Section entitled "SEEDING".

I. Topsoil Stabilization Matting: Topsoil stabilization matting shall be one of the following:
   1. Excelsior mat shall be wood excelsior, 48 + 1 inch in width and weighing 0.8 pounds per square yard, + 5 percent. The excelsior material shall be covered with a netting to facilitate handling and to increase strength and shall be biodegradable.
   2. Jute mat shall be cloth of a uniform plain weave of undyed and unbleached single jute yarn, 48 + 1 inch width and weighing an average of 1.2 pounds per linear yard of cloth with a tolerance of + 5 percent, with approximately seventy-eight warp ends per width of cloth and forty-one weft ends per linear yard of cloth. The yarn shall be of a loosely twisted construction having an average twist of not less than 1.6 turns per inch and shall not vary in thickness by more than one half its normal diameter.

J. Dust Retardant
   1. "Coherex" as manufactured by Golden Bear Division of the Witco Corporation, Chandler, AZ 85244.
   2. "Soil-Sement" as manufactured by Midwest Industrial Supply, Inc., Canton, OH, 44711.
   3. "Soil Seal Concentrate" as manufactured by Soil Seal Corporation, Los Angeles, CA, 90017.
   4. Or approved equal.

K. Calcium Chloride shall be Grade 2, in the form of loose dry granules or flakes, and shall be fine enough to feed through commonly used spreaders at the specified rates.

2.02 CONSTRUCTION FEATURES

A. Silt Fence
   1. Silt fence shall consist of geotextile whose width shall be at least 3 feet to provide for a 2 foot high fence after 1 foot of fabric is buried in the existing soil. Heavy duty silt fence shall consist of geotextile whose width shall be at least 4 feet to provide for a 3 foot high fence after 1 foot of fabric is buried in the existing soil. Sections of fabric shall be joined in such a manner that, when in operation, the sections work effectively as a continuous fence. Fence posts shall be installed at a slight angle toward the anticipated runoff source.
   2. Heavy duty silt fence shall include a welded wire mesh backing for the geotextile. This welded steel wiremeshshallbegalvanizedandcontain4inchsquare openings. The geotextile shall be secured to the welded wire mesh.

B. Haybale Check Dams with Temporary Stone Outlets

1. Haybales shall be embedded 4 inches into the ground and anchored in place with 2 wood stakes per bale. The temporary stone outlets, consisting of riprap stones conforming to the requirements for temporary riprap, shall be placed in the center of each flow line. Coarse aggregate, conforming to ASTM C-33 size No. 2, shall be placed immediately upgrade of each stone outlet.
2. The riprap stones and coarse aggregate shall be placed on geotextile, and shall be embedded into the ground. When sections of geotextile need to be joined, the sections shall be overlapped a minimum of 18 inches in the direction of flow.

C. Temporary Stone Check Dams
1. Temporary stone check dams shall be constructed in ditches to reduce flow velocity.
2. The check dams shall consist of riprap stones conforming to the requirements for temporary riprap. Coarse aggregate, conforming to ASTM C-33 size No. 2, shall be placed immediately upgrade of each check dam.
3. The riprap stones and coarse aggregate shall be placed on geotextile and shall be embedded in the ground. When sections of geotextile need to be joined, the sections shall be overlapped a minimum of 18 inches in the direction of flow.

D. Temporary Slope Drains
1. Temporary slope drains shall be installed on embankment slopes to intercept surface runoff where concentrated runoff will cause excessive erosion of the slope.
2. The drain pipe shall be staked to the slope or secured with riprap stones to prevent movement or displacement. A flared end section shall be attached at each end of the pipe and elbows shall be installed as required to conform wit h the existing changes in slopes.
3. A temporary earth berm and haybales shall be constructed at the top of slope in the vicinity of the slope drain to intercept runoff and channel the runoff to the slope drain. The haybales shall be embedded 4 inches into the ground and anchored in place with 2 wood stakes per bale.
4. Riprap stones, conforming to the requirements for temporary riprap, shall be placed loosely at both ends of the pipe to prevent scour. The riprap stones shall be placed on geotextile which, at the top of slope, shall be draped over the earth berm. When sections of geotextile fabric need to be joined, the sections shall be overlapped a minimum of 18 inches in the direction of flow.

E. Inlet Filters
1. For existing inlet structures, geotextile shall be placed under the grates, over the curb pieces and extend a minimum of 6 inches beyond. Coarse aggregate, size No. 8, shall be placed behind each curb piece and on the geotextile to secure the in place.
2. Openings required in new inlet walls to provide for temporary drainage shall be covered with welded wire mesh, geotextile and coarse aggregate, size No. 8.
3. Inlet filters, consisting of welded steel wire mesh and geotextile shall be installed to control sedimentation at new inlet drainage structures. Inlet filters of geotextile alone shall be installed to control sedimentation at existing inlet drainage structures.
4. For new inlet structures, welded steel wire mesh shall be molded around the inlet frames and grates, or inlet structures, and extend a minimum of 6 inches down each side of the new structures. Geotextile shall then be secured to the welded wire mesh. Coarse aggregate, size No. 8, shall be placed against the inlet structures to hold the inlet filter in place.
5. Inlet filters shall be removed before scheduled paving operations begin.

F. Inlet Protection (Haybale Barrier)
1. Inlet protection (haybale barrier) shall consist of haybales which completely encircle inlet drainage structures. The perimeter length of the haybale barrier shall be at least four times the perimeter length of the inlet structure. Haybales shall not encroach into the traveled way.

2. Haybales placed around inlet structures within earthen areas shall be embedded 4 inches into the ground and anchored in place with 2 wood stakes per bale. Haybales placed around inlet structures within pavement areas shall be placed on top of the pavement, tied together to prevent movement and shall not be anchored in place.

G. Inlet Sediment Traps
1. Inlet sediment traps, consisting of silt fence and temporary stone inlets, shall be constructed to control sedimentation at existing and proposed inlet drainage structures.
2. The silt fence shall consist of geotextile whose width shall be at least 3 feet to provide for a 2 foot high fence after 1 foot of geotextile is buried in the existing soil. Sections of geotextile shall be joined in such a manner that, when in operation, the sections work effectively as a continuous fence. The silt fence shall be installed around the drainage structure and into the stone inlets. Fence posts shall be installed at a slight angle toward the anticipated flow.
3. The temporary stone inlets, consisting of coarse aggregate, conforming to ASTM C-33 size No. 2, shall be placed in each flow line upgrade of the inlet structure. The coarse aggregate shall be placed on geotextile which shall be buried in the soil. When sections of geotextile need to be joined, the sections shall be overlapped a minimum of 18 inches in the direction of flow.

H. Temporary Stone Outlet Sediment Traps
1. Temporary stone outlet sediment traps, consisting of temporary basins and riprap spillways, shall be constructed within existing, proposed and temporary ditches.
2. The spillways shall consist of riprap stones conforming to the requirements for temporary riprap. Coarse aggregate, conforming to ASTM C-33 size No. 2, shall be placed immediately upgrade of the spillways.
3. The riprap stones and coarse aggregate shall be placed on geotextile which shall be buried in the soil. When sections of geotextile need to be joined, the sections shall be overlapped a minimum of 18 inches in the direction of flow.

I. Dewatering Basin
1. Dewatering basins shall be constructed within the Site and outside any undisturbed wetland area, and areas not affected by roadway construction, as a dewatering containment measure in order to control sediment and provide filtration of water.
2. The dewatering basins shall be sized by the Contractor to entirely contain the expected discharge of water and sediment based on the flow rate of the pump to be used and the volume of water present within the area to be dewatered. The material to be used to form the basin is at the discretion of the Contractor. The outfall of the basin shall be such that the water exiting the basin does not cause erosion to, or scouring of, the area onto which the water is being discharged.

PART 3 - EXECUTION

3.01 PREPARATION

A. Clearing and grubbing operations shall be so scheduled and performed that grading, mulching, seeding and other permanent pollution control features can follow immediately thereafter according to the approved progress schedule. Should seasonal limitations make such coordination unattainable, additional temporary soil erosion and sediment control measures shall be performed between successive construction stages, as directed.

B. The amount of surface area of erodable earth material exposed at one time by clearing and grubbing, excavation, borrow or fill operations, without stabilization, shall not exceed 750,000 square feet for clearing and grubbing operations, or 750,000 square feet for grading operations without prior approval. The Engineer may increase o r decrease these amounts commensurate with the Contractor's ability to keep the construction on the approved progress schedule.

C. Obtain the Engineer's approval before starting any operations which would require seeding for stabilization when seeding is restricted by the calendar limitations of the Section entitled "SEEDING". Approval will be based on the Contractor's alternate method for stabilizing disturbed areas when seeding is not reasonable due to seasonal constraints. The alternate method shall be approved by the Engineer before implementation and may include use of the Dust Retardant or other methods.

3.02 INSTALLATION

A. Embankment Areas
   1. Side ditches shall be excavated and stabilized, and perimeter soil erosion and sediment controls installed, before beginning all earthwork. Stabilization for the ditches and swales shall consist of seed, mulch, topsoil stabilization matting or temporary riprap, as required to prevent erosion.
   2. Embankment greater than 25 feet in height shall be stabilized in stages of equal increments not to exceed 15 feet. Each stage shall be either temporarily seeded and mulched, or permanently stabilized, before proceeding with the next stage. At the completion of the final stage of embankment placement, the entire slope, if not previously done, shall be permanently stabilized.
   3. At the end of each work day, temporary stabilized earth berms and slope drains shall be constructed along the top edges of the embankment to intercept surface runoff.

B. Excavation Areas
   1. Ditches to be used in a cut section, and side and outlet ditches, shall be excavated and stabilized, and perimeter soil erosion and sediment controls installed, before beginning all earthwork. Stabilization for the ditches shall consist of seed, mulch, topsoil stabilization matting or temporary riprap, as required to prevent erosion.
   2. Slopes greater than 25 feet in height shall be excavated and stabilized in stages of equal increments not to exceed 15 feet. Each stage shall be permanently stabilized before proceeding with the next stage, in accordance with the time limitations specified herein.

C. Dust Control
   1. Employ construction methods and means that keep flying dust to a minimum. Provide for the laying of water or other dust control materials on the project and on roads, streets and other areas immediately adjacent to the project limits, and wherever traffic or buildings that are occupied or in use are affected by such dust caused by his hauling or other construction operations. The materials and methods used for dust control shall be as specified herein or as directed by the Engineer.
   2. Apply Dust Retardant in accordance with the manufacturer's written instructions. Reapply as often as required. Calcium chloride shall not be used in any areas to be seeded or landscaped.
   3. Calcium chloride may only be used on pavement subgrades subject to the approval of the Engineer. Care shall be exercised when using calcium chloride on steep slopes to prevent the calcium chloride from washing into streams or accumulating around plants or in landscape areas. Calcium chloride shall not be applied in solution. Apply calcium chloride at a rate of approximately 1.5 pounds per square yard.

D. Dirt Control
   1. The Contractor shall provide for prompt removal from existing roadways of all dirt and other materials that have been spilled, washed, tracked or otherwise deposited thereon by his hauling and other operations, whenever the accumulation is sufficient to cause the formation of mud, interfere with drainage, damage pavements or create a traffic hazard.
   2. In order to minimize tracking of dirt and other materials onto existing roadways, a stabilized construction driveway shall be constructed at locations where vehicles exit a work site. The construction driveway shall consist of a layer of broken stone, which shall be a minimum 4 inches thick and 100 feet long where practical, and of sufficient width to

serve the intended purpose. The broken stone shall be 2 1/2 – inch nominal size conforming to ASTM C-33 size No. 2. The driveway shall be maintained by top dressing with additional stone, as directed, and shall be removed when no longer required.

E. Seeding
   1. Temporary and permanent seeding shall be in accordance with the Section entitled "SEEDING".

3.03 SOIL EROSION AND SEDIMENT CONTROL MAINTENANCE

A. Soil erosion and sediment control measures shall be maintained during the Contract even when the Work is suspended. Controls shall be inspected immediately after each rain, and any required corrective work shall immediately be performed. Riprap stones, coarse aggregate, silt fence, or haybales damaged due to washouts or siltation shall be replaced.

B. Sediment traps and basins shall be cleaned out when they are 50 percent filled. Silt fences, stone outlet structures, dams, and haybales shall have sediment removed when the sediment reaches 50 percent of the height of the soil erosion and sediment control measure. Sediment removed shall be disposed of in accordance with the Contract Drawings.

END OF SECTION 02272

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PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope Of Work
   1. Provide all required labor, materials, equipment and supervision for installation of helical piles as shown on the Contract Drawings or as directed by the Engineer.
   2. Before starting work, the Contractor shall check and verify governing dimensions and elevations and approximate locations of the existing structures affected by the work.
   3. The tip elevation and capacity of each Helical Pile shall be certified by a licensed Professional Engineer.

B. Coordination:
   1. Review installation procedures under other Sections and Contracts and coordinate them with the Work specified herein.
   2. Notify other contractors in advance of the installation of the Work included herein to provide them with sufficient time for the 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.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Requirements of related work are included in Division 1 and Division 2 of these Specifications.

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. New York State Building Construction Code.

1.04 SUBSURFACE CONDITIONS

A. Information on subsurface conditions is referenced under Division 1, General Requirements.

1.05 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01300 - Submittals, the Contractor shall submit the following:
   1. Full data on type of pile proposed and on other equipment to be utilized, including but not limited to the following:
      a) Installation equipment.
      b) Torque Monitoring Devices.
      c) Helical Pile materials including lead section, extensions and adaptors.
   2. A description and sketch or catalog data of the pile installation rig including: torque motor.
   3. The proposed pile installation sequence referenced to the Contract Drawings pile plan.
   4. Proposed pile installation procedures.
   5. Qualifications of personnel supervising the performance of pile installation.
   6. A pile identification plan, with pile numbers.

B. Installation Records:
   1. Submit two copies of the installation record of each pile to the Engineer not later than two days after installation is completed. Include the project name and number, name of contractors, pile location and pile capacity, date of installation, starting and finishing times,

total installation time, rate of operation of pile installation equipment, pile dimensions, tip elevation, elevation of butt, ground elevation, pile deviation, and any unusual occurrences during pile installation.

2. Submit Record Drawings showing exact location of each pile as installed.

1.06 JOB CONDITIONS

A. Product Delivery, Storage and Handling:
   1. Contractor shall deliver, store, handle and protect all products, materials and equipment in accordance with Section 01600, Delivery, Storage, and Handling, of the Specific Provisions.
   2. Deliver materials to the site in such quantities and at such times to assure the continuity of pile installation operations to the project schedule.

B. Site Information:
   1. Test borings and other exploratory operations may be made by the Contractor at no additional cost to the County, provided such operations are acceptable to the Engineer, in accordance with contract documents.

C. Line and Level:
   1. A benchmark and a base line will be established on the site for the use of the Contractor in establishing lines and levels for the work. The Contractor shall establish and locate all other lines and levels and be responsible for the correct location and deviation measurements of all piles.

D. Protection:
   1. Protect structures, underground utilities and other construction from damage caused by pile installation operations.
   2. When structures are adjacent to pile installation operations, provide surveyed elevation benchmarks on structures where directed by the Engineer before commencing Work. Record and report the elevation of each benchmark while pile installation is in progress. Should benchmark readings indicate any displacement, halt operations and provide corrective action acceptable to the Engineer.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Helical Piles
   1. Each helical pile shall consist of a __ inch diameter galvanized steel pipe pile helical lead, extension sections and new construction bracket as manufactured by MacLean-Dixie or an approved equal.
   2. The lead section shall consist of 2-7/8 inch diameter pipe with a minimum of 1 helical formed plate welded to it. The pipe shall be steel with a hot dipped galvanized coating. The smallest helix size shall be a minimum of 8 inches. The lead section unit shall be the load carrying element that transfers the load to the soil.
   3. The termination end of the extension shall consist of 2-7/8 inch diameter steel pipe, with hot dipped galvanized coating. Each extension shall be provided with a means for coupling to the lead or to another extension. Each coupling shall be provided with the proper bolts and nuts. Extension lengths shall be chosen by the Contractor as required for installation.
   4. All bolts shall be in accordance with ASTM A325. All welding shall be done by certified welders in accordance with ASW D1.1.
   5. All material shall be hot dipped galvanized in accordance with ASTM A153. All galvanizing of welded areas shall be cleaned and coated with approved galvanizing compound.

PART 3 - EXECUTION

3.01 PRE-INSTALLATION WORK

A. Installer must examine the areas and conditions wherever piles are to be installed.

B. Site Conditions: Do not install piles until earthwork in area which piles are to occupy has been completed, as follows:
   1. Excavations: Earth excavation shall be complete to the bottom of cap before piles are installed.

C. Fills: Fills shall be constructed and compacted to the bottom of pile cap prior to pile installation.

D. Demolish existing building, slabs, where required.

3.02 INSTALLATION

A. General
   1. The installation and of all helical piles shall be done under the supervision of the Engineer.
   2. Helical Piles shall be carefully located as shown on the Contract Drawings and installed to a minimum tip elevation of -. Helical piles shall be installed to an ultimate capacity of (__) tons.
   3. The Contractor shall accurately locate the installation point of each helical pile.
   4. Throughout the installation, constant down pressure shall be maintained and torque shall be applied in a smooth, continuous manner. The rate of helical pile installation rotation shall be in the range of 3 to 20 revolutions per minute.
   5. If the minimum torque requirement has not been satisfied at the minimum depth, the Contractor shall continue installation using additional extension material until specified minimum torque levels are obtained.

B. Equipment
   1. A torque indicator shall be used for all installations. The minimum installed capacity shall be as indicated on the Contract Drawings.
   2. Installation equipment shall have a maximum torque capability. Installation units shall consist of rotary type, torque motor with forward and reverse capability. Installation equipment shall be in good working order and shall be safe to operate.
   3. Installation equipment shall be grounded as required.
   4. Adapters shall be employed to safely connect the installation units to the helical piles.
   5. The torque being applied by the installing units shall be monitored throughout the installation process.

C. Obstructions
   1. If underground obstructions are encountered during installation, the Contractor shall remove and relocate the helical pile. The Contractor shall submit for approval the new location of the helical pile and any revisions to the pile caps or grade beams.
   2. If the helical pile is damaged and cannot be reused as determined by the Engineer, an additional helical pile shall be installed at a new location. The Contractor shall incur all costs associated with additional helical piles required to replace those damaged during installation.
   3. Piles which are damaged due to mishandling during delivery or installation shall be replaced with new piles at the Contractor's expense.
   4. The Contractor shall accurately locate all existing and new buried pipes or structures within the project area prior to helical pile installation. Care shall be taken to prevent damage to buried piping and structures due to pile installation. Any damage caused to

buried piping and structures resulting from pile installation shall be repaired to the satisfaction of the Engineer at the Contractor's expense.

3.03 MEASUREMENT AND PAYMENT

A. The unit of measurement for Helical Piles shall be per linear foot of accepted pile installed. The measured length shall be from tip elevation to cut-off elevation. Payment for Helical Piles shall be made at the unit price bid.

END OF SECTION 02365

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope:
   1. The Contractor shall provide all labor, materials, equipment and incidentals 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 existing shrubs and trees from areas of new construction, store and re-plant on-site where directed by Engineer.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate the installation of items that shall be installed with the landscaping.
   2. Obstructions Below Ground and Utilities: Exercise extreme caution in all operations, as there are underground electric 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. Subcontractor Qualifications:
   1. Subcontract the Work to a single firm specializing in landscape work. Provide the services of an experienced foreman, who will personally supervise all Work.

B. Source Quality Control:
   1. Analysis and Standards: Package standard products with manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Analytical Chemists, wherever applicable or as further specified.
   2. Topsoil stockpiled for reuse: Topsoil will be inspected by the Engineer before reuse. At the time of inspection, the Engineer may require 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, as a result of this analysis, they shall be corrected 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 stripping, transportation and planting.
5. Cut and move sod only when soil moisture conditions are such that favorable results can be expected.
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.

C. Reference Standards: Comply with applicable provisions and recommendations of the following, except where otherwise shown or specified.
1. ASTM C 602, Agricultural Liming Materials.
2. ASTM D 2487, Classification of Soils for Engineering.
3. Association of Official Analytical Chemists, Official Methods of Analysis.
4. Official Seed Analysists of North America, Standards of Quality.
5. FSO-F-241D, Fertilizer, Mixed, Commercial.
6. FSO-P-166E, Peat Moss; Peat, Humus; and Peat, Reed-sedge.

1.03 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. Planting schedule showing scheduled dates for each type of planting in each area of Site.
2. 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.
3. 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 organic matter minimum.
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 locations 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.

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.

1.05 GUARANTEE

A. Guarantee turf through the specified maintenance period.

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. Topsoil shall be stockpiled 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
      1/4-inch: 97-100 percent passing
      No. 100: 40 to 70 percent passing
      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:
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; approximate 0-20-0 formulation, 18 percent available phosphoric acid.
3. Commercial Fertilizer: Complete fertilizer of neutral character, 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 superphosphate, bone, or tankage. Potash derived from muriate of potash, containing 60 percent potash.

Uniform in composition, freeflowing 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 phosphoric 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 content, and inert material. Seed shall be labeled in conformance with U.S. Department of Agriculture rules and regulations under the Federal Seed Act. Seed that has become wet, moldy, or otherwise damaged will not be acceptable. 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				
Proportions of Mixture	Mixture Tolerance		Germination Tolerance	
	Minus	Plus	Germination	Minus
25% Lynn Rye	3%	5%	90%	6%
25% Baron Blue	3%	5%	85%	7%
25% Penn Fine Rye	3%	5%	90%	6%
25% Mustang Fescue	3%	5%	90%	6%

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

MIXTURE B				
Proportions of Mixture	Mixture Tolerance		Germination Tolerance	
	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.

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 Weyerhauser Corporation.

3) Or equal.

2. Water: Potable.

3. Steel Edging: Commercial steel edging fabricated in sections with loops pressed from or welded to face of sections to receive stakes. Provide tapered steel stakes 16 inches long. Finish edging sections and stakes with manufacturer's standard black paint. Provide edging of the following cross-section size:

a. 4 inches by 1/8 inch.

4. Gravel: Hard, durable, well graded stone washed free of loam, sand, clay and other foreign substances, and of the following size, range, and color:

a. Size Range: 1-1/2 inch maximum, 3/4-inch minimum.

b. Color: Uniform tan beige color range.

c. Product and Manufacturer: Provide one of the following:

1) No. 245 Camel Brown as manufactured by George Scholfield Company, Incorporated.
2) Or equal.

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.

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.

PART 3 - EXECUTION

3.01 INSPECTION

A. The Contractor and his installer shall examine the subgrade, verify the elevations, observe the conditions under which the grassing and gravel 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. Layout individual tree and shrub locations and areas for multiple plantings as directed by the Engineer. Stake locations and outline areas and secure the Engineer's acceptance before start of planting work. Make minor adjustments as may be requested. Refer to paragraph 1.1.B. herein for the requirements of coordination by others.

B. 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.

C. 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.
   a. 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.
   a. 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 turfbed areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.

D. 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.
   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.

E. 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. 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. 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 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.
      a. For spring planting, provide additional backfill berm around edge of excavations to form shallow saucer to collect water.

3. 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.
4. Mulch pits, trenches and planted areas. Provide not less than 5-inches of planting bed mulch and finish level with adjacent finish grades.

C. 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.

D. 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.

E. Miscellaneous Landscape Work:
1. Install steel edging between all grassed and graveled areas. Anchor with steel stakes spaced not more than 3 feet on center and driven at least 1 foot below bottom elevation of edging.
2. Place water permeable base film over compacted subgrade prior to placing gravel.
   a. Lap joints 4 inches minimum.
   b. Use one hold-down pin per 4 square feet of film.

c. Take precautions not to tear or puncture base film when placing gravel.

3. Place gravel beds 6 inches deep. Compact soil subgrades before placing gravel.

F. 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. 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.

G. 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 throughly 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. The Contractor shall 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.

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.

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 rejected Work and continue specified maintenance until reinspected by the Engineer and found to be acceptable.

END OF SECTION 02485

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PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Asphaltic concrete paving; wearing, binder or base course.

1.02 RELATED SECTIONS

A. Section 02231 – Aggregate Base Course.

1.03 REFERENCES

A. AI MS-2 - Mix Design Methods for Asphalt Concrete and Other Hot Mix Types.

B. AI MS-8 - Asphalt Paving Manual.

C. ASTM D242 - Mineral Filler for Bituminous Paving Mixtures.

D. ASTM D546 - Test Method for Sieve Analysis of Mineral Filler for Road and Paving Materials.

1.04 SUBMITTALS

A. Submit under provisions of Section 01330.

B. Supplier: Submit name of asphalt supplier to be used on the project prior to placement of any asphalt on the project.

C. Design Data: Submit asphalt mix design for each asphalt type to be used.

D. Testing Firm: Submit name of testing firm to be performing tests on asphalt pavement.

1.05 QUALITY ASSURANCE

A. Obtain materials from the same supplier throughout the duration of the project.

B. Do not alter from mix design requirements.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle products to the site under provisions of Section 01650.

B. Deliver asphalt in sealed, metal containers covered with suitable material to protect the asphalt from the elements.

C. Lightly lubricate the inside surface of the container with a thin oil or soap solution before loading asphalt.

D. All containers must be cleaned of all foreign materials prior to loading.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Do not place asphalt when base surface temperature is less than 40 degrees F, or if surface is wet or frozen.

B. Do not place asphalt when precipitation is occurring.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Asphalt Cement: AC-20; homogeneous, and shall not foam when heated to 347 degrees F.

B. Fine Aggregate: Material passing the 1/8 inch sieve; natural sand of hard, strong, durable particles which are free from coatings or injurious amounts of clay, loam or other deleterious substances.

C. Coarse Aggregate: Material retained on the 1/8 inch sieve; crushed stone or gravel; clean, durable, sharp angled fragments of rock of uniform quality.

D. Mineral Filler: ASTM D242, finely ground particles of limestone, hydrated lime or other mineral dust, free of foreign matter; 100 percent shall pass the No. 30 sieve; a minimum of 85 percent shall pass the No. 80 sieve; and a minimum of 65 percent shall pass the No. 200 sieve as measured in accordance with ASTM D546.

2.02 EQUIPMENT

A. Rollers: Minimum weight of 10 tons; equipped with lubricating devices for the roller wheels.

B. Pavers: Equipped with a vibratory device.

2.03 ACCESSORIES

A. Tack Coat: Homogeneous, medium curing, liquid asphalt.

B. Wheel Lubricant: Oil-water mixture containing maximum 10 percent lubricating oil.

2.04 MIXES

A. Use dry material to avoid foaming. Mix uniformly.

B. Base Course: NYSDOT Type 1; 4.0 to 6.0 percent of asphalt cement by weight in mixture in accordance with the following gradation:

Sieve Size	Percent Passing
2 inches	100
1 ½ inches	90-100
1 inch	78-95
½ inch	57-84
¼ inch	40-72
1/8 inch	26-57
No. 20	12-36
No. 40	8-25
No. 80	4-16
No. 200	2-8

C. Binder Course: NYSDOT Type 3; 4.5 to 6.5 percent of asphalt cement by weight in mixture in accordance with the following gradation:

Sieve Size	Percent Passing
1-1/2 inches	100
1 inch	95-100
1/2 inch	70-90
1/4 inch	48-74
1/8 inch	32-62
No. 20	15-39
No. 40	8-27
No. 80	4-16
No. 200	2-8

D. Wearing Course: NYSDOT Type 6; 5.8 to 7.0 percent of asphalt cement by weight in mixture in accordance with the following gradation:

Sieve Size	Percent Passing
1 inch	100
1/2 inch	95-100
1/4 inch	65-85
1/8 inch	36-65
No. 20	15-39
No. 40	8-27
No. 80	4-16
No. 200	3-6

2.05 SOURCE QUALITY CONTROL

A. Obtain asphalt materials from same source throughout the project.

B. Provide asphalt in accordance with the approved mix design for each type of asphalt.

C. Test samples in accordance with AI MS-2.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify existing conditions and substrate.

B. Verify that compacted subbase is dry and ready to receive work of this section.

C. Verify gradients and elevations of base are correct.

D. Verify that all castings are properly installed and are at the correct elevations.

E. Beginning of installation means installer accepts existing conditions.

3.02 PREPARATION

A. Apply tack coat at uniform rate of 0.03 to 0.07 gal/sq. yd. to contact surfaces of castings, curbs, gutters and any asphalt or concrete material.

B. Do not apply tack coat to wet or frozen surfaces.

C. Coat top surfaces of castings with oil to prevent bond with asphalt pavement.

3.03 INSTALLATION

A. Install work in accordance with AI MS-8.

B. Maintain asphalt temperature between 250 and 325 degrees F during placement.

C. Place asphalt within 24 hours of applying tack coat.

D. Place asphalt to compacted thicknesses as identified on plans. If a multiple course pavement is to be used, place top course within 24 hours of placing bottom course. If more than 24 hours elapse, a tack coat will be required to be placed over the entire surface of the bottom course prior to any additional paving.

E. Utilize the vibratory device on the paver at all times.

F. Compact pavement by rolling. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.

G. Compact pavement to a minimum of 94% maximum density.

H. Develop rolling with consecutive passes to achieve even and smooth finish, without roller marks.

I. Seal all joints between new pavement and existing pavement with asphalt cement.

3.04 TOLERANCES

A. Maximum Variation From Flatness: 1/8 inch measured with 10 foot straight edge.

B. Maximum Variation From Scheduled Compacted Thickness: 1/8 inch.

C. Maximum Variation from True Elevation: 1/4 inch.

3.05 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of Section 01450.

B. Take samples and perform tests in accordance with AI MS-2.

C. Test are to include percent compaction, gradation and asphalt content.

D. Provide an asphalt thermometer for determining the asphalt temperature during paving operations.

E. Frequency of Tests: One test for every 1,000 square feet of each pavement course.

3.06 PROTECTION

A. Protect finished work under provisions of Section 01500.

B. Immediately after placement, protect pavement from mechanical injury until project is accepted by the Owner.

END OF SECTION 02510

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Concrete sidewalks, handicap ramps, driveway aprons.

B. Formwork.

1.02 RELATED SECTIONS

A. Section 02200 - Earthwork.

1.03 REFERENCES

A. ACI 301 - Structural Concrete for Buildings.

B. ANSI/ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement.

C. ANSI/ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.

D. ASTM C33 - Concrete Aggregates.

E. ASTM C94 - Ready Mix Concrete.

F. ASTM C150 - Portland Cement

G. ASTM C260 - Air-Entraining Admixtures for Concrete.

H. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.

I. ASTM C494 - Chemical Admixtures for Concrete.

1.04 SUBMITTALS

A. Submit under provisions of Section 01330.

B. Product Data: Provide data on joint filler, admixtures and curing compounds.

C. Supplier: Submit name of concrete supplier prior to the placement of any concrete on the project.

D. Design Data: Provide a design mix for each type of concrete to be used on the project.

E. Certificates: Submit receipts of all concrete deliveries, indicating source, date, contractor, amount of concrete, concrete strength, truck number and time load was batched.

F. Testing Firm: Submit name of testing firm to be performing tests on concrete.

1.05 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01785.

B. Accurately record locations of each day's concrete pour.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with ACI 301.

B. Obtain concrete only from approved suppliers and maintain the same source throughout the project.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle products to the site under provisions of Section 01650.

B. Deliver concrete in accordance with ASTM C94, Alternative No. 2.

C. Place all concrete within 90 minutes of time load was batched.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Do not place concrete when base surface temperature is less than 40 degrees F, or if surface is wet or frozen.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cement: ASTM C150, air entraining, Type 1A Portland, gray color.

B. Aggregates: ASTM C33.

C. Water: Potable and not detrimental to concrete.

D. Reinforcement: ANSI/ASTM A185 plain welded steel wire fabric; in flat sheets; uncoated finish.

2.02 ACCESSORIES

A. Forms: Douglas Fir plywood type; solid, sound, undamaged sheets.

B. Joint Filler: ANSI/ASTM D1751; 1/2 inch thick.

C. Air Entraining Admixture: ASTM C260.

D. Chemical Admixture: ASTM C494, type as required.

E. Curing Compound: ASTM C309, Type 1, Class A.

F. Form Release Agent: Colorless material which will not stain concrete or absorb moisture.

G. Detectable Warning Surface: SAFTI-TRAX Mats or equal.

2.03 MIXES

A. Concrete shall be mixed and prepared in accordance with the approved mix design and ASTM C94, Alternative No. 2.

B. The mix shall be such that the concrete shall attain the following characteristics:
   1. Compressive Strength (28 days): 4,000 psi.
   2. Slump: 2½ to 3½ inches.

3. Air Entrainment: 6% ±1%.

C. Use chemical admixtures only when approved by the Engineer. Use of admixtures will not relax placement requirements.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify existing conditions and substrate.

B. Verify datum and all elevations are as indicated on the plans.

C. Verify compacted granular subbase has been properly prepared and is ready to receive work of this section.

D. Beginning of installation means installer accepts existing conditions.

3.02 PREPARATION

A. Compact base to minimum 95 percent maximum dry density in accordance with ANSI/ASTM D1557.

B. Moisten base to a minimum depth of 1/2 inch to minimize absorption of water from fresh concrete.

C. Coat surfaces of manhole and catch basin frames with oil to prevent bond with concrete pavement.

D. Place and secure forms to correct location, dimension and profile.

E. Assemble formwork to permit easy stripping and dismantling without damaging concrete. Coat forms with form release agent.

3.03 INSTALLATION

A. Place joint filler vertical in position in straight lines. Secure to formwork during concrete placement.

B. Place reinforcement as indicated on the plans. Interrupt reinforcement at expansion joints.

C. Place concrete in accordance with ACI 301.

D. Ensure reinforcement and formed joints are not disturbed during concrete placement.

E. Place concrete continuously between predetermined construction joints. Do not break or interrupt successive pours such that joints occur.

F. Vibrate concrete adjacent to forms.

G. Place concrete to pattern indicated.

H. Place expansion joints with joint filler at 20 foot intervals.

I. Place scored contraction joints at 4 foot intervals.

J. Place joint filler between paving components and building or other appurtenances and in expansion joints.

K. Apply a light broom finish perpendicular to traffic.

L. Place curing compound on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.

3.04 FIELD QUALITY CONTROL

A. Field inspection and testing shall be performed under provisions of Section 01450.

B. Take six concrete test cylinders for every 50 cu. yds. or fraction thereof of each class of concrete placed each day.

C. Cure test cylinders on site under same conditions as concrete sidewalk.

D. Take one slump test for each set of test cylinders taken.

E. Concrete not meeting slump requirements will be rejected.

F. Concrete represented by cylinders which do not meet required strength will be removed and replaced at no additional cost to the Owner.

3.05 PROTECTION

A. Protect finished work under provisions of Section 01500.

B. Immediately after placement, protect sidewalk from premature drying, excessive temperatures and mechanical injury.

C. Protect sidewalk from damage until project is accepted by the Owner.

END OF SECTION 02521

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Reinforced concrete curb.

B. Formwork.

1.02 RELATED SECTIONS

A. Section 02200 - Earthwork.

1.03 REFERENCES

A. ACI 301 - Structural Concrete for Buildings.

B. ANSI/ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.

C. ASTM A615 - Deformed and Plain Billet Steel for Concrete Reinforcement.

D. ASTM C33 - Concrete Aggregates.

E. ASTM C94 - Ready Mix Concrete.

F. ASTM C150 - Portland Cement

G. ASTM C260 - Air-Entraining Admixtures for Concrete.

H. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.

I. ASTM C494 - Chemical Admixtures for Concrete.

1.04 SUBMITTALS

A. Submit under provisions of Section 01330.

B. Product Data: Provide data on joint filler, admixtures and curing compounds.

C. Supplier: Submit name of concrete supplier prior to the placement of any concrete on the project.

D. Design Data: Provide a design mix for concrete to be used on the project.

E. Certificates: Submit receipts of all concrete deliveries, indicating source, date, contractor, amount of concrete, concrete strength, truck number and time truck load was batched.

F. Testing Firm: Submit name of testing firm to be performing tests on concrete.

1.05 PROJECT RECORD DOCUMENTS

A. Accurately record locations of each day's concrete pours.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with ACI 301.

B. Obtain concrete only from approved suppliers and maintain the same source throughout the project.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver concrete in accordance with ASTM C94, Alternative No. 2.

B. Place all concrete within 90 minutes of time load was batched.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Do not place concrete when base surface temperature is less than 40 degrees, or if surface is wet or frozen.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cement: ASTM C150, Type 1 Portland, gray color.

B. Aggregates: ASTM C33.

C. Water: Potable and not detrimental to concrete.

D. Reinforcement: ANSI A615 steel; 60 ksi yield grade; deformed billet steel bars; uncoated finish.

E. Dowels: ASTM A615 steel; 60 ksi yield grade; plain steel, uncoated finish.

F. Sealant: Prepared expansion joints shall be coated with a primer followed by installation of a bond breaker and a self-leveling two-component polyurethane-based elastomeric sealant. The Contractor shall apply the following sealant: Sikaflex 429 primer with Sikaflex - 2C, SL sealant Sonneborn 733 primer with Sonolastic SL 2 sealant Manufactured by Manufactured by Sika Corp., Lyndhurst, NJ. Sonneborn and Chem Rex, Inc., Shakopee, MN.oe approved equal

2.02 ACCESSORIES

A. Steel Forms: Minimum 16 gauge thick, stiffened to support weight of concrete with a minimum deflection.

B. Wood Forms: Douglas Fir species; solid, sound, undamaged sheets; minimum 2 inches (50 mm) thick.

C. Joint Filler: ANSI/ASTM D1751; 1/2 inch thick.

D. Air Entraining Admixture: ASTM C260.

E. Chemical Admixture: ASTM C494, type as required.

F. Curing Compound: ASTM C309, Type 1, Class A.

G. Form Release Agent: Colorless material which will not stain concrete or absorb moisture.

2.03 MIXES

A. Concrete shall be mixed and prepared in accordance with the approved mix design and ASTM C94, Alternative No. 2.

B. The mix shall be such that the concrete shall attain the following characteristics:
   1. Compressive Strength (28 days): 4,000 psi.
   2. Slump: 2½ to 3½ inches.
   3. Air Entrainment: 6% ±1%.

C. Use chemical admixtures only when approved by the Engineer. Use of admixtures will not relax placement requirements.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify existing conditions and substrate.

B. Verify datum and all elevations are as indicated on the plans.

C. Verify compacted granular subbase has been properly prepared and is ready to receive work of this section.

D. Beginning of installation means installer accepts existing conditions.

3.02 PREPARATION

A. Excavate to the required depth and compact surface.

B. Place and secure forms to correct location, dimension and profile.

C. Assemble formwork to permit easy stripping and dismantling without damaging concrete.

D. Moisten base to a minimum depth of 1/2 inch to minimize absorption of water from fresh concrete.

E. Coat forms with form release agent.

3.03 INSTALLATION

A. Place joint filler vertical in position and at equal spaces not exceeding 20 feet. Secure to formwork during concrete placement.

B. Place dowels through joint filler as indicated on the plans. One end of dowel is to be greased or set in a capped sleeve to allow longitudinal movement.

C. Place reinforcement as indicated on the plans. Interrupt at expansion joints.

D. Place concrete in accordance with ACI 301.

E. Ensure reinforcement, dowels, joint filler or forms are not disturbed during concrete placement.

F. Place concrete continuously between construction joints. Do not break or interrupt successive pours such that cold joints occur.

G. Vibrate concrete adjacent to forms.

H. After concrete sets, but prior to curing, remove front forms without damaging concrete and apply a light broom finish to the top and face of the curb.

I. Place curing compound on exposed surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.

3.04 FIELD QUALITY CONTROL

A. Field inspection and testing shall be performed under provisions of Section 01450.

B. Take six concrete test cylinders for every 50 cu. yds. or fraction thereof of concrete placed each day.

C. Cure test cylinders on site under same conditions as curb.

D. Take one slump test for each set of cylinders taken.

E. Concrete not meeting slump requirements will be rejected.

F. Concrete represented by cylinders which do not meet required strength will be removed and replaced at no additional cost to the Owner.

3.05 PROTECTION

A. Protect finished work under provisions of Section 01500.

B. Immediately after placement, protect curb from premature drying, excessive temperatures, rain and mechanical injury.

C. Protect curb from damage until project is accepted by the Owner.

END OF SECTION 02522

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Seeding.

B. Mulch, fertilizer and other accessories.

C. Maintenance.

1.02 RELATED SECTIONS

A. Section 02218 – Landscaping and Topsoil.

1.03 REFERENCES

A. FS O-F-241 - Fertilizers, Mixed, Commercial.

1.04 DEFINITIONS

A. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel and Brome Grass.

1.05 SUBMITTALS

A. Product Data: Provide data on seed mixtures, fertilizer and lime.

B. Certificates: Provide certificates indicating that all fertilizer, pesticides and herbicides comply with all applicable regulatory agency requirements.

1.06 OPERATION AND MAINTENANCE DATA

A. Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer.

1.07 QUALITY ASSURANCE

A. Seed: Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

1.08 REGULATORY REQUIREMENTS

A. Comply with applicable regulatory agencies for fertilizer, pesticide and herbicide composition.

B. All fertilizer, pesticides and herbicides to be used shall comply with all applicable regulatory agency requirements.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01650.

B. Deliver grass seed mixture in original sealed containers. Seed in damaged packaging is not acceptable.

C. Deliver fertilizer in waterproof bags showing weight, chemical analysis and name of manufacturer.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Do not sow immediately following rain, during windy periods or if ground is frozen.

B. Do not sow when the ambient temperature is expected to drop below 40 degrees F or rise above 90 degrees F during the time in which the seed will establish itself.

C. Planting Season: April 1st through May 15th or September 1st through October 15th.

1.11 COORDINATION

A. Coordinate with grading and placement of topsoil.

B. Coordinate with installation of underground sprinkler system piping and watering heads.

1.12 WARRANTY

A. Include coverage for one continuous growing season; reseed areas of dead or unhealthy grass at no additional cost to the Owner.

1.13 MAINTENANCE SERVICE

A. Maintain seeded areas immediately after placement until grass is well established and exhibits a vigorous growing condition, as determined by at least two cuttings, or until the job is accepted by the Owner, whichever occurs last.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Seed: Dry, fresh, re-cleaned seed of the latest crops and of the following proportions:

% of Grass Type	Minimum Mixture	Minimum % % Purity	Germination
Kentucky Bluegrass	45	90	80
Creeping Red Fescue	45	97	80
Perennial Rye Grass	10	95	95

2.02 ACCESSORIES

A. Mulching Material: Hemlock species wood cellulose fiber, dust form, free of growth or germination inhibiting ingredients.

B. Fertilizer: FS O-F-241, Type I, Grade A; recommended for grass, with fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil, to the following proportions: Nitrogen 10 percent, phosphoric acid 6 percent, soluble potash 4 percent.

C. Limestone: Ground dolomitic limestone containing a minimum of 90 percent calcium and magnesium carbonates. One hundred percent (100%) shall pass a No. 10 mesh screen and a minimum of 50 percent shall pass a No. 100 mesh screen.

D. Peat Moss: Shredded, loose, sphagnum moss; free of lumps, roots, inorganic material or acidic materials; minimum of 90 percent organic material measured by oven dry weight; pH range of 4 to 5 percent; moisture content of 30 percent; with moisture absorptive capacity of 450 to 500 percent.

E. Water: Clean, fresh and free of substances or matter which could inhibit vigorous growth of grass.

F. Stakes: Softwood lumber, chisel pointed.

G. String: Inorganic fiber.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify existing substrate and site conditions.

B. Verify that prepared soil base is ready to receive the work of this section.

C. Beginning of installation means installer accepts existing conditions.

3.02 PREPARATION

A. Rake topsoil smooth.

3.03 APPLICATION

A. Apply fertilizer at a rate of 21 lbs per 1,000 square feet.

B. Do not apply fertilizer at same time or with same machine as will be used to apply seed.

C. Mix thoroughly into upper 2 inches of topsoil and water lightly to aid the dissipation of fertilizer.

D. Apply seed at a rate of 4 lbs per 1000 sq ft evenly in two intersecting directions. Rake in lightly.

E. Do not seed areas in excess of that which can be mulched on same day.

F. Roll seeded area with roller not exceeding 100 lbs per foot of width.

G. Immediately following seeding and compacting, apply mulch at a rate of 92 lbs per 1,000 square feet. Maintain clear of shrubs and trees.

H. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil. Discontinue watering if washing begins to occur.

I. Identify seeded areas with stakes and string around area periphery. Set string height to 24 inches. Space stakes at 8 feet on center.

J. Cover seeded slopes where grade is 30 percent or greater with erosion fabric. Roll fabric onto slopes without stretching or pulling.

K. Lay fabric smoothly on surface, bury top end of each section in 6 inch deep excavated topsoil trench. Provide 12 inch overlap of adjacent rolls. Backfill trench and rake smooth, level with adjacent soil.

L. Secure outside edges and overlaps at 36 inch intervals with stakes.

M. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.

N. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 12 inches.

3.04 MAINTENANCE

A. Maintain grass until job is accepted by the Owner or until the grass exhibits a vigorous growing condition, as determined by at least 2 cuttings, whichever occurs last.

B. Mow grass at regular intervals to maintain at a maximum height of 2-1/2 inches. Do not cut more than 1/3 of grass blade at any one mowing.

C. Neatly trim edges and hand clip where necessary.

D. Immediately remove clippings after mowing and trimming.

E. Water to prevent grass and soil from drying out.

F. Immediately reseed areas which show bare spots.

3.05 PROTECTION

A. Protect seeded areas with warning signs during maintenance period.

END OF SECTION 02936

PART 1 – GENERAL

1.01 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall 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 are:
   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. CONTRACTOR or formwork Supplier shall retain a licensed design engineer legally qualified 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 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. Form liner section sufficiently large to show two full repeating patterns, at least 12 inches square.
      c. Controlled permeability forming liner material, eight inches square, minimum.
      d. Form Liner Sample Panel:
         1) Sample shall show texture and surface pattern, required backing, form tie treatment, and treatment at liner panel joints. Use form material to be used in the Work.
         2) Minimum Size: Three feet by four feet.

B. Informational Submittals: Submit the following:
   1. Shop Drawings: When requested by ENGINEER, 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 or Supplier'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 or Supplier'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.
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. Provide solid backing and form supports to ensure stability of form liners.
2. Form Material: Overlaid plywood in accordance with NIST PS 1. Provide B-B high density overlaid concrete form, Class I.
3. Form Liners: Rigid PVC or fiberglass in pattern shown or indicated.
4. Form Reuse: To be determined by ENGINEER at time of installation.
5. Rustication Joints: Rigid PVC in profile shown or indicated.
6. Panel Joints: Conceal joints behind rustication joints, unless approved by ENGINEER in writing.

D. Cylindrical Columns and Supports:
1. Form round-section members with paper or fiber tubes, constructed of laminated plies using water-resistant type adhesive with wax-impregnated exterior for weather and moisture protection. Provide units with sufficient wall thickness to resist loads imposed by wet concrete without deformation.
   a. Provide manufacturer's seamless units to minimize spiral gaps or seams.
2. Fiberglass or steel forms may be used for cylindrical columns if accepted by ENGINEER in writing.

E. Pan Forms: Not Used

F. 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, CONTRACTOR shall submit hole repair details for ENGINEER approval.
6. Wire ties are not allowed.
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.

G. 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.

H. Controlled Permeability Formwork (CPF) Liner: Not Used.

I. 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 biodegradeable. 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 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.

F. 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.

G. 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.

H. 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.

I. 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.

J. Joints:
   1. For joint treatment, comply with Section 03251, Concrete Accessories. Locate joints as shown and specified.

K. 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.

L. 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.

M. Cleaning and Tightening:
   1. 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.

N. Tie Hole Repair:

1. 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.

C. For concrete surfaces that will be in contact with potable water or water that will be treated to become potable, form coating shall be mineral-oil base coating.

D. Do not use form coatings on form surfaces covered with CPF liner material.

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:
   1. 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 CONTROLLED PERMEABILITY FORMING LINER

A. Where shown or indicated in the Contract Documents, install controlled permeability forming (CPF) liner material in accordance with manufacturer's instructions so that liner entirely and continuously covers forming surface.

B. Do not use form release agent on forms with CPF liner. Remove residual traces of release agent on previously used forms prior to placing liner.

C. Joints and seams in CPF liner shall be taped with materials recommended by liner manufacturer. Attach CPF liner to form surface at intermediate spacing to prevent buckles and ripples in liner material when warmed by fresh concrete placement. Spacing of attachments shall not exceed two feet.

D. Form panel edges, except the bottom, shall be taped around corner with materials recommended by liner manufacturer. Edges of penetrations through form, including form tie holes, shall be taped or otherwise sealed. Leave open the liner at bottom edge of forms to facilitate drainage.

E. CPF liner can be reused one time without removing liner from forms. Prior to reuse, wash the liner material and remove all concrete and other foreign material.

3.06 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.

3.07 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.

3.08 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. Additional effects of the construction shall be accounted for by CONTRACTOR 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:
   1. Comply with requirements of Table 03100-A of this Section:

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	See Paragraph 3.8.C.2 of this Section	750 psi
Columns	Two days	Three days	Four days		1000 psi
Side of beams and girders	One day	One day	Two days		500 psi
Slab and foundation edges	One day	One day	Two days		500 psi

2. 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.
3. Concrete Strength Requirements for Form Removal:
   a. 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.
   b. For beams and elevated slabs, do not remove supporting forms or shoring until concrete attains minimum of 90 percent of its specified compressive strength.

D. 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.

E. 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.

F. Leave form facing material in place for minimum of four days after concrete placement, unless otherwise approved by ENGINEER.

G. 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.

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 013100

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PART 1 – GENERAL

1.01 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall 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 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 flat strip 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 of80 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 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.
   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.

PART 3 – EXECUTION

3.01 INSPECTION

A. CONTRACTOR and installing Subcontractor, if any, shall examine substrate and conditions under which the Work is to 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.
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 M 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.
   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 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 Supplier 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.

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 03251

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 ACI350.5 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. The Work also includes:
      a. 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:
   1. 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:
      a. All concrete, unless otherwise shown or indicated.
   2. Class “AF” concrete may be used in lieu of Class “A” concrete for the following:
      a. 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.
   5. Class “C” concrete shall be provided where shown or indicated for slabs that require enhanced durability against wear.
   6. 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.

1.02REFERENCES

A. Standards referenced in this Section are:
   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 Con-crete 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.
   2. Batch Plant: NRMCA Program for Certification of Ready-Mixed Concrete Production Facilities or approved equivalent program.
   3. 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 Design Engineer.
   4. Flatwork Finisher: Unless otherwise permitted, at least one person on finishing crew shall be certified as an ACI Flatwork Finisher, or equivalent.
   5. Water Reducing Admixture Manufacturer:
      a. Water-reducing admixtures shall be manufactured under strict quality control in facilities operated under a quality assurance program. Submit copy of manufacturer's quality assurance handbook to document program existence.
      b. Manufacturer shall maintain a concrete testing laboratory approved by CCRL at NIST.
      c. 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.

4. Submit for each trial batch the following information:
   a. Project identification name and number (if applicable).
   b. Date of test report.
   c. Complete identification of aggregate source of supply.
   d. Tests of aggregates for compliance with the Contract Documents.
   e. Scale weight of each aggregate.
   f. Absorbed water in each aggregate.
   g. Brand, type, and composition of cementitious materials.
   h. Brand, type, and amount of each admixture.
   i. Amounts of water used in trial mixes.
   j. Proportions of each material per cubic yard.
   k. Gross weight and yield per cubic yard of trial mixtures.
   l. Measured slump.
   m. Measured air content.
   n. 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.
   o. 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:
   1. 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.

2. 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 otherwise 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.
2. 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.
3. 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.

I. Thermal Control Plan

1. A thermal control plan shall be developed for all concrete placements in excess of 30 inches in thickness.
2. Prior to start of concrete placement, test concrete placements a minimum of 6 feet by 6 feet by the 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.

3. If internal peak temperature exceeds 155 degrees F, one or more of the following actions shall be taken:
   a. Concrete placement temperature shall be reduced by cooling mix ingredients so that the peak temperature does not reach 155 degrees F.
   b. The concrete mix design shall be adjusted to use supplemental cementitious materials in quantities that will reduce heat of hydration.
   c. A lower heat of hydration Portland cement shall be used.
   d. Means to provide internal cooling of the concrete shall be designed and submitted for approval.
4. 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.

J. 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. CONTRACTOR shall 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).

1.04 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. Test results per ASTM C33 confirming meets limit on deleterious material in fine aggregate.
d. Test results per ASTM C1260, ASTM C1293, and ASTM C1567 to determine potential for alkali-silica reactivity.
e. Certificate of compatibility of combined admixtures.
f. Certification of mix designer.

2. 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.
3. Product Data:
   a. Manufacturers' specifications with application and installation instructions for proprietary materials and items, including admixtures and bonding agents.
4. Samples:
   a. Submit Samples of materials as specified and as requested by ENGINEER. Include with each Sample names of product and Supplier, and description.
   b. Colored Cement Pigment Color Samples: Submit complete selection of manufacturer's standard and custom colors for final selection by ENGINEER.
5. Thermal Control Plan:
   a. Submit plan for controlling internal temperature and temperature gradients within specified limits.
6. Curing and Protection Plans:
   a. Submit detailed plan for curing and protection of concrete placed and cured in cold weather.
   b. Submit detailed plan for curing and protection of concrete placed and cured in ambient temperatures over 80 degrees F.

B. 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.
   2. 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.
   3. Minutes of the Concrete Coordination Conference and other subsequent structure specific concrete construction conferences.

1.05 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:

1. For storage, provide bins or platforms with hard, clean surfaces.

PART 2 – PRODUCTS

2.01 GENERAL

A. Not used.

2.02 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.
   2. Fly ash shall be considered to be a cementitious material.
   3. 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:
   1. 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.

2.03 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.

2.04 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.

2.05 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.
1. Air entraining admixture shall be vinsol resin or vinsol rosin-based.

C. Water-Reducing Admixture: ASTM C494, Type A or D.
1. 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.
1. 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.

E. Plasticizing Admixtures: ASTM C1017, Type I or Type II
1. 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.

F. 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.

G. Calcium Chloride: Do not use calcium chloride.

H. Shrinkage Reducing Admixture:

1. 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.

I. 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.
   3. Adjust quantity of mix water to account for water portion of calcium nitrite solution.
   4. Provide retarding admixtures as required, if set time is accelerated.

J. Colored Cement Pigments:
   1. Provide the following, where shown or indicated: Commercial iron oxide, manganese dioxide, ultramarine blue, chromium oxide, or carbon black compounded for use in concrete.
   2. Product and Manufacturer: Provide one of the following:
      a. Truetone Mortar Colors by Frank D Davis Company, subsidiary of Rockwood Industries, Inc.
      b. Sonobrite by Sonneborn Building Products, division of Rexnord Chemical Products, Inc.
      c. Or equal.
   3. Do not exceed pigment-to-cement ratios, by weight, of one-to-35 for carbon black, and one-to-seven for other pigments.
   4. ENGINEER will select colors from manufacturer's full range of standard colors.

2.06 PROPORTIONING AND DESIGN OF MIXES

A. Prepare concrete design mixes in accordance with Table 03300-A:

TABLE 03300-A CONCRETE DESIGN MIX CRITERIA

Concrete Class	Coarse Aggregate (1)		Minimum	Max. W/CM (4)	Slump (2)	Air (6) (%)	Min. Comp Strength (3) (psi)
	Size A	Size B	Cementitious (5) (lbs/cu yd)				
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

Notes Applicable to Table 03300-A:

1. 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.
2. Slumps indicated are prior to addition of high range water reducing admixture or plasticizing admixture.
3. 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.
4. 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.
5. 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.
6. 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.

B. Lightweight Concrete: Not used.

C. 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.

D. 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.

E. Slump Limits with High-Range Water Reducer:

1. 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.

F. 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.

G. Color: Provide colored concrete where shown and indicated. Incorporate pigments into concrete mix according to pigment manufacturer’s written instructions. Match color of Sample approved by ENGINEER.

2.02 BONDING AGENT

A. Provide epoxy and epoxy-cement bonding agents in accordance with Section 03251, Concrete Accessories.

2.03 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.

2.04 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.

2.05 CRACK INJECTION MATERIALS

A. Structural Crack Repair System:
1. Epoxy for Injection: 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. Hydrophobic Polyurethane Chemical Grout:
   a. Provide hydrophobic polyurethane that forms a flexible gasket.
   b. Products and Manufacturers: Provide one of the following:
      1) SikaFix HH LV, by Sika Chemical Company.
      2) Hydro Active Flex SLV, by De Neef Construction Chemicals, Inc.
      3) Or equal.
   c. Shrinkage limit shall not exceed 4.0 percent in accordance with ASTM D1042.
   d. Minimum elongation of 250 percent in accordance with ASTM D3574.
   e. Minimum tensile strength of 150 psi in accordance with ASTM D3574.
2. Hydrophilic Acrylate-Ester Resin:
   a. Hydrophilic crack repair system shall be acrylate-ester resin that forms a flexible gasket and increase in volume a minimum of 50 percent when in contact with water.
   b. Products and Manufacturers: Provide one of the following:
      1) Duroseal Multigel 850, manufactured by BBZ USA, Inc.
      2) Superflex AR, by De Neef Construction Chemicals, Inc.
      3) Or equal.

2.06 CONCRETE REPAIR MATERIALS

A. Concrete repair mortar shall be pre-packaged, polymer-modified cementitious repair mortar with the following minimum properties:
1. Compressive Strength at One Day: 2,000 psi (ASTM C109).
2. Compressive Strength at 28 Days: 6,000 psi (ASTM C109).
3. Bond Strength at 28 Days: 1,800 psi (ASTM C882 modified).

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-CA or S66-CR, by Master Builders Inc. Use formulation from among those listed in this paragraph recommended by manufacturer for specific application conditions.
4. 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. Cement Mortar: Shall consist of mix of one part cement to 1.5 parts sand with sufficient water to form trowelable consistency. Minimum compressive strength at 28 days shall be 4,000 psi. Where required to match the color of adjacent concrete surfaces, blend white portland cement with standard portland cement so that, when dry, patching mortar matches the color of surrounding concrete.

2.07 CHEMICAL HARDENER

A. Provide clear chemical hardener of fluosilicate family.

B. Product and Manufacturer: Provide one of the following:

1. Lapidolith, by Sonneborn ChemRex Inc.
2. Hornolith, by A.C. Horn, Inc.
3. Or equal.

2.08 SHAKE-ON METALLIC HARDENER

A. Provide metallic hardener formulated, processed, and packaged under stringent quality control at metallic hardener manufacturer-owned and -controlled factory. Hardener shall be a mixture of specially-processed and -graded aggregate, selected portland cement, and plasticizing agents.

B. Product and Manufacturer: Provide one of the following:
   1. Euco-Plate H.D., by Euclid Chemical Company.
   2. Masterplate 200, by Master Builders, Inc.
   3. Or equal.

2.09 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.
   2. Products and Manufacturers: Provide one of the following:
      a. Stego Wrap 10-mil Vapor Retarder, by Stego Industries LLC.
      b. Griffolyn 10-mil, by Reef Industries.
      c. Moistop Ultra, by Fortifiber Industries.
      d. 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.
   3. Vapor Proofing Mastic:
      a. Mastic shall have a water vapor transmission rate ASTM E96, 0.3 perms or lower.
   4. Pipe Boots:
      a. Construct pipe boots from vapor barrier material, pressure sensitive tape, mastic, or a combination thereof, in accordance with manufacturer’s recommendations.

2.10 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.
   2. Do not exceed mixer manufacturer's published rating of the mixer, or mixer nameplate capacity, for total volume of materials used per batch.
   3. Equip mixer with automatic controls for proportioning materials and proper, measured quantities.
   4. 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.
   2. When silica fume is used in dry compacted form, comply with the following mix requirements and ensure full dispersion:
      a. 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.

b. 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. 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 result submittal has been approved by ENGINEER.

B. 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.

C. 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.

D. 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.

E. 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.

F. Prepare joint surfaces in accordance with Section 03251, Concrete Accessories.

G. 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.

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.
2. 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 in excess of 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.

I. Underwater Placing:

1. Concrete placement in water will be allowed if conditions render it impossible or inadvisable to dewater excavations or liquid-retaining structures before placing concrete, and only when allowed by ENGINEER in writing.
2. Revise and submit concrete mix design to suit underwater placement, and obtain ENGINEER's approval before commencing underwater placement of concrete. Deposit concrete by tremie method or other suitable means in continuous placement to prevent forming layers or intrusion of water.

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, damp proofing, 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.
   2. Use grout cleaned finish for the following:
      a. Interior exposed walls and other vertical surfaces.
      b. Exterior exposed walls and other vertical surfaces down to one foot below grade.
      c. Interior and exterior horizontal surfaces.
      d. Interior exposed vertical surfaces of liquid-containing structures down to one foot below normal operating liquid level.
      e. 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:
   1. 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. Special Finish, Troweled Polyester Composition:
   1. For floors receiving troweled polyester composition finish, the following apply:
      a. Provide wood float finish.
      b. Elevation shall be uniform within 1/4-inch tolerance in ten feet.
      c. Use approved curing and hardening compound or proper moist curing procedures.
      d. Cure slabs for 21 days minimum prior to topping.

e. Protect slabs against oil and greases. Remove from slab surface drip- ping, flaking, and loose substances and other bonded foreign particles that might prevent adhesion of composition.
f. Patch and repair other floor imperfections in accordance to finish manufacturer's recommendations.

E. Shake-On Metallic Finish:
1. For each slab shown or indicated to receive shake-on metallic finish, provide application of shake-on metallic hardener at rate of two pounds per square foot. First shake shall comprise two-thirds of specified quantity of hardener. Provide first application after initial floating operation, unless climatic conditions dictate earlier application. Shake-on metallic hardener shall be floated in the second application. Surface shall be floated again after second application to properly bond hardener to base concrete slab. Surface shall then be troweled at least twice to smooth, dense finish.
2. Furnish field service upon five days notice by the hardener manufacturer to assist CONTRACTOR in obtaining maximum benefits of product under prevailing conditions at the Site. Hardener manufacturer's representative shall attend concrete coordination conference required in Article 1.3 of this Section.
3. Use shake-on metallic hardener finish with Class "C" concrete for slabs shown or indicated on the Drawings as receiving this finish.
4. Protect slabs against oil and greases. Remove from slab surface dripping, flaking, or loose substances and other bonded foreign particles that might prevent adhesion of finish.
5. Patch and repair other floor imperfections in accordance with hardener manufacturer's recommendations.

F. 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.

2. Form Curing. Cure by one of the following methods:
   a. Forms shall be maintained and loosened during curing period.
   b. Immediately after forms are loosened or removed, continue with the required curing method as applicable, for remainder of curing period.
   c. Where wood forms are kept in place, apply water to keep forms wet.
3. Moisture Retaining Cover Curing. Cure as follows:
   a. 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.
4. Liquid Compound Curing. Cure as follows:
   a. 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, hardener, 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.
   b. 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.
   c. 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.
   d. 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.
   e. 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.
   2. Formed Slab Underside and Beam Surfaces Where Will Retain Liquid:
      a. Form curing is allowed for the full curing period.
      b. Immediately after forms are loosened or removed, continue with water curing for remainder of curing period.

c. When slab surface will not receive surface treatment and when allowed by ENGINEER, use of liquid curing compound is allowed.

3. Vertical Joint Surfaces and Surfaces to Receive Surface Treatment:
   a. Form curing is allowed for entire curing period.
   b. Immediately after forms are loosened or removed, continue with water curing for remainder of curing period.
4. 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.
2. Construction Joint Surfaces and Slab and Mat Surfaces to Receive Surface Treatment.
   a. Water curing.
   b. Moisture-retaining cover curing.
3. 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:
1. 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.

5. 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. CONTRACTOR shall 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.
g. Compressive Strength Tests:
1) 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.
2) Adjust mix design if test results are unsatisfactory and resubmit for approval.
3) Concrete that does not comply with strength requirements will be considered as defective Work.
h. Water/Cementitious Materials Ratio: Perform one test from each sample from which compression test specimens are taken, in accordance with AASHTO TP23.

i. 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.
3. Compressive Strength:
a. 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.
b. Questionable Field Conditions During Concrete Placement:
1) 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.
2) 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.
3) 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.
4) 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.
c. 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, CONTRACTOR shall 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.

2. Fill core holes solid with non-shrink grout in accordance with Section 03600, Grouting, and finish to match adjacent concrete surfaces.
3. 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:
1. 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.

3. 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.

D. Steel Pan Stairs:

1. Provide concrete fill for steel pan stair treads, landings, and associated items. Screed, tamp, and finish concrete surfaces as shown or indicated.
   a. Cast into the concrete fill safety inserts and accessories as shown or indicated.

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.
2. Repair the following defects in smooth-finish surfaces, in addition to those listed above in this Section:
   a. 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.
   b. 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.
   c. Fins, offsets, and other projections shall be completely removed and smoothed.
   d. Scratches and gouges in concrete surface.
   e. 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.
3. 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.
3. Structural Cracks: Pressure-grout structural cracks using injectable epoxy installed using pressurized system. Apply in accordance with epoxy manufacturer's directions and recommendations.
4. Non-structural Cracks: Shall be pressure-grouted using hydrophobic or hydrophilic resin. Install in accordance with resin manufacturer's directions and recommendations.
5. Determination of the crack type shall be made by the ENGINEER.
6. Holes Through Concrete:
   a. 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.
   b. 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.
7. 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 03300

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Precast concrete structures.

1.02 REFERENCES

A. ACI 304R - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.

B. ACI 308R - Standard Practice for Curing Concrete.

C. ACI 350R - Concrete Sanitary Engineering Structures.

D. ANSI/ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement.

E. ASTM A615/A615M - Deformed and Plain Billet Steel Bars for Concrete Reinforcement.

F. ASTM C33/C33M - Concrete Aggregates.

G. ASTM C150/C150M - Portland Cement.

H. ASTM C260/C260M - Air Entraining Admixtures for Concrete.

I. ASTM C478 - Precast Reinforced Concrete Manhole Sections.

J. CRSI 63 - Recommended Practice for Placing Reinforcing Bars.

1.03 SUBMITTALS

A. Submit under provisions of Section .

B. Precast Concrete Structures: Indicate structure dimensions, sleeve locations and size, concrete strength and location and size of reinforcement.

C. Provide manufactures data on concrete accessories.

D. Submit the following related to design mixes:
   1. Name, address, and telephone number of Contractor's laboratory.
   2. Mix proportions.
   3. Source of cement, type, brand and certified copies of mill reports, including physical and chemical analysis.
   4. Source of fine aggregates and results of tests made in accordance with ASTM C33/C33M and ASTM C40.
   5. Source of coarse aggregates and results of tests made in accordance with ASTM C33/C33M.
   6. For each mix proposed, make and cure four (4) standard 6-inch concrete test specimens in the lab in accordance with ASTM C192. Furnish compression test results made in accordance with ASTM C39/C39M. Break two (2) cylinders at seven (7) days and two (2) at 28 days.
   7. If the concrete is intended to be pumped, design mix accordingly and submit certification that it has been tested for pumping.

E. The Engineer may approve the use of previously established design mixes if all test results, made within the last six (6) months by a recognized testing laboratory, are positive and provide

sufficient evidence of full compliance with this specification. If the Engineer determines that insufficient documentation and test results exist, the Engineer may request additional testing or the Engineer may request a new design mix with complete test results.

F. If the adopted mix fails to produce concrete meeting the requirements for strength and placibility, the Engineer may order additional cement or adjustments to mix proportions.

1.04 COORDINATION

A. Coordinate placement of sleeves for penetrations.

B. Coordinate with piping installation.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Do not excavate or backfill during inclement weather or when precipitation is occurring.

B. Do not backfill over or with wet or frozen materials.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. OLD CASTLE

B. LONG ISLAND PRECAST, INC.

C. COASTAL PIPELINE PRODUCTS CORP.

2.02 MATERIALS

A. Concrete:
1. Cement: ASTM C150/C150M Type II or Type III, Portland type, gray color.
2. Fine and Coarse Aggregates: ASTM C33/C33M.
3. Water: Clean and not detrimental to concrete.
4. Air entrainment: 5 1/2 +/- 1 percent.
5. Mix concrete with a minimum 28 day compressive strength of 4,000 psi.
6. Provide waterproofing.

B. Reinforcing Steel:
1. ANSI/ASTM A185 or ASTM A615/A615M, 60 ksi yield grade, plain finish.
2. ASTM A1064/A1064M, 60 ksi yield grade, plain finish.
3. Tie Wire: Minimum 16 gauge, annealed type.

C. Waterstop: Polyvinylchloride, 6 inches wide, heat sealed joints, Type A-H manufactured by Anti-Hydro Co., Inc.

D. Manhole Steps: Copolymer polypropylene plastic steel reinforced manhole steps, M. A. INDUSTRIES, Model PS2-PF.

E. Waterstop: Krystol Waterstop Grout (External) by Kryton or equal.

F. Air entraining admixture: ASTM C260/C260M.

G. Concrete Waterproofing: Krystol Internal Membrane (KIM-HS) as manufactured by Kryton or equal.

2.03 FINISHES

A. Provide smooth finish on exposed formed concrete surfaces. Provide fine broom finish on exterior walking surfaces.

2.04 SOURCE QUALITY CONTROL

A. Notify Engineer at least 48 hours before pouring precast concrete sections.

B. Mark precast concrete structures in accordance with ASTM C478.

C. Age precast concrete structures at least two weeks before shipment.

D. Testing and analysis of concrete shall be performed under the requirements in Section 01660 - QUALITY CONTROL.

E. The testing laboratory shall take cylinders and perform slump and air entrainment tests in accordance with ACI 301 and Section 01660 - QUALITY CONTROL.

PART 3 - EXECUTION

3.01 ERECTION OF CONCRETE STRUCTURES

A. Determine required inside diameter of each wall opening, in accordance with manufacturer's recommendation, to assure a water-tight joint, for openings which accommodate penetration seals.

B. Place concrete in accordance with ACI 304R.

C. Fabricate concrete reinforcing in accordance with CRSI 63.

D. Ensure reinforcement, sleeves and embedded parts are not disturbed during concrete placement.

E. Provide continuous flexible bentonite waterstop at tongue and groove joints. Install waterstop in accordance with manufacturer’s installation instructions.

F. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures and mechanical injury.

3.02 EXAMINATION

A. Verify that excavation is ready to receive work and excavations, dimensions and elevations are as indicated on drawings.

3.03 PREPARATION

A. Hand trim excavations to required elevations. Correct over excavation with Select fill, as defined in Section 02200-EARTHWORK.

B. Remove large stones or other hard matter which could damage pipe or impede consistent backfilling or compaction.

3.04 INSTALLATION

A. Form bottom of excavation clean and smooth to correct elevation.

B. Install precast concrete base, shaft and slab top plumb and level.

C. Establish elevations and pipe inverts for inlets and outlets as indicated.

D. Adjust lock joint flexible sleeve and install non-shrink grout to provide water-tight pipe penetration.

E. Waterproof below grade concrete structures, or as may be indicated on the Contract Drawings, in accordance with the requirements of Section 03300 - CAST-IN-PLACE CONCRETE.

3.05 SITE TOLERANCES

A. Maximum variation from proposed top of structure elevation: 1/4 inch.

3.06 FIELD QUALITY CONTROL

A. Perform field inspection and testing under Section 01660 - QUALITY CONTROL.

B. Request inspection prior to and immediately after placing backfill.

C. Perform compaction testing in accordance with Section 01660 - QUALITY CONTROL.

D. If tests indicate Work does not meet specified requirements, remove work, replace and retest at no cost to Owner.

3.07 PROTECTION

A. Protect structures and appurtenances from damage or displacement until Project is accepted by Owner.

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 grout and perform grouting Work.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before grouting Work.

C. Related Sections:
   1. Section 03251, Concrete Accessories.
   2. Section 03300, Cast-In-Place Concrete.

D. Application and Grout Material:
   1. The following is a listing of grouting applications and the corresponding type of grout material to be provided for the associated application. Unless shown or indicated otherwise in the Contract Documents, provide grout in accordance with the following:

TABLE 03600-A, 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	Class III Non-Shrink Epoxy (unless otherwise recommended by equipment

Application	Required Grout Material Type
motorized equipment or machinery equipment less than 50 horsepower subject to severe shock loads or high vibration	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
Grout for setting filter underdrain blocks, and for filling voids between filter underdrain blocks, and for filling voics between filter underdrain blocks and walls	Filter Underdrain Blocks Grout
Applications not listed above, where grout is indicated on the Drawings	Class I Non-Shrink, unless shown or indicated otherwise

1.02 REFERENCES

A. Standards referenced in this Section are:
   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. ASTM C109/C109M, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
   5. ASTM C230/C230M, Specification for Flow Table for Use in Tests of Hydraulic Cement.
   6. ASTM C531, Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
   7. ASTM C579, Test Methods for Compressive Strength of Chemical- Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
   8. ASTM C827, Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures.
   9. ASTM C882/C882M, Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.
   10. ASTM C939, Text Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
   11. ASTM C1107/C1107M, Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
   12. ASTM C1181, Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts.
   13. NSF/ANSI 61, Drinking Water System Components - Health Effects.

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Grout Testing Laboratory:
   a. Independent testing laboratory employed for design and testing of grout materials and mixes shall comply with testing laboratory requirements in Section 03300, Cast-in-Place Concrete and other applicable requirements in the Contract Documents.
2. Manufacturer: Shall have a minimum of five years experience of producing products substantially similar to that required and shall be able to submit documentation of at least five satisfactory installations that have been in successful operation for at least five years each.
3. Manufacturer's Field Service Technician: When required, provide services of manufacturer's full-time employee, factory-trained in handling, use, and installing the products required, with at least five years of experience in field applications of the products required.

B. Trial Batch:
1. Each grout fill and construction joint grout mix proportion and design shall be verified by laboratory trial batch or field experience methods. Comply with ACI 211.1 and submit to ENGINEER a report with the following data:
   a. Complete identification of aggregate source of supply.
   b. Tests of aggregates for compliance with specified requirements.
   c. Scale weight of each aggregate.
   d. Absorbed water in each aggregate.
   e. Brand, type, and composition of cement.
   f. Brand, type, and amount of each admixture.
   g. Amounts of water used in trial mixes.
   h. Proportions of each material per cubic yard.
   i. Unit weight and yield per cubic yard of trial mixtures.
   j. Measured slump.
   k. Measured air content.
   l. Compressive strength developed at seven days and 28 days, from not less than three test specimens cast for each seven-day and 28-day test, and for each design mix.
2. Laboratory Trial Batches: When laboratory trial batches are used to select grout proportions, prepare test specimens and conduct strength tests as specified in ACI 301.
3. Field Experience Method: When field experience methods are used to select grout proportions, establish proportions as specified in ACI 301.

1.04 SUBMITTALS

A. Action Submittals: Submit the following:
1. Shop Drawings:
   a. Schedule of Project-specific grout applications, installation locations, and the grout type proposed for each.
   b. 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. Do not start laboratory trial batch testing until submittal is approved by ENGINEER.
   c. Trial Batch Reports: Submit laboratory test reports for grout materials and mix design tests.
2. Product Data:

a. Data sheets, certifications, and manufacturer's specifications for all materials proposed for use.

B. Informational Submittals: Submit the following:
1. Manufacturer's Instructions:
a. Special instructions for shipping, storing, protecting, and handling.
b. Installation instructions for the materials.
2. Supplier Reports:
a. Submit written report of results of each visit to Site by Supplier's field service technician, including purpose and time of visit, tasks performed, and results obtained. Submit within two days of completion of visit to the Site.
3. Qualifications Statements:
a. Testing laboratory, when not submitted under other Sections.
b. Manufacturer, when submittal of qualifications is required by ENGINEER.
c. Manufacturer's field service technician, when submittal of qualifications is required by ENGINEER.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Storage of Materials: Store grout materials in a dry location, protected from weather and protected from moisture.

PART 2 – PRODUCTS

2.01 GENERAL

A. All grout materials, admixtures, cementitious materials, and other materials used in grout that contact potable water or water that will be treated to become potable shall be listed in NSF/ANSI 61.

2.02 NON-SHRINK GROUT 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.

B. Class I Non-Shrink Grout:
1. 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 Table 03600-A in this Section.
2. Products and Manufacturer: Provide one of the following:
a. Masterflow 928, by Master Builders, Inc.
b. Five Star Grout, by Five Star Products, Inc.
c. Hi-Flow Grout, by Euclid Chemical Company.
d. Or equal.
3. 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.

4. 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.
5. Non-shrink property shall not be based on chemically-generated gas or gypsum expansion.
6. Fluid grout shall pass through the flow cone, with continuous flow, one hour after mixing.

C. Class II Non-Shrink Grout:
1. 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 Table 03600-A in this Section.
2. Products and Manufacturer: Provide one of the following:
   a. Construction Grout, by Master Builders, Inc.
   b. FSP Construction Grout, by Five Star Products, Inc.
   c. NS Grout, by Euclid Chemical Company.
   d. Or equal.
3. 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.
4. When tested, grout shall not bleed at maximum allowed water.
5. Non-shrink property shall not be based on chemically-generated gas or gypsum expansion.

D. Class III Non-Shrink Epoxy Grout:
1. Epoxy grout shall be a pourable, non-shrink, 100-percent solids system.
2. Products and Manufacturer: Provide one of the following:
   a. E3G, by Euclid Chemical Company.
   b. Sikadur 42 Grout Pak, by Sika Corporation.
   c. HP Epoxy Grout, by Five Star Products, Inc.
   d. Or equal.
3. 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.
4. 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.

2.03 GROUT MATERIALS OTHER THAN NON-SHRINK GROUT

A. General: Materials for grouts (other than non-shrink grouts) shall be in accordance with Section 03300, Cast-In-Place Concrete, except as otherwise specified in this Section.

B. Grout Fill:
1. Grout fill shall be comprised of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and mixed in accordance with this Section.
   a. Minimum Compressive Strength: 4,000 psi at 28 days.
   b. Maximum Water-Cement Ratio: 0.45 by weight.
   c. Coarse Aggregate: ASTM C33/C33M, No. 8 size.
   d. Fine Aggregate: ASTM C33/C33M, approximately 60 percent by weight of total aggregate.
   e. Air Content: Seven percent (plus or minus one percent).
   f. Minimum Cement Content: 564 pounds per cubic yard.
   g. Slump for grout fill shall be adjusted to match placing and finishing conditions, and shall not exceed four inches.

C. Construction Joint Grout:
1. Construction joint grout shall be comprised of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned with similar cementitious characteristics as Class “A” concrete specified in Section 03300, Cast-In-Place Concrete. Mix design shall result in grout that is flowable with high mortar content. Mix requirements are:
   a. Minimum Compressive Strength: 4,500 psi at 28 days.
   b. Maximum Water-Cement Ratio: 0.42 by weight.
   c. Coarse Aggregate: ASTM C33/C33M, No. 8 size.
   d. Fine Aggregate: ASTM C33/C33M, approximately 60 percent by weight of total aggregate.
   e. Air Content: Seven percent (plus or minus one percent).
   f. Minimum Cement Content: 752 pounds per cubic yard.
   g. Slump for Construction Joint Grout: Seven inches (plus or minute one inch).

D. Filter Underdrain Blocks Grout:
1. Grout shall comply with Article 2.1 of this Section. Grout shall consist of one part cement to two parts sand with shrinkage-reducing admixture. Class

   I or Class II non-shrink grout may be used in lieu of filter underdrain blocks grout.
   a. Minimum Compressive Strength: 4,000 psi at 28 days.
   b. Maximum Water-Cement Ratio: 0.45 by weight.

2.04 CURING MATERIALS

A. Curing materials shall comply with Section 03300, Cast-in-Place Concrete, and shall be as recommended by the manufacturer of prepackaged grouts.

PART 3 – EXECUTION

3.01 INSPECTION

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

3.02 INSTALLATION

A. General:
   1. Place grout as shown and indicated, and in accordance with Laws and Regulations and grout manufacturer's instructions. If manufacturer's instructions conflict with the Contract Documents, obtain clarification or interpretation from ENGINEER before proceeding.
   2. Consistency of non-shrink grouts shall be as required to completely fill the space to be grouted for the particular application. Do not install grout for dry-packing without approval of ENGINEER. When dry-packing is approved by ENGINEER, dry-pack consistency shall be such that grout has sufficient water to ensure hydration and grout strength development, and remains plastic, moldable, and that does not flow.
   3. Grouting shall comply with temperature and weather limitations in Section 03300, Cast-In-Place Concrete.
   4. Cure grout in accordance with grout manufacturer's instructions for prepackaged grout and Section 03300, Cast-In-Place Concrete, for grout fill.

B. Columns and Beams:
   1. After shimming columns and beams to proper elevation, securely tighten anchors. Properly form around base plates allowing sufficient room around edges for placing grout. Provide adequate depth between bottom of base plate and top of concrete base to assure that void is completely filled with non-shrink grout.

C. Equipment Bases:
   1. Install equipment in accordance to manufacturer's recommendations, Laws, and Regulations, and the Contract Documents. After shimming equipment to proper elevation, securely tighten anchors. Properly form around base plates, allowing sufficient room around edges for placing grout. Provide adequate depth between bottom of equipment base and top of concrete base to ensure that voids are completely filled with non-shrink grout.

D. Handrail Posts:
   1. After posts have been properly inserted into holes or sleeves, fill annular space between posts and sleeve with non-shrink grout. Bevel grout at juncture with post so that water will flow away from post.

D. Construction Joints:
   1. Place a six-inch minimum thick layer of construction joint grout over contact surface of concrete at interface of horizontal construction joints in accordance with Section 03251, Concrete Accessories, and Section 03300, Cast-In-Place Concrete.

E. Grout Fill:
   1. All mechanical, electrical, and finish work shall be completed prior to placing grout fill. Base slab shall be provided with a scratched finish in accordance with Section 03300, Cast-In-Place Concrete. Roughen existing slabs shall by abrasive blasting or hydroblasting exposing aggregates to ensure bonding to base slab.
   2. Minimum thickness of grout fill shall be one-inch. Where finished surface of grout fill is to form an intersecting angle of less than 45 degrees with concrete surface against which grout will be placed, form a key in the concrete surface at the intersection point. Key shall be minimum of 3.5 inches wide by 1.5 inches deep.
   3. Thoroughly clean and wet base slab prior to placing grout fill. Do not place grout fill until slab is completely free of standing water. A thin coat of neat Type II cement slurry shall be broomed into surface of slab. Place grout fill while slurry is wet. Grout fill shall be compacted by rolling or tamping, brought to elevation, and floated. In tanks and basins where scraping-type equipment will be installed, grout fill shall be screeded by blades attached to revolving mechanism of equipment in accordance with procedures recommended by equipment manufacturer after grout is brought to elevation.
   4. Grout fill placed on sloping slabs shall be installed uniformly from bottom of slab to top, for full width of placement.
   5. Test grout fill surface with a straight edge to detect high and low spots; immediately correct high and low spots in grout fill. When grout fill has hardened sufficiently, grout fill shall be steel troweled to provide a smooth surface free of bug holes and other imperfections. While an acceptable type of mechanical trowel may be used in this operation, the last pass over the grout fill surface shall be by hand-troweling. During finishing, do not apply the following to the grout fill surface: water, dry cement, or mixture of dry cement and sand.
   6. Cure and protect grout fill in accordance with Section 03300, Cast-In-Place Concrete.

3.03 FIELD QUALITY CONTROL

A. Field Testing Services:
   1. OWNER will employ testing laboratory to perform field quality control testing for grout. ENGINEER will direct the testing requirements.

B. Field Testing Services:
   1. CONTRACTOR shall employ an independent testing laboratory to perform field quality control testing for grout. ENGINEER will direct where samples are to be obtained.
   2. CONTRACTOR shall provide all curing and necessary cube storage facilities in accordance with ASTM C31.
   3. Comply with testing laboratory requirements in Section 03300, Cast-In-Place Concrete for required testing laboratory qualifications.

C. Quality Control Testing During Construction:
   1. Grout Fill: Perform sampling and testing for field quality control during grout fill placing as follows:
      a. Sampling Fresh Grout Fill: ASTM C172.
      b. Slump: ASTM C143; one test for each load of grout at point of discharge.
      c. Air Content: ASTM C231; one sample for every two grout loads at point of discharge, and when a change in the grout is observed.
      e. Compression Test Specimens:
         1) In accordance with ASTM C109/C109M; make one set of compression cubes for each 50 cubic yards of grout, or fraction thereof, of each mix design placed each day. Each set shall be four standard cubes, unless

otherwise directed by ENGINEER.

2. Non-shrink Grout: Perform sampling and testing for field quality control during non-shrink grout placing as follows:
   a. Perform compression testing of non-shrink grout in accordance to ASTM C109/C109M at intervals during construction as selected by ENGINEER. Make a set of four specimens for testing compressive strength at a period of time selected by the ENGINEER.
   b. Perform compression tests on epoxy grout and fabricate specimens for epoxy grout testing in accordance with ASTM C579, Method B, at intervals during construction as selected by the ENGINEER. Make a set of four specimens for testing compressive strength at a period of time selected by ENGINEER.

D. Evaluation of Field Quality Control Tests:
   1. Do not use grout, delivered to final point of placement, having slump or total air content that does not comply with the Contract Documents.
   2. Compressive strength tests for laboratory-cured cubes will be acceptable if averages of all sets of three consecutive compressive strength test results equal or exceed the required 28-day design compressive strength of the associated type of grout.
   3. If the compressive strength tests do not comply with the requirements in the Contract Documents, the grout represented by such tests will be considered defective and shall be removed and replaced, or subject to other action required by ENGINEER, at CONTRACTOR's expense.

E. Manufacturer's Services:
   1. Manufacturers of proprietary materials shall make available upon 72 hours notification the services of qualified, full time employee, experienced in serving as a field service technician for the products required, to aid in assuring proper use of products under the actual conditions at the Site.

END OF SECTION 03600

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PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install masonry mortaring and grouting for unit masonry construction.

B. This Section includes masonry mortaring and grouting for masonry products specified in:
   1. Section 04211, Brick Masonry.
   2. Section 04220, Concrete Unit Masonry.

C. Types of materials required under this Section include:
   1. Portland cement-lime mortars.
   2. Fire-resistant mortars.
   3. Ready-mixed mortar
   4. Fine grout.
   5. Coarse grout.
   6. Grout fill around reinforcement in masonry lintels and bond beams.

1.02 RELATED SECTIONS

A. Section 04201, Unit Masonry Construction.

B. Section 04211, Brick Masonry.

C. Section 04220, Concrete Unit Masonry.

1.03 REFERENCES

A. Standards referenced in this Section are:
   1. ANSI/UL 263, Fire Resistance Ratings.
      a. BXUV U901, Bearing Wall Rating – 4 HR.; Nonbearing Wall Rating – 4 HR.
      b. BXUV U902, Bearing Wall Rating – 4 HR., Alternative Detail.
      c. BXUV U904, Bearing Wall Rating – 3 HR.; Nonbearing Wall Rating – 3 HR.
      d. BXUV U905, Bearing Wall Rating – 2 HR.; Nonbearing Wall Rating – 2 HR.
      e. BXUV U906, Bearing Wall Rating – 2 HR.; Nonbearing Wall Rating – 2 HR.
      f. BXUV U907, Nonbearing Wall Rating – 3 or 4 HR.
      g. BXUV U909, Nonbearing Wall Rating – 3 or 4 HR.
      h. BXUV U910, Bearing Wall Rating – 4 HR.; Nonbearing Wall Rating – 4 HR.
      i. BXUV U912, Bearing Wall Rating – 3 HR.; Nonbearing Wall Rating – 3 HR.
      j. BXUV U913, Bearing Wall Rating – 2 HR.; Nonbearing Wall Rating – 2 HR.
      k. BXUV U914, Bearing Wall Rating – 3 HR.; Nonbearing Wall Rating – 3 HR.
   3. ASTM C5, Specification for Quicklime for Structural Purposes.
   4. ASTM C144, Specification for Aggregate for Masonry Mortar.
   5. ASTM C150/C150M, Specification for Portland Cement.
   6. ASTM C207, Specification for Hydrated Lime for Masonry Purposes.
   7. ASTM C270, Specification for Mortar for Unit Masonry.
   8. ASTM C387/C387M, Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
   9. ASTM C404, Specification for Aggregates for Masonry Grout.
   10. ASTM C1019, Test Method for Sampling and Testing Grout.

1.04 QUALITY ASSURANCE

A. Component Supply and Compatibility: Do not change source or brands of mortar materials during the Project.

B. Regulatory Requirements: Where fire-resistance classification is shown or indicated for unit masonry construction (four-hour, three-hour, and similar designations), proportion mortar and masonry grouts to comply with requirements established by fire rating designations of ANSI/UL 263 indicated in this Section, Laws and Regulations, and requirements of authorities having jurisdiction.

C. Job Mockup: Refer to Section 04201, Unit Masonry Construction.

D. Pre-submittal Meeting:
   1. Before submitting Samples of colored mortar for approval, Contractor and Supplier shall meet at the Site with Engineer to review existing mortar to be matched and to preview proposed materials and colors.
   2. Refer to Section 04201, Unit Masonry Construction.

1.05 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Schedule of locations where each mortar type will be used in the Work.
      b. Grout mix design and material certification.
   2. Product Data:
      a. Manufacturer's specifications and instructions for each manufactured material or product.
      b. Compression test results of grout mix, for identical mix previously prepared and tested, in accordance with ASTM C1019, at maximum aggregate allowed. If no previously-prepared mix is identical, perform tests on the job mix design in accordance with ASTM C1019 and submit to Engineer.
      c. Product data and specifications for integral waterproofing admixture.
   3. Samples:
      a. Each type of colored mortar, showing range of color expected in the Work.
      b. Label samples to indicate type and quantity of colorant used.
      c. Engineer's review will be for color only. Compliance with other requirements is Contractor's responsibility.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Portland Cement: Provide the following for Portland cement-lime mortars:
   1. ASTM C150/C150M:
      a. Use Type I when installation temperature is 50 degrees F or higher.
      b. Use Type III, high-early strength, when installation temperature is lower than 50 degrees F.
   2. Products and Manufacturers: Provide one of the following:
      a. Type I and Type III Portland Cement, by Essroc Italcementi Group.
      b. Type I and Type III Portland Cement, by Lehigh Portland Cement Company.
      c. Or equal.
   3. Provide non-staining Portland cement of natural color or of color required to be compatible with required mortar pigment color selected by Engineer.

B. Hydrated Lime: ASTM C207, Type S, or lime putty ASTM C5.

C. Sand Aggregates:
   1. Mortar Aggregates: ASTM C144, except for joints less than 1/4-inch use aggregate graded with 100 percent passing the No. 16 sieve.
   2. Colored Mortar Aggregates: Provide ground marble, granite or other sound stone, as required to match the Sample approved by Engineer for portland cement-lime mortars.
   3. Fine Aggregate for Grout: ASTM C404, Size No. 1.
   4. Coarse Aggregate for Grout: ASTM C404, Size No. 8 or Size No. 89.

D. Colored Mortar Pigments: Provide the following for Portland cement-lime mortars:
   1. Commercial iron oxide, manganese dioxide, ultramarine blue, chromium oxide, or carbon black, compounded for use in mortar mixes.
   2. Products and Manufacturers: Provide one of the following:
      a. True-Tone Mortar Colors, by Davis Colors, a Subsidiary of Rockwood Pigments, Inc.
      b. SGS Concentrated Mortar Colors, by Solomon Colors.
      c. Or equal.
   3. Do not exceed pigment to cement ratios, by weight, of one-to-35 for carbon black, and one-to-seven for other pigments.
   4. Submit complete selection of manufacturer's standard and custom colors for final selection by Engineer.

E. Ready-mixed Mortar: Cementitious materials, water, and aggregate complying with requirements specified in Article 2.1 of this Section, combined with set-controlling admixtures to produce a ready-mixed mortar complying with ASTM C270 and ASTM C387/C387M.

F. Water: Free of injurious amounts of oils, acids, alkalis, and organic matter, and clean, fresh, and potable.

G. Water-repellent Admixture for Exterior Masonry Mortar:
   1. Provide cross-linked acrylic polymer integral waterproofing system.
   2. Products and Manufacturers: Provide one of the following:
      a. DRY-BLOCK Mortar Admixture, by Grace Construction Products Division, W. R. Grace & Company.
      b. Eucon Blocktite Mortar Admixture, by Euclid Chemical Company.
      c. Or equal.
   3. Proportion: In accordance with manufacturer's instructions.

2.02 MORTAR MIXES

A. General:
   1. Material Performance:
      a. Masonry Strength: Refer to Section 04201, Unit Masonry Construction.
      b. If questions of compliance with the Contract Documents arise, Specifications for mortar properties shall take precedence over Specification for mortar proportions.
   2. Do not change proportions established for mortar approved, and do not use materials with different physical characteristics in mortar used in the Work, unless compliance with the Contract Documents for mortar properties is re-established via submittals approved by Engineer.
   3. Do not combine in mortar different air-entraining materials.
   4. Anti-freeze Admixture or Agents: Not allowed.
   5. Calcium Chloride: Not allowed.

B. Fire-Resistant Mortar:
   1. Reference Standard: ANSI/UL BXUV U901 through BXUV U914.

2. Proportion: Use one-part Portland cement, three parts clean sand, and 15 percent hydrated lime (by cement volume).

C. Mortar for All Other Unit Masonry: Comply with ASTM C270, Table 2, except limit materials to those specified in this Section. Limit cement-to-lime ratio by volume as follows:
1. Type S:
   a. Provide the following proportions by volume:
      1) Portland Cement: One part.
      2) Hydrated Lime or Lime Putty: Over 1/4 to 1/2, maximum.
      3) Aggregate Ratio (measured in damp loose condition): Not less than 2-1/4 and not more than three times sum of volumes of cementitious materials.
   b. Properties:
      1) Average Compressive Strength, ASTM C270: 1,800 psi.
      2) Minimum Water Retention, ASTM C270: 75 percent.
      3). Maximum Air Content, ASTM C270: 12 percent.
2. Type N:
   a. Provide the following proportions by volume:
      1) Portland Cement: One part.
      2) Hydrated Lime or Lime Putty: Over 1/2 to 1-1/4, maximum.
      3) Aggregate Ratio (measured in damp loose condition): Not less than 2-1/4 and not more than three times sum of volumes of cementitious materials.
   b. Properties:
      1) Average Compressive Strength, ASTM C270: 750 psi.
      2) Minimum Water Retention, ASTM C270: 75 percent.
      3) Maximum Air Content, ASTM C270: 12 percent.

D. Grout:
1. Fine Grout:
   a. Provide the following proportions by volume:
      1) Portland Cement: One part.
      2) Hydrated Lime or Lime Putty: Zero to 1/10 part.
      3) Aggregate Ratio (measured in a damp loose condition): Sand; not less than 2-1/4 and not more than three times sum of volumes of cementitious materials.
   b. Mix grout to have slump of ten inches plus or minus one inch at time of placement.
2. Coarse Grout:
   a. Provide the following proportions by volume:
      1) Portland Cement: One part.
      2) Hydrated Lime or Lime Putty: Zero to 1/10 part.
      3) Fine Aggregate Ratio (measured in a damp loose condition): Sand; not less than 2-1/4 and not more than three times sum of volumes of cementitious materials.
      4) Coarse Aggregate Ratio: Not less than one and not more than two times the sum of volumes of cementitious materials.
   b. Mix grout to have slump of ten inches plus or minus one inch at time of placement.

E Grout Fill Around Reinforcement in Masonry Lintels: Portland cement, sand, gravel and water, to be proportioned as required to provide 28-day minimum compressive strength of 2,000 psi.

PART 3 – EXECUTION

3.01 INSPECTION

A. Examine conditions under which the Work will be performed 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 are corrected.

3.2 PREPARATION

A. Measurement of Materials:
   1. Cement and Hydrated Lime: Batched by the bag.
   2. Sand: Batched by volume in suitably calibrated containers. Make allowance for bulking and consolidation, and for weight per cubic foot of contained moisture.
   3. Proportion of Volumetric Mixtures: One 94-pound sack of Portland cement and one 50-pound sack of hydrated lime constitute nominal one cubic foot.
   4. Shovel measurement: Unacceptable.

B. Mortar Mixing:
   1. Type of Mixer: Machine mix in appropriate mixer in which quantity of water is accurately and uniformly controlled.
   2. While mixer is operating, add approximately three-quarters of required water, half the sand, all the cement, and then add remainder of sand.
   3. Allow batch to mix briefly and then add balance of water in small quantities until satisfactory workability is obtained.
   4. Mix for not less than five minutes after all materials have been added.
   5. Hydrated Lime for Mortar Requiring Lime Content: Use dry-mix method. Turn materials over together for each batch until even color of mixed, dry materials indicates that cementitious material has been thoroughly distributed throughout the mass, and then add water to obtain required plasticity.
   6. Prepare lime putty, if approved for use, in accordance with ASTM C5.
   7. Waterproofing Admixture: Add to mortar mix for all exterior masonry in accordance with manufacturer’s instructions.
   8. Mixer drum shall be completely emptied before recharging the next batch.
   9. Limit batch size to avoid re-tempering. Re-tempering of mortar is not allowed.

3.3 INSTALLATION AND MORTAR AND GROUT TYPE LOCATION

A. For mortar and grout type, location, and installation requirements, refer to Section 04201, Unit Masonry Construction.

3.4 FIELD QUALITY CONTROL

A. Site Tests: Refer to Section 04201, Unit Masonry Construction, for load-bearing masonry wall strength tests

END OF SECTION 04060

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PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install masonry anchorages and reinforcing.
   1. Section specifies masonry anchorages and reinforcing for Work specified in:
      a. Section 04201, Unit Masonry Construction.
   2. Types of products required include:
      a. Continuous horizontal wire reinforcing and ties.
      b. Individual wire ties.
      c. Anchoring and positioning devices.
      d. Miscellaneous masonry accessories, reinforcing bars, compressible filler, and pre-molded control joint strips.

B. Coordination:
   1. Provide masonry anchorages and reinforcing of sizes, dimensions and configurations coordinated with unit masonry construction system component sizes, dimensions and configurations.
   2. Where continuous horizontal cavity wall reinforcement is required for restraining cavity wall insulation, coordinate dimensions with specified thickness of cavity wall insulation for proper clearances. Refer to Section 07210, Building Insulation.

1.02 RELATED SECTIONS

A. Section 04201, Unit Masonry Construction.

B. Section 07210, Building Insulation.

C. Section 07620, Sheet Metal Flashing and Trim.

D. Section 07920, Joint Sealants.

E. Section 09900, Painting.

1.03 REFERENCES

A. Reference Standards: Standards referenced in this Section are:
   1. ACI 315, Details and Detailing of Concrete Reinforcement.
   2. ASTM A36/A36M, Specification for Carbon Structural Steel.
   3. ASTM A1064/A1064M, Specification for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
   4. ASTM A153/A153M, Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
   5. ASTM A240/A240M, Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
   6. ASTM A615/A615M, Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   7. ASTM A663/A663M, Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties.
   8. ASTM A1008/A1008M, Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

9. 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.
10. ASTM D2240, Test Method for Rubber Property – Durometer Hardness.
11. ASTM D2287, Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
12. UL U901, Bearing Wall Rating – 4 HR.; Nonbearing Wall Rating – 4 HR (ANSI/UL 263).
13. UL U902, Bearing Wall Rating – 4 HR., Alternative Detail (ANSI/UL 263).
14. UL U904, Bearing Wall Rating – 3 HR.; Nonbearing Wall Rating – 3 HR (ANSI/UL 263).
15. UL U905, Bearing Wall Rating – 2 HR.; Nonbearing Wall Rating – 2 HR (ANSI/UL 263).
16. UL U906, Bearing Wall Rating – 2 HR.; Nonbearing Wall Rating – 2 HR (ANSI/UL 263).
17. UL U907, Nonbearing Wall Rating – 3 or 4 HR (ANSI/UL 263).
18. UL U909, Nonbearing Wall Rating – 3 or 4 HR (ANSI/UL 263).
19. UL U910, Bearing Wall Rating – 4 HR.; Nonbearing Wall Rating – 4 HR (ANSI/UL 263).
20. UL U912, Bearing Wall Rating – 3 HR.; Nonbearing Wall Rating – 3 HR (ANSI/UL 263).
21. UL U913, Bearing Wall Rating – 2 HR.; Nonbearing Wall Rating – 2 HR (ANSI/UL 263).
22. UL U914, Bearing Wall Rating – 3 HR.; Nonbearing Wall Rating – 3 HR (ANSI/UL 263).

1.04 QUALITY ASSURANCE

A. Component Supply and Compatibility:
   1. Provide all metal sheet, wire, plate and bar stock masonry anchorages and reinforcing from same manufacturer.
   2. Miscellaneous masonry accessory items other than metal sheet, wire, plate and bar stock shall each be obtained from a single, manufacturer, which may be different from the manufacturer of other products specified in this Section.

B. Regulatory Requirements: Where fire-resistance classification (four-hour, three-hour, and similar designations) is shown or indicated for unit masonry construction, provide masonry anchorages and reinforcing complying with requirements established by UL tests referenced in this Section (UL U901 through UL U914, as applicable), Laws and Regulations, and requirements of authorities having jurisdiction.

1.05 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Submit drawings and material schedules showing all dimensions and sizes of masonry anchorages and reinforcing coordinated with unit masonry Work and other Work in which masonry anchorages and reinforcing will be embedded, be supported from, or restrained.
      b. Submit schedule indicating type, location, and spacing of each masonry accessory in unit masonry construction and that type, location, and spacing are in compliance with code requirements.
   2. Product Data: Manufacturer’s product literature and specifications for each masonry accessory required. Include data substantiating that materials comply with the Contract Documents.
   3. Samples: One unit or one modular length of each item specified.

B. Informational Submittals: Submit the following:
   1. Manufacturer's Instructions: Manufacturer’s instructions for handling, storing, and installing for each masonry accessory required.

1.06 DELIVERY, STORAGE AND HANDLING

A. Comply with:
   1. Applicable requirements of standards referenced in this Section.
   2. Section 01610, Transportation and Handling of Materials and Equipment.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Continuous Horizontal Wire Reinforcing and Ties: Provide the following for all masonry walls unless otherwise shown or indicated:
   1. General: Provide the following:
      a. Reinforcement, wire and ties of cold-drawn steel wire complying with ASTM A1064 and hot-dipped galvanized after fabrication with 1.5 ounces per square foot of zinc coating complying with ASTM A153.
      b. Welded wire units, prefabricated in straight lengths, at least ten feet long, with matching corner “L” and intersection “T” units, all with deformed continuous nine-gage side rods and plain nine-gage truss-type diagonal cross-rods, butt-welded to side rods, not more than 16 inches on centers, with unit width of 1.5 to two inches less than thickness of wall or partition.
      c. Rectangular boxes, pintles and ties fabricated of 3/16-inch diameter wire, unless otherwise specified.
   2. Single-wythe and Multi-wythe Masonry Walls (except cavity wall):
      a. Wall reinforcement system with one horizontal rod beneath each unit masonry face shell wall.
      b. Products and Manufacturers: Provide products of one of the following:
         1) Truss Mesh Reinforcement with #120 Truss-Mesh by Hohmann & Barnard, Inc.
         2) #DA 3100 Truss by Dur-O-Wal, Division of Dayton Superior.
         3) Or equal.
   3. Multi-wythe Masonry Cavity Walls:
      a. Tab-type wall reinforcing and support system with single pair of side rods in interior wythe, four-inch wide boxes with restraint bar welded across box and adjustable rectangular pintle ties spaced not more than 16 inches on centers. Space side rods for embedment in each face shell wall of back-up wythe and extend box to allow engagement of rectangular pintle box tie for proper embedment in facing wythe.
      b. Products and Manufacturers: Provide one of the following:
         1) #165 Truss, by Hohmann & Barnard, Inc.
         2) DA 3300 - Adjustable Dur-O-Tab with Restraint Bar, by Dur-O-Wal, Division of Dayton Superior.
         3) Or equal.
         4.) Provide special, custom-fabricated shapes to accommodate curved cavity, multi-wythe and single-wythe wall construction.

B. Individual Wire Ties for Masonry: Provide the following where shown:
   1. General: Provide the following:
      a. Reinforcing, wire, and ties of cold-drawn steel wire complying with ASTM A82 and hot-dipped galvanized after fabrication with 1.5 ounces per square foot of zinc coating complying with ASTM A153.
      b. Crimped with vee-drip for use in cavity wall construction and of length required for proper embedment in outer-most face shell walls of wythes of masonry shown or indicated.
      c. Rectangular box ties and adjustable box ties fabricated of 3/16-inch diameter wire.
   2. Single-piece Ties (where facing and back-up joints align):

a. For use with hollow masonry units laid with cells vertical and with solid masonry units or hollow units laid with cells horizontal, provide four-inch wide rectangular shaped box-ties.
b. Products and Manufacturers: Provide one of the following:
1) Rectangular Box Ties, by Hohmann & Barnard, Inc.
2) No. 253 Rectangular Wire Ties, by Heckmann Building Products.
3) Or equal.

C. Anchoring Devices for Masonry: Provide the following, unless otherwise shown or indicated:
1. General: Provide the following:
a. Cold-rolled steel sheet complying with ASTM A1008; hot-rolled steel sheet and strip complying with ASTM A1011; plates and bars complying with ASTM A36; and cold-drawn steel wire complying with ASTM A82 all hot-dipped galvanized after fabrication with 1.5 ounces per square foot of zinc coating complying with ASTM A153
b. Rectangular, corrugated, one-inch wide ties, fabricated of 12-gage sheet metal, unless otherwise specified.
c. Size tie lengths to extend to within one-inch of outside face of outer wythe face shell of opposite face of masonry or to a maximum depth of 12 inches and between 1.5 to two inches less than width of masonry abutting webs and to maximum depth of 12 inches abutting flanges of structural supports. Provide wire crimped with a vee-drip for use in cavity wall construction.
d. Flexible Anchors: Where masonry abuts structural walls or framework, provide flexible anchors that allow horizontal and vertical movement of masonry, but provides lateral restraint.
2. Anchorage to Cast-in-Place Concrete Walls, Columns and Spandrels: Provide the following for lateral restraint of unit masonry walls abutting cast-in-place concrete members:
a. Two-piece anchors with 14-gage dovetail head and 3/16 inch diameter by 7 inch long flexible dovetail brick tie, as shown.
b. Products and Manufacturers: Provide one of the following:
1) #315 - Flexible Dovetail Brick Tie and #305 - Dovetail Slot, by Hohmann & Barnard, Inc.
2) No. 103 - Dovetail Triangular Tie and No. 100 - Standard Anchor Slot, by Heckmann Building Products.
3) Or equal.
3. Anchorage to Steel Columns and Steel Beam Webs: Provide the following for lateral restraint of unit masonry walls at structural steel framework:
a. U-shaped, 7.5-inch long channels welded to steel structure, with 5.5 inches of vertical adjustment, fabricated from 11-gage steel with slotted ties.
b. Products and Manufacturers: Provide one of the following:
1) #360 - Gripstay Channels and #364 - Corrugated Gripstay Anchor, by Hohmann & Barnard, Inc.
2) No. 130 Channel Anchor Slots and No. 134 Corrugated Anchor, by Heckmann Building Products.
3) Or equal.
4. Anchorage to Bottom of Concrete Beams and Slabs and Bottom of Steel Beam Flanges: Provide the following for lateral restraint of unit masonry walls at bottom of beam flanges and concrete slabs:
a. Products and Manufacturers: Provide one of the following:
1) #PTA - 420 - Partition Top Anchors with PTA Tube, by Hohmann & Barnard, Inc.
2) #419 Pin Type with #421 Plastic Tube, by Heckmann Building Products.
3) Or equal.

b. Factory-fabricated partition anchor assembly consisting of 1/4-inch thick plate welded to 3/8-inch diameter, eight-inch long rod at center of plate face. Provide plate with two holes to accept fasteners.
c. Clear acrylic tube with compressible polyethylene filler, one for each rod.

5. Lateral Supporting Masonry Wall Anchors: Provide the following for bracing freestanding walls exceeding allowable unbraced span:
   a. Products and Manufacturers: Provide one of the following:
      1) #344 Rigid Partition Anchor, by Hohmann & Barnard, Inc.
      2) #140 Masonry Anchor, by Heckmann Building Products.
      3) Or equal.
   b. Plate, 1/4-inch thick by two inches wide fabricated with two-inch long bent legs at 90 degrees to flat face of anchor and of length to extend to center of each wythe of wall, but not less than 2.33 feet long. Cut to length as required.
6. Rebar Positioners: Provide the following:
   a. Products and Manufacturers: Provide one of the following:
      1) #RB Series and #RB-Twin Series Rebar Positioners, by Hohmann & Barnard, Inc.
      2) Rebar Positioners, by Heckmann Building Products.
      3) Or equal.
   b. Nine-gage reinforcing bar positioners that accommodate both horizontal and vertical reinforcing steel.
   c. Fabricate units as required for the Work.

D. Miscellaneous Masonry Accessories: Provide the following where shown:
1. Reinforcing Bars:
   a. Deformed carbon steel, ASTM A615, Grade 60 for bars No. 3 to No. 18, except as otherwise shown.
   b. Plain carbon steel, ASTM A663, Grade 80 where No. 2 bars are shown or required.
   c. Provide galvanized steel reinforcing bars complying with ASTM A153, Class B-1, where shown.
2. Compressible Filler: Provide watertight joint filler where unit masonry construction abuts structural framework members, or as shown. Provide the following:
   a. Products and Manufacturers: Provide one of the following:
      1) Polytite Standard, by Polytite Manufacturing Corp.
      2) Polyseal, by Sandell Manufacturing Company, Inc.
      3) Or equal.
   b. Polyurethane foam strip saturated with polybutylene waterproofing material that, when installed at a compression ratio of two-to-one, is impermeable to water.
   c. Resilient to -40 degrees F with 100 percent movement recovery.
   d. Elongation of 140 percent with a tensile strength of not less than 53 pounds per square inch.
3. Masonry Control Joint Components: Provide the following:
   a. Premolded Control Joint Strips: Provide complete selection of solid extruded rubber and PVC strips with a Shore A durometer hardness of 80 to 90 complying with ASTM D2240 and ASTM D2287, designed to fit standard sash block and maintain lateral stability in masonry wall. Size and configuration shall be as shown.
      1) Products and Manufacturers: Provide one of the following:
      2) #RS-12 - Control Joints, by Hohmann & Barnard, Inc.
      3) 352-12 Control Joints, by Heckmann Building Products.
      4) Or equal.
   b. Sealants: Refer to Section 07920, Joint Sealants.
4. Weep Holes: Provide the following:
   a. Products and Manufacturers: Provide one of the following:
      1) #342 - Plastic Weep Holes, by Hohmann & Barnard, Inc.
      2) No. 330 Plastic Weepholes, by Heckmann Building Products.

3) Or equal.
b. Rectangular 3/8-inch wide by 1.5 inches high, 3.5 inches long clear butyrate tubes.
4. Weep Vents: Provide the following:
a. Products and Manufacturers: Provide one the following:
1) Goodco Brick Vents, by Williams Products, Inc.
2) No. 602 Louvered Weep Holes and Vents, by WIRE-BOND.
3) Or equal.
b. Provide injection molded flexible polyvinylchloride brick vents of custom color to match face brick mortar color with top flap, flexible side wings, vertical louvers and water ridges.
5. Cavity Fill Mesh: Provide the following:
a. Products and Manufacturers: Provide one of the following:
1) #MGS - Mortar/Grout Screen, by Hohmann & Barnard, Inc.
2) No. 267 Plastic Mesh Wall Ties, by Heckmann Building Products.
3) Or equal.
b. Monofilament screen of polypropylene polymers 1/4-inch mesh hardware cloth. Provide below all block courses that are to be filled with mortar.
6. Cavity Drainage Material:
a. Manufactured of high density polyethelene or nylon strands woven into a 90 percent open mesh
1) Product and Manufacturer: Provide one of the following:
a) Mortar Net, by Hohmann and Barnard, Inc.
b) Mortar Net, by Heckmann Building Products.
c) Or equal.
7. Imbedded Flashing Materials:
a. Metal Flashing: Refer to Section 07620, Sheet Metal Flashing and Trim.

2.02 FABRICATION

A. Shop-fabricate reinforcing bars that are shown or required to be bent or hooked. Comply with ACI 315 for fabricating reinforcing steel for unit masonry Work.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Refer to the following:
1. Section 04201, Unit Masonry Construction.

END OF SECTION 04090

PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install all unit masonry construction.

B. The Work also includes providing openings in unit masonry construction to accommodate the Work under this and other Sections and building into unit masonry construction all items such as sleeves, anchorage devices, inserts, and other items to be embedded in unit masonry construction for which placement is not specifically included under other Sections.

C. Coordination:
   1. Review installation procedures under other Sections and coordinate the installation of items to be installed with or before unit masonry construction Work.
   2. Remove and rebuild unit masonry construction advanced without built-in flashings and other built-in items at no additional cost to Owner, even after unit masonry construction has been completed.

1.02 RELATED SECTIONS

A. Section 04060, Masonry Mortaring and Grouting.

B. Section 04090, Masonry Anchorage and Reinforcing.

C. Section 05501, Miscellaneous Metal Fabrications.

D. Section 06100, Miscellaneous Rough Carpentry.

E. Section 07210, Building Insulation.

F. Section 07620, Sheet Metal Flashing and Trim.

G. Section 07920, Joint Sealants.

H. Section 09900, Painting.

1.03 REFERENCES

A. Standards referenced in this Section are:
   1. ACI 530, Building Code Requirements for Masonry Structures.
   2. ACI 530.1, Specification for Masonry Structures.
   3. ASTM C67, Test Methods for Sampling and Testing Brick and Structural Clay Tile.
   4. ASTM C140, Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
   5. ASTM C780, Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unity Masonry.
   6. ASTM C1091, Test Method for Hydrostatic Infiltration Testing of Vitrified Clay Pipe Lines.
   7. ASTM C1093, Practice for Accreditation of Testing Agencies for Unit Masonry.
   8. ASTM C1314, Test Method for Compressive Strength of Masonry Prisms.
   9. BIA, Technical Notes on Brick Construction.

1.04 TERMINOLOGY

A. The following words or terms are not defined but, when used in this Section, have the following meaning:
   1. “Masonry control joint” is a joint in interior and exterior masonry walls that allows expansion and contraction to occur independently without damage to the masonry.
   2. “Masonry expansion joint” is a control joint in interior and exterior masonry walls, located at the separation between adjoining parts of a concrete or steel structure that is provided to allow movements transferred to the masonry to occur independently without damage to the masonry.

1.05 QUALITY ASSURANCE

A. Qualifications:
   1. Installer:
      a. Engage a single installer regularly engaged in preformed unit masonry installation and with successful and documented experience in erecting unit masonry of the scope and type of Work required; and who employs only tradesmen with specific skill and successful experience in the type of Work required. Submit name and qualifications with the following information for a minimum of three successful projects:
         1) Names and telephone numbers of owners, architects, or engineers responsible for projects.
         2) Approximate contract cost of unit masonry.
         3) Quantity (area) of unit masonry installed.
   2. Testing Laboratory:
      a. In accordance with ASTM C1093.

B. Component Supply and Compatibility:
   1. Obtain each type of concrete masonry units from one manufacturer, cured by one process and of uniform texture and color or in an established uniform blend thereof.
   2. Use a single source and brand of mortar materials throughout the Work.

C. Regulatory Requirements: Where fire-resistance classification is shown or indicated (e.g., four-hour rating, three-hour rating, and similar designations) for unit masonry construction, comply with applicable requirements for materials and installation established by UL tests referenced in this Section and requirements of authorities having jurisdiction .

D. Job Mock-up:
   1. Prior to installing unit masonry and after Engineer’s approval of Samples, erect job mock-ups using materials, pattern bond, and joint tooling shown or specified. Build mock-up at the Site, at location acceptable by Engineer, of full required wall thickness. Mock-up shall be approximately four feet by 3.33 feet unless another size or location is shown or indicated for the job mock-up. Provide special features as directed, including finished opening 16 inches by 16 inches, finished end, and masonry control joint. Indicate proposed range of color, texture, and workmanship to be expected in the completed Work. Obtain Engineer’s approval of visual qualities of mock-up before starting unit masonry construction. Retain and protect mock-up during construction as a standard for judging unit masonry Work. Do not alter, move, or destroy mock-up until given permission by Engineer.
   2. Build as many mock-up panels as required to obtain Engineer’s approval.
   3. Masonry construction that does not comply with standards approved on mock-up panel shall be removed and rebuilt to conform to the Contract Documents. Provide mock-up panel for the following:

a. Typical complete exterior walls, including metal cavity wall flashing, anchors and masonry wall ties, and other components of complete exterior wall system.
b. Typical complete interior partition of concrete unit masonry where both sides will remain visually exposed upon completion of the Work.
c. Typical interior prefaced concrete masonry partition using all shapes and accessories shown on the approved Shop Drawings and other submittals.
d. Typical interior partition of concrete unit masonry using all shapes and accessories shown or indicated on the approved Shop Drawings and other submittals.

E. Pre-Construction Masonry Conference:
1. Prior to installing unit masonry construction, Contractor and Contractor's installer shall attend pre-construction masonry conference at the Site. Review foreseeable methods and procedures related to unit masonry construction including, but not limited to, the following:
a. Requirements of the Contract Documents.
b. Structural concept.
c. Sequence of masonry construction.
d. Special masonry details.
e. Standard of workmanship.
f. Prism and grout sampling, and unit masonry test results.
g. Quality control requirements.
h Project organization and availability of materials, tradesmen, equipment, and facilities required to avoid delays.
i. Masonry control and expansion joint locations and materials.
j. Modular planning requirements.
k. Weather and forecasted weather conditions, and procedures for coping with unfavorable conditions.
l. Required inspection, testing, and certifying procedures.
m. Requirements for complying with building codes.
2. Attendance at the conference is mandatory for the following:
a. Masonry Subcontractor's superintendent and foreman.
b. Authorized representative of face brick and concrete unit masonry Suppliers.
c. Engineer
d. Resident Project Representative.
e. Coordinating Special Inspector.
3. If additional information is required to adequately cover items on agenda, reconvene conference as soon as possible.
4. Contractor shall record discussions of conference and decisions and agreements (or disagreements) and furnish a copy of the record to each person and entity attending.

1.06 SUBMITTALS

A. Action Submittals: Submit the following:
1. Shop Drawings:
a. Complete layout of all masonry walls showing modular planning and all special shapes to be used in the Work. Show all details for each condition encountered in the Work. Submit plan and elevation views drawn at scale of 1/4-inch equal to one foot, and details drawn at scale of 1.5-inch equal to one foot. Show all items included in the unit masonry construction.
b. Masonry control joint locations and details.
c. Drawings showing location, extent, and accurate configuration and profile of all items required by the Contract Documents, in this and other Sections, for unit masonry construction. Provide elevations drawn at scale of 1/4-inch equal to one foot, and details drawn at scale of 1.5-inch equal to one foot.

d. Drawings for fabricating, bending, and placing of reinforcing bars. Submit bar schedules, diagrams of bent bars, stirrup spacing, lateral ties, and other arrangements and assemblies required for fabricating and placing of reinforcing for unit masonry construction.
e. Job Mock-Up: Shop Drawings showing location, extent, and accurate configuration of items to be built-in to mock-ups. Provide elevations drawn at scale of 1.5-inch equal to one foot.

2. Samples: Mock-ups.

B. Informational Submittals: Submit the following:
1. Field Quality Control Submittals:
a. Pre-installation test results in accordance with ASTM C140 and ASTM C1314, and the field quality control Article of this Section.
b. Post-installation quality control submittals in accordance with the field quality control Article of this Section.
2. Qualifications Statements:
a. Installer.
b. Testing laboratory.

C. Closeout Submittals: Submit the following:
1. Record Documentation:
a. Comply with Section 01720, Record Documents.
b. Indication location of all masonry control joints and expansion joints.

1.07 DELIVERY, STORAGE AND HANDLING

A. General:
1. Comply with Section 01600, Delivery, Storage and Handling.
2. Storage: Maintain temperatures in shelter so that masonry materials are above 20 degrees F when installed.

1.08 SITE CONDITIONS

A. Environmental Requirements:
1. General:
a. Temporary Facilities and Temporary Utilities: Provide supplemental heat sources and energy as required for unit masonry construction in cold weather.
b. Do not perform unit masonry construction when air temperature is below 28 degrees F for rising temperature, or below 36 degrees F for falling temperatures, without providing temporary enclosures and heat, or without heating materials or other measures necessary to prevent freezing as specified.
c. Do not use frozen materials and do not build on frozen unit masonry construction.
d. Remove and replace all unit masonry construction damaged by cold temperatures and freezing.
2. Protection:
a. Cold Weather Protection: Protect unit masonry construction against freezing for at least 48 hours after placement, as follows:
1) When anticipated minimum temperature will be between 40 degrees F and 25 degrees F, cover newly constructed masonry with weather-resistive membrane for 48 hours after installation.
2) When anticipated minimum temperature will be between 25 degrees F and 20 degrees F, completely cover newly constructed masonry with weather-resistive insulating blankets, or equal protection, for 48 hours after installation.
3) When anticipated minimum temperature will be below 20 degrees F, maintain newly constructed masonry at temperature above 32 degrees F for at least 48

hours after installation by using heated enclosures, electric heating blankets, infrared lamps, or other acceptable methods of supplementary heating.

b. Hot Weather Protection: When mean daily temperature exceeds 100 degrees F, or exceeds 90 degrees F with wind velocity greater than eight miles per hour, fog-spray newly constructed masonry until damp at least three times per day until masonry is 72 hours old.

c. When Work is not in progress, protect partially-completed unit masonry construction against rapid heat loss and from water entering the masonry by covering top of walls with strong, waterproof, non-staining membrane. Extend membrane at least two feet down both sides of wall and secure in place using wall cover clamps spaced at intervals of four feet and at each end, and at joints in the membrane.

d. Do not apply floor or roof loading for at least 72 hours after completing masonry columns or walls.

e. Do not apply concentrated loads for at least 168 hours after completing masonry columns or walls.

3. Cold Weather Unit Masonry Construction:

a. When mean daily temperature is below 40 degrees F, mortar used in unit masonry construction shall be portland cement-lime-sand mortar using high-early strength portland cement. Use mortar within 1.5 hours of initial mixing. Use grout within 1.5 hours of initial mixing.

b. Clay or shale unit masonry with suctions in excess of 20 grams of water per 30 square inches per minute shall be sprinkled with heated water just prior to installation. Provide water temperature above 70 degrees F when temperature of masonry units is above 32 degrees F. Water temperature shall be above 120 degrees F when temperature of masonry units is below 32 degrees F.

c. For Air Temperatures of 40 degrees F to 32 degrees F: Water and aggregates used in mortar and grout shall not be heated above 140 degrees F. Heat mortar sand or mixing water to produce mortar temperatures between 40 degrees F and 120 degrees F at time of mixing. Heat water and aggregates for grout when water or aggregate temperature is below 32 degrees F.

d. For Air Temperatures of 32 degrees F to 25 degrees F: Comply with Paragraph 1.7.A.3.c of this Section and the following: Maintain mortar temperature above freezing until used in masonry. Heat aggregates and mixing water for grout to produce grout temperature between 70 degrees F and 120 degrees F at time of mixing. Maintain grout temperature above 70 degrees F at time of grout placement.

e. For Air Temperatures of 25 degrees F to 20 degrees F: Comply with Paragraphs 1.7.A.3.c and 1.7.A.3.d of this Section and the following: Heat masonry surfaces under construction to 40 degrees F. Provide temporary wind breaks or enclosures when wind velocity exceeds 15 miles per hour. Prior to grouting, heat the masonry to minimum of 40 degrees F.

f. For Air Temperatures of 20 degrees F and Below: Comply with Paragraphs 1.7.A.3.c, 1.7.A.3.d, and 1.7.A.3.e of this Section and the following: Provide temporary enclosures and auxiliary heat to maintain air temperature within temporary enclosure above 32 degrees F. Temperature of masonry units when laid shall not be less than 20 degrees F.

4. Hot Weather Unit Masonry Construction: Using methods acceptable to Engineer, protect unit masonry construction from direct exposure to wind and sun when ambient air temperature is 99 degrees F in shade with relative humidity less than 50 percent.

a. When ambient temperature exceeds 100 degrees F, or exceeds 90 degrees F with wind velocity greater than eight miles per hour, maintain temperature of mortar and grout below 120 degrees F. Flush mixers, mortar transport containers, and mortarboards with cool water before they come into contact with mortar ingredients or mortar. Maintain mortar consistency by re-tempering with cool water. Use mortar within two hours of initial mixing. Use grout within 1.5 hours of initial mixing. Maintain sand piles in damp, loose condition.

b. When ambient temperature exceeds 115 degrees F, or exceeds 105 degrees F with wind velocity greater than eight miles per hour, comply with Paragraph 1.7.A.4.a of this Section and the following: Use cool mixing water for mortar and grout. Use of ice will be allowed in mixing water prior to use; ice is not allowed in the mixing water when added to other mortar or grout materials. Shade materials and mixing equipment from exposure to direct sunlight.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Material requirements for masonry materials are in the following:
   1. Section 04060, Masonry Mortaring and Grouting.
   2. Section 04090, Masonry Anchorage and Reinforcing.
   3. Section 04211, Brick Masonry.
   4. Section 04220, Concrete Unit Masonry.

B. Mortar, General:
   1. Where question of compliance with or interpretation of requirements of this Section arises, mortar properties Specification will take precedence over mortar proportion Specifications.
   2. Make no change in proportions established for mortar approved under property Specifications, and do not use materials with different physical characteristics in mortar unless compliance with requirements of property Specifications is re-established by Shop Drawing or submittal data.
   3. Do not combine two air-entraining materials in mortar.

PART 3 – EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which unit masonry construction will be installed, and notify Engineer in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Wetting of Masonry Units:
   1. Face Brick: Wet brick having ASTM C67 absorption rates in excess of 20 grams of water per 30 square inches per minute, so that rate of absorption when laid does not exceed the following.
      a. Determine absorption by placing 20 drops of water using medicine dropper inside one-inch diameter circle on typical brick units. If water is absorbed within 90 seconds, wet the brick before laying.
   2. Use wetting methods that ensure that each masonry unit is nearly saturated, but surface-dry when laid.
   3. Concrete Masonry Units: Except for absorbent units specified to be wetted, lay masonry units dry. Do not wet concrete masonry units.

B. Cleaning of Reinforcing: Before placing, remove loose rust, mill scale, earth, ice, and other contamination from reinforcing materials. Do not use reinforcing bars with kinks or bends not shown or approved Shop Drawings, or bars with reduced cross-section due to rusting or other causes.

3.03 INSTALLATION, GENERAL

A. Thickness: Build walls, floors, and other unit masonry construction to thickness shown or indicated. Build single wythe walls to actual thickness of masonry units using units of nominal thickness shown or indicated.

B. Build chases and recesses as shown or required by others, as specified. Provide not less than eight inches of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.

C. Leave openings for equipment, piping, ducts, and other items to be installed subsequent to starting unit masonry construction. After installation of said items, complete unit masonry construction to match the Work immediately adjacent to openings.

D. Cut masonry units using motor-driven wet cutting saws to provide clean, sharp, unchipped edges. Cut units as required to provide pattern shown and to fit adjoining Work neatly. Use full-size units without cutting where possible. Provide special unit masonry shapes for transitions and intersections. Do not attempt to field-cut special shapes from regular unit masonry shapes, and do not use other options for special unit masonry shapes.

E. Build interior masonry walls visible from both sides in the finished Work using two wythes of masonry. Masonry shall be continuous over entire plane of wall, including walls that continue behind fixtures, equipment, furniture, lockers, and similar items

F. Matching Existing Masonry: Match with existing masonry the coursing, pattern bond, color, and texture of new unit masonry construction

3.04 LAYING MASONRY WALLS

A. General:
   1. Mortar Types: Unless otherwise shown or indicated, use mortar specified in Section 04060, Mortar and Masonry Grout, as follows:
      a. Use Type S mortar for other exterior walls and interior load-bearing walls.
      b. Use Type N mortar for interior, non-load-bearing walls.
      c. Use grout fill for structural requirements and for grouting reinforcing steel in unit masonry construction.
      d. Do not use mortar that has begun to set or if more than thirty minutes have elapsed since initial mixing. Re-temper mortar during the thirty-minute period only as required to restore workability.
   2. Lay out walls in advance for accurate spacing of surface pattern bond with uniform joint widths and to properly locate openings, masonry control joints, returns, and offsets. Avoid using less than half-size units at corners, jambs, and where possible at other locations.
   3. Lay up walls plumb and true to comply with specified tolerances, with courses level, accurately spaced, and coordinated with other work.
   4. Pattern Bond:
      a. Lay exterior, and interior concrete unit masonry in running bond pattern with vertical joints in each course centered on units in courses above and below. Avoid using less than full-size units.
      b. Lay concrete unit masonry scheduled or shown to be concealed by finish materials, except paint, with units in wythe bonded by lapping not less than two inches.
      c. Do not use units with less than four-inch horizontal face dimensions at corners or jambs.
   5. Color and Texture:
      a. Lay brick masonry using mortar of natural color.
      b. Lay concrete unit masonry using mortar of natural color.

B. Construction Tolerances:
   1. Variation from Plumb: For lines and surfaces of columns, walls and arises, do not exceed 1/4-inch in ten feet, or 3/8-inch in a story height (20 feet), maximum, nor 1/2-inch in 40 feet or more. Except for external corners, expansion joints and other conspicuous lines, do not exceed 1/4-inch in any story or 20 feet maximum, nor 1/2-inch in 40 feet or more.
   2. Variation from Level: For lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, do not exceed 1/4-inch in any bay or 20 feet maximum, nor 3/4-inch in 40 feet or more.
   3. Variation of Linear Building Line: For position shown and related portion of columns, walls and partitions, do not exceed 1/2-inch in any bay or 20 feet maximum, nor 3/4-inch in 40 feet or more.
   4. Variation in Cross Sectional Dimensions: For columns and thickness of walls, from dimensions shown, do not exceed minus 1/4-inch nor plus 1/2-inch.

C. Mortar Bedding and Jointing:
   1. Lay solid masonry units with completely filled bed and head joint; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints.
   2. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course of piers, columns, and pilasters, and where adjacent to cells or cavities to be reinforced or filled with concrete or grout.
   3. Maintain joint widths shown, except for minor variations required to maintain pattern bond alignment. If not shown, lay unit masonry to provide the following joint widths:
      a. Brick and Concrete Unit Masonry: 3/8-inch.
   5. Cut joints flush for masonry walls to be concealed or to be covered by other materials, except paint, unless otherwise shown.
   6. Tool exposed joints slightly concave, when mortar is “thumbprint hard”, unless otherwise required to match existing joint treatment. Rake out mortar 1/2-inch deep in preparation for application of calking or sealants.
   7. Concave-tool exterior joints below grade.
   8. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners at jambs to fit stretcher units that have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.

D. Collar Joints: Fill vertical space between wythes solidly with mortar by parging the in-place wythe and shoving units into the parging.

E. Stopping and Resuming Work: Rake back one unit masonry length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly, if required, and remove loose masonry units and mortar prior to laying new masonry.

F. Built-in Work:
   1. As the Work progresses, build-in the items shown, specified or required in the Contract Documents. Fill cores in one-block width solidly with mortar around built-in items.
   2. Do not fill space between hollow metal frames and masonry solidly with mortar.
   3. Where built-in items are to be embedded in cores of hollow masonry units, place layer of cavity fill mesh in the joint below and rod mortar or grout into core.
   4. Where required by Laws or Regulations, or to comply with thickness-to-height ratio, or to provide required fire resistance, fill all cells of unit masonry construction solid with grout.

G. Structural Bonding of Multi-Wythe Masonry:
   1. Use individual metal ties embedded in horizontal joints to bond wythes together Refer to Section 04090, Masonry Anchorage and Reinforcing, for type of ties required. Provide ties as shown, but not less than one metal tie for four square feet of wall area spaced not to exceed two feet on centers horizontally and vertically. Stagger ties in alternate

courses. Provide additional ties within 12 inches of openings and space not more than three feet apart around perimeter of openings.

2. Use continuous reinforcing embedded in horizontal mortar joints for bond tie between wythes as specified in this Section.
3. Corners: Provide interlocking masonry unit bond in each course at corners, unless otherwise shown or indicated.
   a. For horizontally reinforced masonry, provide continuity at corners with prefabricated “L” units as specified in this Section, in addition to masonry bonding.
4. Intersecting and Abutting Walls: Unless vertical expansion or masonry control joints are shown at juncture, provide same type of bonding specified for structural bonding between wythes and space as follows:
   a. Provide masonry bond in alternate courses.
   b. Provide individual metal ties at not more than two feet on centers vertically.
   c. Provide continuity with horizontal joint reinforcing using prefabricated “T” and “L” units.

H. Non-Load-Bearing Interior Partitions and Non-Load-Bearing Interior Cavity Wall Wythe:
1. Build full height of story to underside of structure above, unless otherwise shown or indicated.
2. Tie non-load-bearing partitions and non-load-bearing interior wythe of cavity walls at top and sides with masonry anchors at terminations. Build in end blocks as shown and specified to facilitate placing compressible filler. Insert compressible filler, specified in Section 04090, Masonry Anchorage and Reinforcing, in all horizontal and vertical joints where non-load-bearing masonry and non-load- bearing interior wythe of cavity walls terminate. Insert filler 3/4-inch from both faces of masonry. Use filler four times as thick as widest part of joint. Thickness of filler shall be a minimum of 1.5 times the compressed thickness. Compress filler to less than thickness of joint and insert. At splices, overlap strips by three inches and compress ends to form tight joint. Finish with backer rod and sealant.
3. At terminations of non-load-bearing masonry walls and non-load-bearing interior wythe of cavity walls requiring a fire rating, use fire-safing insulation specified in Section 07210, Building Insulation. Build in end blocks to facilitate placing fire-safing insulation. Insert insulation in a continuous, vapor-tight, solid blanket to 3/4-inch from both faces of masonry. Finish with backer rod and sealant.

I. Cavity Walls:
1. Verify that fluid applied membrane air barrier is installed.
2. Position insulation as shown and in accordance with Section 07210, Building Insulation.
3. Install cavity drainage material.
4. Keep cavity clean of mortar droppings during construction by using continuous horizontal board of same width as cavity with lifting wires at each end. Lift board upward before placing horizontal joint reinforcing. Clean mortar droppings from board. Do not clean into cavity. Joints facing cavity shall be struck flush.
5. Tie exterior wythe to back-up with individual metal ties spaced not more than 16 inches on centers vertically and 16 inches on centers horizontally. Stagger in alternate courses.
6. Tie exterior wythe to back up with continuous horizontal joint reinforcing, embedded in mortar joints at not more than 16 inches on centers vertically. Refer to Section 04090, Masonry Accessories, for type of reinforcing required.
7. Provide weep holes in exterior wythe of cavity wall located in wall foundation courses and immediately above ledges and flashing, spaced two feet on centers, unless closer spacing is shown or indicated. Install plastic weep tubes. Keep weep holes free of mortar and other obstructions.
8. Provide weep vents in exterior wythe of cavity wall in wall top courses and immediately below ledges and flashing, spaced two feet on centers, unless closer spacing is shown or

indicated. Provide plastic weep vents. Keep weep vents free of mortar and other obstructions.

J. Horizontal Joint Reinforcing:
   1. Provide continuous horizontal joint reinforcing as shown and specified. Refer to Section 04090, Masonry Accessories, for reinforcing units required. Fully embed longitudinal side rods in mortar for entire length of rods with minimum cover of 5/8-inch on exterior side of walls and 1/2-inch at other locations. Lap reinforcing minimum of six inches at ends of units. Do not bridge masonry control joints and building expansion joints with reinforcing.
   2. Reinforce walls with continuous horizontal joint reinforcing unless specifically indicated as being omitted.
   3. Provide continuity at corners and wall intersections by using prefabricated “L” and “T” sections. Cut and bend units in accordance with manufacturer’s written instructions for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.
   4. Space continuous horizontal reinforcing as follows:
      a. For multi-wythe walls, solid or cavity, that are structurally bonded by masonry headers or individual wire ties, space horizontal reinforcing two feet on centers vertically.
      b. For multi-wythe walls, solid or cavity, where continuous horizontal reinforcing also acts as structural bond or tie between wythes, space reinforcing as required by Laws and Regulations, but not more than 16 inches on centers vertically.
      c. For single-wythe walls, space reinforcing at 16 inches on centers vertically, unless otherwise shown.
      d. For parapets, space reinforcing at eight inches on centers vertically, unless otherwise shown.
   5. Reinforce masonry openings greater than 12 inches wide, with horizontal joint reinforcing placed in two horizontal joints approximately eight inches apart, immediately above lintel and immediately below sill. Extend reinforcing a minimum of two feet beyond jambs of opening.
   6. In addition to wall reinforcing, provide additional reinforcing at openings as required to comply with the above.

K. Structural Reinforced Unit Masonry Construction:
   1. Comply with ACI 530, ACI 530.1 and Laws and Regulations for structural reinforced unit masonry construction.
   2. Shape and dimension reinforcement as shown and required by applicable ACI standards and Laws and Regulations.
   3. Position reinforcing accurately at spacing shown on approved Shop Drawings. Support and secure vertical bars against displacement using rebar positioners.
   4. Where vertical bars are shown in close proximity, provide clear distance between bars of not less than the greater of the nominal bar diameter or one-inch.
   5. Provide lapped splices with reinforcing steel placed in contact and wire tied. Provide minimum lap required by Laws and Regulations, unless requirements that are more stringent are shown or indicated. Do not splice reinforcing at points other than shown or as approved on Shop Drawings.
   6. Provide substantial and tight formwork and shores as required for temporary support of reinforced masonry elements. Design, erect, support, brace, and maintain formwork.
   7. Construct formwork to conform to shape, line and dimensions shown. Make sufficiently tight to prevent leakage of mortar grout. Brace, tie, and support as required for maintaining position and shape during construction and curing of reinforced masonry.
   8. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and all other temporary loads that may be placed on them during construction.

9. Allow not less than the following duration to elapse after completing a member before removing shores or forms, provided suitable curing conditions have been obtained during the curing period:
    a. Girders and Beams: Ten days.
    b. Slabs: Seven days.
    c. Reinforced Masonry Soffits: Seven days.

L. Grouting Structural Reinforced Unit Masonry Construction:
1. Limit extent of masonry construction to sections that do not exceed the maximum pour requirements specified. Provide temporary dams or barriers to control horizontal flow of grout at ends of wall sections. Build dams to full height of grout pour. If masonry units are used, do not bond into permanent masonry wythes. Remove temporary dams after completing grout pour.
2. Use fine grout for filling spaces less than four inches in both horizontal directions. Use coarse grout for filling spaces four inches or larger in both horizontal directions.
3. For spaces 10 inches and larger, use concrete fill.
4. Low-Lift Grouting:
    a. Use low-lift grouting techniques using fine grout mix for the following:
        1) Two-wythe walls with grout space of two inches or less in width.
        2) Multi-wythe walls.
        3) Grout spaces less than 2-inches in width at intervals not to exceed two feet in lifts of six to eight inches.
        4) At Contractor's option, low-lift-grouting technique may be used for structural reinforced unit masonry construction with grout spaces wider than two inches, except use coarse grout mix and place in lifts not to exceed eight inches in height.
    b. Construct low-lift structural reinforced unit masonry construction by placing reinforcing, laying masonry units and pouring grout as the Work progresses.
    c. Place vertical reinforcing bars and supports prior to laying of masonry units. Extend above elevation of maximum pour height as required to allow for splicing. Horizontal reinforcing bars may be placed progressively with laying of masonry units.
    d. Limit grout pours as required to prevent displacing masonry by grout pressure (blowout), but do not exceed 12-inch pour height.
    e. Lay masonry units prior to each grout pour, but do not construct more than 12 inches above maximum grout pour height in one exterior wythe and four inches above in other exterior wythe. Provide metal wall ties, if required, to prevent blowouts.
    f. Pour grout using container with spout and consolidate immediately by rodding or puddling; do not use trowels. Place grout continuously; do not interrupt pouring of grout for more than one hour. If poured in lifts, place from center-to-center of masonry courses. Terminate pour 1.5 inches below top of highest course in pour.
5. High-Lift Grouting:
    a. High-lift grouting technique may be used for the following structural reinforced unit masonry construction:
        1) Two-wythe walls with grout spaces of 2.5 inches or greater width.
    b. Place reinforcing and support in proper position, prior to laying of masonry units, except if shown to be placed in mortar joints, place as masonry units are laid. Place horizontal bars in grout spaces on same side of vertical bars.
    c. Construct high-lift structural reinforced unit masonry construction by laying masonry to full height and width prior to placing of grout. Provide cleanout holes in first course of masonry, and use high-pressure water jet stream to remove excess mortar from grout spaces, reinforcing bars and top surface of structural members, which support wall. Clean grout spaces daily during construction of masonry.
    d. Walls: Omit every other masonry unit in first course of one wythe to provide cleanout holes. Tie wythes together with metal ties as shown or required by Laws and Regulations, but provide not less than nine-gage wire ties spaced not less than two

feet on centers horizontally and 16 inches on centers vertically for running pattern bond or 12 inches on centers vertically for stack bond.

e. Preparation of Grout Spaces: Prior to grouting, inspect and clean grout spaces. Remove dirt, dust, mortar droppings, loose pieces of masonry, and other foreign materials from grout spaces. Clean reinforcing and adjust to proper positioning. Clean top surface of structural members supporting masonry to ensure bond. After cleaning and inspection, close cleanout holes with matching masonry units and brace closures to resist grout pressures.

f. Place grout after entire height of masonry to be grouted has attained sufficient strength to resist grout pressure, but not less than three days curing time. Install shores and bracing, if required, before starting grouting operations.

g. Place grout by pumping into grout spaces, unless alternate methods are acceptable to Engineer.

h. Use coarse grout mix. Rod or vibrate each grout lift during placing and again after excess moisture has been absorbed, but before plasticity is lost. Do not penetrate or damage grout placed in previous lifts or pours.

i. Limit grout pours to sections that can be completed in one working day with not more than one-hour interruption of pouring operation. Limit pours to not exceed capacity of masonry to resist displacement or loss of mortar bond due to grout pressures.

1) Do not exceed 12 feet pour height.

2) Do not exceed 25 feet horizontal pour dimension.

j. Where pour height exceeds four feet place grout in series of lifts not exceeding four feet in height. Place each lift as continuous pouring operation. Allow at least 30 minutes and not more than 60 minutes between lifts of each pour.

k. When more than one pour is required to complete a section of masonry, extend reinforcing beyond masonry as required for splicing. Pour grout to within 1.5 inches of top course of first pour. After grouted masonry is cured, remove temporary dams, lay masonry units, and place reinforcing for second pour section before grouting.

M. Anchoring Masonry Work:

1. Provide anchoring devices as specified under Section 04090, Anchorage and Reinforcing. If not shown or indicated, provide standard type for facing and back-up involved in compliance with Laws and Regulations.

2. Anchor masonry to structural members where masonry abuts or faces such members to comply with the following:

a. Provide an open space not less than a 1/2-inch or more than one-inch in width between masonry and structural members, unless otherwise shown. Keep open space free of mortar and other rigid materials.

b. Anchor masonry to cast-in-place concrete and structural steel members with metal ties embedded in masonry joints and attached to structure. Provide anchors with flexible tie sections.

c. Space anchors as shown, but not more than two feet on center vertically and three feet on centers horizontally.

d. Provide end blocks where masonry abuts structural support to facilitate installation of compressible filler, fire-safing insulation, backer rod, and sealant.

3. Anchor single-wythe masonry veneer to backing with metal ties as follows:

a. Anchor veneer to structural members with metal anchors embedded in masonry joints and attached to structure. Provide anchors with flexible tie section, unless otherwise shown.

b. Anchor veneer to concrete back-up with dovetail anchors and to structural steel back-up with slotted anchors.

c. Space anchors as shown, but not more than two feet on centers vertically and three feet on centers horizontally.

N. Masonry Control and Expansion Joints:

1. Provide vertical expansion and control joints in masonry where shown. Build in related items as unit masonry construction progresses. Rake out mortar in preparation for application of calking and sealants, in accordance with Section 07920, Joint Sealants.
2. Provide masonry control and expansion joints items specified under Section 04090, Masonry Anchorage and Reinforcing where masonry control and expansion joints are shown.
    a. Build-in compressible fillers as specified. Install in accordance with manufacturer's written instructions.
    b. Build-in factory-premolded control joint strips into masonry. Build-in sash block and premolded control joint strips as the Work progresses.
    c. Provide end blocks where masonry partitions abut structure to facilitate installation of compressible filler, fire-safing insulation, backer rod, and sealant.
3. Brick Masonry Control Joint Spacing: Where location of masonry control joints are not shown, place vertical joints spaced not to exceed 50 feet on centers for clay masonry and 35 feet on centers for concrete masonry wythes if reinforced, or 30 feet on centers for unreinforced concrete masonry wythes. Provide masonry control joints at points of natural weakness in unit masonry construction including the following:
    a. At structural column or joint between bays.
    b. Above expansion or control joints in the supporting structure.
    c. Above major openings at end of lintels upward, and below at ends of sills downward. Place at one side of jamb for openings less than six feet wide and at both sides for openings over six feet wide.
    d. At vertical chases, recesses and other points of reduction in wall thickness.
    e. At locations where masonry wall height changes by more than 20 percent.
    f. Where masonry abuts supporting structure.
    g. At distance equal to half the wall height from corners or intersections with other masonry.
    h. Submit locations of joints in Shop Drawings.
4. Masonry Control and Expansion Joint Spacing: Provide masonry control and expansion joints as shown.

O. Lintels and Bond Beams:
1. Provide steel lintels where shown and as specified in Section 05501, Miscellaneous Metal Fabrications.
2. Provide masonry lintels and bond beams where shown and where openings of 16-inches or greater are shown without structural steel lintels. Provide formed-in-place masonry lintels and bond beams. Temporarily support formed-in-place lintels and bond beams.
    a. Unless otherwise shown or indicated, provide one horizontal No. 4 deformed reinforcing bar for each four inches of wall thickness.
    b. For hollow masonry unit walls, use specially formed U-shaped lintel and bond beam units with reinforcing bars placed as shown, filled with grout as specified in Section 04060, Masonry Mortaring and Grouting.
3. Provide minimum bearing at each jamb, of four inches for openings less than six feet wide, and eight inches for wider openings.
4. On concrete and clay unit masonry walls where pattern bond remains visually exposed, increase minimum bearing of masonry lintels to maintain joint pattern of wall and install to be indistinguishable from surrounding masonry.

P. Flashing of Masonry Work:
1. Provide concealed flashings in masonry Work as shown or indicated. Refer to Section 07620, Sheet Metal Flashing and Trim, for flashing requirements. Prepare masonry surfaces smooth and free from projections that might puncture flashing. Place through-wall flashing on bed of mortar and cover with mortar. Seal flashing penetrations with mastic before covering with mortar. Terminate flashing 1/2-inch from face of wall, unless otherwise shown or indicated.

a. Extend flashings beyond edge of lintels and sills at least four inches and turn up edge on sides to form pan to direct moisture to exterior.
b. Interlock end joints of deformed metal flashings by overlapping deformations not less than 1.5 inches and seal lap with elastic sealant.
c. Install flashings in accordance with manufacturer's instructions and approved Shop Drawings and other submittals.
d. Provide flexible flashings in accordance with manufacturer's instructions and approved Shop Drawings and other submittals.

2. Provide weep holes in head joints of first course of masonry immediately above concealed flashings. Spacing is specified elsewhere in this Section.
3. Install reglets and nailers for flashing and other related Work where shown to be built into unit masonry construction.
4. Install flexible masonry flashing into cast-in-place elastic masonry flashing reglets with lead wedges and fill reglet with elastic flashing manufacturers recommended bonding rubber-based adhesive cement.

3.05 REPAIR, POINTING AND CLEANING

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

B. Pointing: During tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point up all joints at corners, openings, and adjacent Work to provide a neat, uniform appearance, properly prepared for application of sealant compounds.

C. Cleaning Exposed, Unglazed Masonry Surfaces:
1. Wipe off excess mortar as the Work progresses. Dry-brush at end of each day's work.
2. Final Cleaning: After mortar is thoroughly set and cured, clean sample wall area of approximately 20 square feet as described below. Obtain Engineer's acceptance of sample cleaning before proceeding to clean remainder of masonry Work.
   a. Dry clean to remove large particles of mortar using wood paddles and scrappers. Use chisel or wire brush if required.
   b. Presoak wall by saturating with water and flush off loose mortar and dirt.
   c. Scrub down wall with stiff fiber brush and solution of half-cup of sodium hexameta phosphate and half-cup of household detergent dissolved in one gallon of water.
   d. Rinse walls, using clean, pressurized water, to neutralize cleaning solution and remove loose material.
   e. Acid cleaning of masonry is unacceptable.

D. Protection:
1. Protect the unit masonry construction from deterioration, discoloration, and damage during subsequent construction operations. At areas where items are installed that project from the finish plane of masonry walls, such as concrete curbs, precast concrete sills, and the like, immediately upon completion of the projecting portion of the Work, provide a minimum 3/4-inch thick plywood cover, cut to fit, to prevent damage from operations continuing above the work. Refer to Section 06100, Miscellaneous Rough Carpentry.

3.06 FIELD QUALITY CONTROL

A. Tests and Inspections:
1. Pre-construction Testing:

a. Engage independent testing laboratory to obtain samples and conduct the following tests prior to the start of installation of unit masonry construction:
   1) Mortar Test: For each mix required: ASTM C780.
   2) Grout Test: For each mix required: ASTM C1019 and ACI 530.1.
   3) Prism Test: For each type of construction required: ASTM C1314 and ACI 530.1.
   4) Compressive strength of completed concrete unit masonry walls shall be at least 1,500 psi as determined by methods in ACI 530.1.
b. Obtain Engineer's acceptance of tests results prior to commencing installation of materials.
c. After initial test, Engineer will require performance of up to five additional tests Engineer's discretion.

2. During and After Installation:
   a. Comply with Section 01416, Special Inspections:
   b. Test and inspect unit masonry during construction in accordance with quality assurance program defined in ACI 530, ACI 530.1 and Laws and Regulations in effect at the Site, including building code. Level of special inspections shall comply with requirements of International Building Code classification and occupancy.
3. Repair masonry walls that do not comply with requirements of the special inspections in a manner acceptable to Engineer.

END OF SECTION 04201

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PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide all labor, materials, tools, equipment, and incidentals as shown, specified and required to furnish and install all brick masonry.
   1. Extent of each type of brick masonry is shown.
   2. Types of products required include:
      a. Custom shapes, profiles, textures, colors, and sizes.
      b. Building (common) brick.
      c. Brick masonry units required to match existing.

1.02 RELATED SECTIONS

A. Section 04201, Unit Masonry Construction.

1.03 REFERENCES

A. Reference Standards: Standards referenced in this Section are:
   1. ASTM C216, Specifications for Facing Brick (Solid Masonry Units Made from Clay or Shale).

1.04 QUALITY ASSURANCE

A. Component Supply and Compatibility:
   1. Obtain each type of brick masonry from one manufacturer, of uniform texture and color or uniform blend in the variation thereof, for each continuous area and for visually related areas.
   2. Do not change source or brands of brick masonry materials during the Work.

B. Regulatory Requirements:
      a. Where a fire-resistance classification is shown or scheduled for brick masonry (four-hour, three-hour and similar designations), provide brick masonry complying with requirements established by UL tests referenced in this Section, applicable codes, and authorities having jurisdiction.

1.05 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Product Data:
      a. Submit copies of brick manufacturer's specifications and test data for each type of brick masonry required.
   2. Samples:
      a. Straps of each type of brick masonry specified. Select units to show range of color and texture expected in finished Work.
      b. Each type of custom molded brick masonry shapes shown or required.
      c. Engineer's review will be for color and texture only. Compliance with other requirements is responsibility of Contractor.

B. Informational Submittals: Submit the following
   1. Certifications:
      a. Recycle Content Face Brick Certifications:

1) Proof of compliance with requirements of federal and state authorities having jurisdiction regarding processing of recycled material transportation, testing, and handling.
2) Proof of successful operation and production of face brick units as specified.

b. Certification of Compliance: Submit certification that each type of brick masonry required complies with the Contract Documents and applicable referenced standards.

2. Supplier Instructions:
   a. Submit instructions for handling, storing, installing, and protecting each type of brick masonry.
3. Source Quality Control Submittals:
   a. Submit for approval laboratory testing acceptable to Engineer establishing minimum recycle content of face brick.

PART 2 – PRODUCTS

2.01 BRICK SIZE

A. Size: Unless otherwise shown or specified, provide standard modular-size brick for 3/8-inch mortar joints. Actual size for exposed vertical brick when laid as a stretcher shall be 7-5/8 inches long by 2-1/4 inches high by 3-5/8 inches wide.
   1. Provide custom-molded shapes, profiles, and sizes where shown and for applications that cannot be sawed from standard brick sizes.
   2. Where specified brick masonry is comprised of a mix or range of colors or textures, provide custom-molded brick masonry shapes in same mix or range of colors and textures as brick masonry specified.

B. Size: Unless otherwise shown or specified, provide nominal eight-inch by eight-inch by four-inch brick. Actual size for exposed vertical brick masonry shall be 7-5/8 inches by 7-5/8 inches by 3-5/8 inches.
   1. Provide custom-molded shapes, profiles, and sizes where shown and for applications that cannot be sawed from standard brick sizes.
   2. Where specified brick masonry is comprised of a mix or range of colors or textures, provide custom-molded brick masonry shapes in same mix or range of colors and textures as brick masonry specified.

2.02 BRICK

A. Solid Face Brick: ASTM C216, Grade SW, of the following types:
   1. Type FBX.
   2. Color and Texture:
      a. Provide blended brick colors to match existing brick on the existing pump station in both color, texture and brick face finish.
   3. Where shown or specified to “match existing”, provide brick of matching custom color, texture, shape, and size. Provide handmade shapes required to match existing detail and ornamentation.
   4. Manufacturers: Provide one of the following:
      a. Consolidated Brick.
      b. Hebron Brick Company.
      b. Or equal.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Refer to the following: Section 04201, Unit Masonry Construction.

END OF SECTION 04211

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PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install concrete unit masonry.
   1. Extent of each type of concrete unit masonry is shown and indicated.
   2. Types of materials and features required include:
      a. Hollow load-bearing units.
      b. Hollow non-load-bearing units.
      c. Solid load-bearing units.
      d. Unit masonry complying with Section 01416, Special Inspections.
      e. Lightweight aggregates, high recycle content, special and custom shapes required to complete the Work, complete selection of manufacturer's standard and custom colors and other special, and custom features.

1.02 RELATED SECTIONS

1. Section 04201, Unit Masonry Construction.
2 Section 07210, Building Insulation.
3. Section 09900, Painting.

1.03 REFERENCES

A. Standards referenced in this Section are:
   1. ASTM C90, Specification for Load bearing Concrete Masonry Units.
   2. ASTM C129, Specification for Non-load-bearing Concrete Masonry Units.
   3. ASTM C140, Test Methods for Sampling and Testing Concrete Masonry Units.
   4. ASTM C331, Specification for Lightweight Aggregates for Concrete Masonry Units.
   5. ASTM C426, Test Method for Drying Shrinkage of Concrete Masonry Units.
   6. ASTM C744, Specification for Prefaced Concrete and Calcium Silicate Masonry Units.
   7. ASTM C1093, Practice for Accreditation of Testing Agencies for Unit Masonry.
   8. ASTM E84, Test Method for Surface Burning Characteristics of Building Materials.
   9. ASTM E119, Test Methods for Fire Tests of Building Construction and Materials.
   10. UL U 901, Bearing Wall Rating – 4 HR.; Nonbearing Wall Rating – 4 HR.
   11. UL U 902, Bearing Wall Rating – 4 HR., Alternative Detail.
   12. UL U 904, Bearing Wall Rating – 3 HR.; Nonbearing Wall Rating – 3 HR.
   13. UL U 905, Bearing Wall Rating – 2 HR.; Nonbearing Wall Rating – 2 HR.
   14. UL U 906, Bearing Wall Rating – 2 HR.; Nonbearing Wall Rating – 2 HR.
   15. UL U 907, Nonbearing Wall Rating – 3 or 4 HR.
   16. UL U 909, Nonbearing Wall Rating – 3 or 4 HR.
   17. UL U 910, Bearing Wall Rating – 4 HR.; Nonbearing Wall Rating – 4 HR.
   18. UL U 912, Bearing Wall Rating – 3 HR.; Nonbearing Wall Rating – 3 HR.
   19. UL U 913, Bearing Wall Rating – 2 HR.; Nonbearing Wall Rating – 2 HR.
   20. UL U 914, Bearing Wall Rating – 3 HR.; Nonbearing Wall Rating – 3 HR.

1.04 QUALITY ASSURANCE

A. Testing Laboratory Qualifications: In accordance with ASTM C1093.

B. Component Supply and Compatibility: Obtain each type of concrete masonry units from one manufacturer, cured by one process and of uniform texture and color or an established uniform blend texture and color.

C. Regulatory Requirements: Where fire-resistance classification is shown (four-hour, three-hour, and similar designations) for concrete unit masonry construction, provide materials complying with requirements established by UL tests referenced in this Section (UL U901 through UL U914), Laws and Regulations including applicable building codes, and requirements of authorities having jurisdiction.

1.05 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Complete layout of masonry walls showing modular planning, colors, patterns and all special shapes to be provided. Show details for each condition encountered in the Work. Provide plans and elevation at scale of 1/4-inch equals one foot, and details at scale of 1.5-inch equals one foot.
   2. Product Data:
      a. Manufacturer's specifications, manufacturing procedures, and test data for each material specified. Include instructions for handling, storage, installation, and protection of each type of concrete masonry unit.
      b. Laboratory test reports in accordance with ASTM C140.
   3. Samples:
      a. Submit Sample of each type of concrete masonry unit required. Select each type of concrete masonry unit to show range of color and texture that will be provided in finished Work.
      b. Complete selection of manufacturer's standard and custom colors.
      c. Engineer's review will be for color and texture only. Compliance with other requirements is responsibility of Contractor.

B. Informational Submittals: Submit the following:
   1. Certifications: Submit certification that concrete unit masonry has been manufactured using only licensing manufacturer's approved materials, manufacturing methods, product standards, and is in accordance with ASTM C744.
   2. Source Quality Control Submittals:
      a. Submit test results as specified in this Section.
   3. Qualifications Statements:
      a. Testing laboratory, if not explicitly included in submittals furnished under other Sections.

1.06 DELIVERY, STORAGE AND HANDLING

A. At time of unloading at Site, concrete masonry units shall comply with ASTM C90, Table 2.

1.07 PROJECT CONDITIONS

A. Environmental Requirements: Maintain temperature in area of storage and installation so that masonry products are above 20 degrees F when installed.

PART 2 – PRODUCTS

2.01 GENERAL, CONCRETE UNIT MASONRY

A. General:
   1. Unless specifically modified by other requirements of the Contract Documents, provide concrete unit masonry in compliance with classifications, weights, grades, colors, textures, scores, thermal resistance values, and other features specified in this Section.
   2. Cure units by autoclave treatment at minimum temperature of 350 degrees F, and minimum pressure of 125 pounds per square inch.

B. Hollow and Solid Load-bearing Concrete Masonry Units: ASTM C90, with minimum of 15 percent coal fly ash and 50 percent recycle aggregate as part of concrete mix.
   1. Minimum compressive strength: 1,900-psi average of three units.

C. Hollow Non-load-bearing Concrete Masonry Units: ASTM C129, with minimum of 15 percent coal fly ash and 50 percent recycle aggregate as part of concrete mix.

D. Size: Manufacturer's standard units with nominal face dimensions of 16 inches long by eight inches high (15-5/8 inches by 7-5/8 inches actual).

E. Moisture Control:
   1. Limit total moisture absorption until time of installation to maximum percentage specified for the weight classification in ASTM C90, Table 2.
   2. Total linear dry shrinkage at time of installation shall be less than 0.065 percent.

F. Special Shapes: Provide the following:
   1. Lintels, bond beams, reinforcing units, and flush-end reinforcing units, interior and exterior corner shapes, solid jambs, sash block, coves, pre-molded control joint blocks, headers, and other special conditions.
   2. Bullnose units for outside vertical corners including doors, windows, louvers and other openings, unless specifically shown on the Drawings indicating that such feature is not required.
   3. End blocks at locations where masonry walls abut concrete, or steel columns, to facilitate installation of compressible filler, backer rod, and sealant or fire-rated fire stop sealant systems, if required.

G. Weight: Provide lightweight units using aggregate complying with ASTM C331 producing dry net weight of not more than 105 pounds per cubic foot.

H. Exposed Faces: Provide manufacturer's standard colors and textures as specified for type of concrete masonry unit.

I. Provide two-core concrete masonry units.

2.02 SOURCE QUALITY CONTROL

A. Tests: Provide test data verifying total linear drying shrinkage based on tests of concrete masonry units made with same materials, concrete mix proportions, manufacturing process, and curing method, conducted in accordance with ASTM C426. Tests shall have been conducted within 24 months prior to delivery to Site

PART 3 – EXECUTION

3.01 INSTALLATION

A. Refer to Section 04201, Unit Masonry Construction.

END OF SECTION 04220

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PART 1 -- GENERAL

1.01 THE REQUIREMENT

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 WORK SPECIFIED ELSEWHERE

A. Section 05010 - Metal Materials

B. Section 05035 - Galvanizing

C. Section 05120 - Structural Steel Framing

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.
   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.

B. 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.

C. 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.

D. 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.

E. Welds and high strength bolts used in connections of structural steel will be visually inspected in accordance with Article 3.04.

F. 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.

G. 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-dip 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-dip galvanized in accordance with ASTM A325.

2.03 STAINLESS STEEL BOLTS

A. Stainless steel bolts shall conform to ASTM F-593. 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 CONCRETE ANCHORS

A. General
   1. Where concrete anchors are called for on the Drawings, one of the types listed below shall be used; except, where one of the types listed below is specifically called for on the Drawings, only that type shall be used. The determination of anchors equivalent to those listed below shall be on the basis of test data performed by an approved independent testing laboratory. There are two types used:
      a. Expansion anchors shall be mechanical anchors of the wedge, sleeve, drop-in or undercut type.
      b. Adhesive anchors shall consist of threaded rods or bolts anchored with an adhesive system into hardened concrete. Adhesive anchors shall be two part injection type using the manufacturer's static mixing nozzle and shall be supplied as an entire system.
   2. Expansion anchors shall not be used to hang items from above or in any other situations where direct tension forces are induced in anchor.
   3. Unless otherwise noted, all concrete anchors which are submerged or are used in hanging items or have direct tension induced upon them, or which are subject to vibration from equipment such as pumps and generators, shall be adhesive anchors.
   4. Adhesive anchors shall conform to the requirements of ACI 355.4 or alternately to AC 308. Expansion or mechanical anchors shall conform to the requirements of ACI 355.2 or

alternately to AC 193. Anchors in Seismic Design Categories C through F shall conform to Building Code of New York State 1908.1.16, including, seismic test requirements, in accordance with ASTM E488.

5. Fire Resistance: All anchors installed within fire resistant construction shall either be enclosed in a fire resistant envelope, be protected by approved fire-resistive materials, be used to resist wind and earthquake loads only, or anchor non-structural elements.

B. Concrete Anchor Design:

An anchor design consists of specifying anchor size, quantity, spacing, edge distance and embedment to resist all applicable loads. Where an anchor design is indicated on the Drawings, it shall be considered an engineered design and anchors shall be installed to the prescribed size, spacing, embedment depth and edge distance. If all parts of an anchor design are provided on the Drawings except embedment depth, the anchors will be considered an engineered design and the Contractor shall provide the embedment depth as indicated in Paragraph B.3 unless otherwise directed by the Engineer. Where an anchor design is not indicated by the Engineer on the Drawings, the Contractor shall provide the anchor design per the requirements listed below.

1. Structural Anchors: All concrete anchors shall be considered structural anchors if they transmit load between structural elements; transmit load between non-structural components that make up a portion of the structure and structural elements; or transmit load between life-safety related attachments and structural elements. Examples of structural concrete anchors include but are not limited to column anchor bolts, anchors supporting non-structural walls, sprinkler piping support anchors, anchors supporting heavy, suspended piping or equipment, anchors supporting barrier rails, etc. For structural anchors, the Contractor shall submit an engineered design with signed and sealed calculations performed by an Engineer currently registered in the State of New York. Structural anchors shall be of a type recommended by the anchor manufacturer for use in cracked concrete and shall be designed by the Contractor in accordance with ACI 318 Appendix D.
2. Non-Structural Anchors: All other concrete anchors may be considered non-structural concrete anchors. The Contractor shall perform an engineered design for non-structural anchors. The Engineer may request the Contractor provide anchor design details for review, but submission of a signed, sealed design is not required. Non-structural anchors shall be designed by the contractor for use in uncracked concrete.
3. Minimum anchor embedment shall be as indicated on the Drawings or determined by the Contractor’s engineered design. Concrete anchors shall be embedded no less than the manufacturer’s standard embedment (expansion or mechanical anchors) or to provide a minimum allowable bond strength equal to the allowable yield capacity of the rod/bolt (adhesive anchors).

C. Structural Anchors:

1. Mechanical Anchors:
   a. Wedge Anchors: Wedge anchors shall be “Kwik Bolt TZ” by Hilti, Inc., “TruBolt +” by ITW Redhead, “Strong-Bolt” or “Strong-Bolt 2” by Simpson Strong-Tie Co. or “DEWALTtud SD-1” or “DEWALTtud SD-2” by DEWALT Fasteners.
   b. Screw Anchors: Screw anchors shall be “Kwik HUS-EZ” and “KWIK HUS-EZ-I” by Hilti, Inc., “Titen HD” by Simpson Strong-Tie Co., or “Wedge-Bolt +” by DEWALT Fasteners. Bits specifically provided by manufacturer of chosen system shall be used for installation of anchors.
   c. Sleeve Anchors: Sleeve anchors shall be “HSL-3 Heavy Duty Sleeve Anchor” by Hilti, Inc. or “Power-Bolt +” by DEWALT Fasteners.
   d. Undercut Anchors: Undercut anchors shall be “HDA Undercut Anchor” by Hilti, Inc., “Torq-Cut Undercut Anchor” by Simpson Strong-Tie Co., “Atomic + Undercut Anchor” by DEWALT Fasteners
2. Adhesive Anchors:

a. Adhesive anchors shall be “Epcon G5” by ITW Redhead, “HIT HY-150 Max SD” by Hilti, Inc., “SET-XP” by Simpson Strong-Tie Co., or “DEWALT 1000+” by DEWALT Fasteners.
b. Structural adhesive anchor systems shall be IBC compliant and capable of resisting short term wind and seismic loads (Seismic Design Categories A through F) as well as long term and short term sustained static loads in both cracked and uncracked concrete in all Seismic Design Categories. Structural adhesive anchor systems shall comply with the latest revision of ICC-ES Acceptance Criteria AC308, and shall have a valid ICC-ES report in accordance with the applicable building code. **No or equal products will be considered unless prequalified and approved by the Engineer and Owner.**

D. Non-Structural Anchors: In addition to the acceptable non-structural anchors listed below, all structural anchors listed above may also be used as non-structural anchors.
1. Mechanical Anchors:
a. Wedge Anchors: Wedge anchors shall be “Kwik Bolt 3” by Hilti, Inc. or “TruBolt” by ITW Redhead.
b. Screw Anchors: Screw anchors shall be “Kwik HUS” by Hilti, Inc., “Wedge-Bolt” by DEWALT Fasteners or “Large Diameter Tapcon (LDT) Anchor” by ITW Redhead. Bits specifically provided by manufacturer of chosen system shall be used for installation of anchors.
c. Sleeve Anchors: Sleeve anchors shall be “HSL Heavy Duty Sleeve Anchors” by Hilti, Inc. “Power-Bolt” by DEWALT Fasteners or “Dynabolt Sleeve Anchor” by ITW Redhead.
d. Drop-In Anchors: Drop-in anchors shall be “Drop-In” by Simpson Strong-Tie Co., “HDI Drop-In Anchor” by Hilti, Inc. or “Multi-Set II Drop-In Anchor” by ITW Redhead.
e. Undercut Anchors: Undercut anchors shall be “HDA Undercut Anchor” by Hilti, Inc.
2. Adhesive Anchors:
a. Adhesive anchors shall be “Epcon A7” or “Epcon C6” by ITW Redhead, “HIT HY-150 Max” by Hilti, Inc., “SET Epoxy Tie” or “AT” by Simpson Strong-Tie Co., or “DEWALT AC 100+ Gold” or “T308+ Epoxy” by DEWALT Fasteners.
b. Non-structural adhesive anchors systems shall be IBC compliant and capable of resisting short term wind and seismic (Seismic Design Categories A and B) as well as long term and short term sustained static loads in uncracked concrete
c. Non-structural adhesive anchor embedment depth of the rod/bolt shall provide a minimum allowable bond strength that is equal to the allowable yield capacity of the rod/bolt unless noted otherwise on the Drawings.
d. **No or equal products will be considered unless prequalified and approved by the Engineer and Owner.**

E. Concrete Anchor Rod/Bolt Materials:
1. Concrete anchors used to anchor structural steel shall be a threaded steel rod per manufacturer’s recommendations for proposed adhesive system, but shall not have a yield strength (fy) less than 58 ksi nor an ultimate strength (fu) less than 72.5 ksi, unless noted otherwise. Where steel to be anchored is galvanized, concrete anchors shall also be galvanized unless otherwise indicated on the Drawings.
2. Concrete anchors used to anchor aluminum, FRP, or stainless steel shall be Type 304 stainless steel unless noted otherwise. All underwater concrete anchors shall be Type 316 stainless steel.
3. Nuts, washers, and other hardware shall be of a material to match the anchors.

2.**0**5 MASONRY ANCHORS

A. Anchors for fastening to solid or grout-filled masonry shall be adhesive anchors as specified above for concrete anchors.

B. Anchors for fastening to hollow masonry or brick shall be adhesive anchors consisting of threaded rods or bolts anchored with an adhesive system dispensed into a screen tube inserted into the masonry. The adhesive system shall use a two-component adhesive mix and shall inject into the screen tube with a static mixing nozzle. Thoroughly clean drill holes of all debris and drill dust with nylon (not wire) brush prior to installation of adhesive and anchor. Contractor shall follow manufacturer's installation instructions. The adhesive system shall be "Epcon System A7 or C6" as manufactured by ITW Ramset/Redhead, "HIT HY-70 System" as manufactured by Hilti, Inc., "SET Epoxy-Tie" or "AT Acrylic-Tie" as manufactured by Simpson Strong-Tie Co., or "AC100+ Gold by DEWALT Fasteners.

C. Masonry anchors used to anchor steel shall be a threaded steel rod per manufacturer's recommendations for proposed adhesive system, but shall not have a yield strength (fy) less than 58 ksi nor an ultimate strength (fu) less than 72.5 ksi, unless noted otherwise. Where steel to be anchored is galvanized, masonry anchors shall also be galvanized.

D. Masonry anchors used to anchor aluminum, FRP, or stainless steel shall be Type 304 stainless steel unless noted otherwise. All underwater anchors shall be Type 316 stainless steel.

2.06 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.

2.07 WELDED STUD CONNECTORS

A. Welded stud connectors shall conform to the requirements of AWS D1.1 Type C.

2.08 EYEBOLTS

A. Eyebolts shall conform to ASTM A489 unless noted otherwise.

2.09 HASTELLOY FASTENERS

A. Hastelloy fasteners and nuts shall be constructed of Hastelloy C-276.

2.10 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. The Contractor shall verify all dimensions and review the Drawings and shall report any discrepancies to the Engineer for clarification prior to starting fabrication.

3.02 ANCHOR INSTALLATION

A. Anchor Rods, Concrete Anchors, and Masonry Anchors

1. Anchor rods shall be installed 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. The Contractor shall verify that all concrete and masonry anchors have been installed in accordance with the manufacturer's recommendations and that the capacity of the installed anchor meets or exceeds the specified safe holding capacity.
3. Concrete anchors shall not be used in place of anchor rods without Engineer's approval.
4. 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. Concrete Anchors
1. Concrete at time of anchor installation shall be a minimum age of 21 days.
2. Concrete anchors designed by the Contractor shall be classified as structural or non-structural based on the requirements indicated above.
3. Concrete Anchor Testing:
   a. At all locations where concrete anchors meet the requirements for structural anchors at least 25 percent of all concrete anchors installed shall be proof tested to the value indicated on the Drawings, with a minimum of one tested anchor per anchor group. If no test value is indicated on the Drawings but the installed anchor meets the requirements for structural anchors, the Contractor shall notify the Engineer to allow verification of whether anchor load proof testing is required.
   b. Contractor shall submit a plan and schedule indicating locations of anchors to be tested, load test values and proposed anchor testing procedure (including a diagram of the testing equipment proposed for use) to the Engineer for review prior to conducting any testing. Testing of anchors shall be in accordance with ASTM E488 for the static tension test. If additional tests are required, inclusion of these tests shall be as stipulated on Contract Drawings.
   c. Where Contract Documents indicate anchorage design to be the Contractor's responsibility and the anchors are considered structural per the above criteria, the Contractor shall submit a plan and schedule indicating locations of anchors to be proof tested and load test values, sealed by a Professional Engineer currently registered in the State of New York. The Contractor's Engineer shall also submit documentation indicating the Contractor's testing procedures have been reviewed and the proposed procedures are acceptable. Testing procedures shall be in accordance with ASTM E488.
   d. Concrete Anchors shall have no visible indications of displacement or damage during or after the proof test. Concrete cracking in the vicinity of the anchor after loading shall be considered a failure. Anchors exhibiting damage shall be removed and replaced. If more than 5 percent of tested anchors fail, then 100 percent of anchors shall be proof tested.
   e. Proof testing of concrete anchors shall be performed by an independent testing laboratory hired directly by the Contractor and approved by the Engineer. The Contractor shall be responsible for costs of all testing, including additional testing required due to previously failed tests.
4. All concrete anchors shall be installed in strict conformance with the manufacturer's printed installation instructions. A representative of the manufacturer shall be on site when required by the Engineer.

5. All holes shall be drilled with a carbide bit unless otherwise recommended by the manufacturer. No cored holes shall be allowed unless specifically approved by the Engineer. If coring holes is allowed by the manufacturer and approved by the Engineer, cored holes shall be roughened in accordance with manufacturer requirements. Thoroughly clean drill holes of all debris and drill dust with compressed air followed by a wire brush prior to installation of adhesive and threaded rod/bolt unless otherwise recommended by the manufacturer. Degree of hole dampness shall be in strict accordance with manufacturer recommendations. Where depth of hole exceeds the length of the static mixing nozzle, a plastic extension hose shall be used to ensure proper adhesive injection from the back of the hole. Injection of adhesive into the hole shall utilize a piston plug to minimize the formation of air pockets. Wipe rod free from oil that may be present from shipping or handling.

D. 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.

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.

C. Post-installed concrete anchors shall be inspected as required by ACI 318.

3.05 CUTTING OF EMBEDDED REBAR

A. The Contractor shall not cut embedded rebar cast into structural concrete during installation of post-installed fasteners without prior approval of the Engineer.

END OF SECTION 05050

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 anchor systems.
   2. This Section includes all anchor systems required for the Work, but not specified under other Sections.

B. Coordination:
   1. 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 are:
   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 Surfacings.
   13. ASTM C579, Test Methods for Compressive Strength of Chemical- Resistant Mortars, Grouts, Monolithic Surfacings, 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.
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:
      a. 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:
      a. 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.
         1) 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:
      a. 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:
      a. 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:
      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.

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, Subcontractor, or Supplier, 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.
   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:
    a. To support piping or conduit six-inch diameter and smaller, use low- profile drop-in anchors, hollow concrete masonry adhesive anchors, or through-bolts.

b. 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.
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:
   a. 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	**Uncracked Concrete**		**Cracked Concrete**	
Rod Diameter / Dowel Size	**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

Table Notes:

1. Bond strengths listed for hammer-drilled, dry hole.
2. Bond strengths listed for maximum short term concrete temperature of 110 degrees F and maximum long term concrete temperature of 75 degrees F.
3. 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.

B. 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:
   a. Adhesive system shall use two-component adhesive mix.
   b. Acrylate hybrid adhesives shall comply with the following:
      1) ASTM C579 compressive strength greater than 7,252 psi, or ASTM D695 compressive yield strength greater than or equal to 10,210 psi.
      2) 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.
4. Anchor:
   a. 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.

C. Hollow Concrete Masonry Adhesive Anchors:
1. General:

a. 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 10^6 psi or ASTM D695 compressive modulus of elasticity greater than 0.668 x10^6 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:
   a. 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 shall be AISI 304 stainless steel.

D. 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 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.
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.

E. Grout-filled Masonry Wedge Expansion Anchors:
1. General:
   a. 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.

F. Hollow Concrete Masonry Sleeve Expansion Anchors:
1. General:
   a. 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.

G. Drop-in Expansion Anchors:
1. General:
   a. 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 FSA-A-55614, Type I. Anchors shall be flush or shell type. Provide low- profile anchors for use in precast concrete planks.

H. Concrete Undercut Anchors:
1. General:
   a. 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.
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.
   a. 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.

I. 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.

J. Drive-In Expansion Anchors:
1. General:
   a. 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.

K. Unless approved by Engineer, do not use power-actuated fasteners or other types of bolts and fasteners not specified in this Section.

L. 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.
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 F593 Type 316, Condition A				F1554 Grade 55			
	Minimum Embedment (inch)	Minimum Edge Distance and Spacing[2]	Shear[3,4] (lb)	Tension[3] (lb)	Minimum Embedment (inch)	Minimum Edge Distance and Spacing[2]	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

Table Notes:
1. 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.
2. 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.
3. 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:

1. 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.
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 systems 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.
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

A. Site Tests:
1. OWNER Will employ testing agency to perform field quality tensile testing of production adhesive anchors at the Site, unless otherwise specified.
   a. Testing shall comply with ASTM E488.
   b. 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.
   c. Engineer will direct which adhesive anchors are to be tested and indicate test load to be used
   d. Apply test loads with hydraulic ram.

e. Displacement of post-installed anchors shall not exceed D/10, where D is nominal diameter of anchor being tested.

2. Mechanical Anchors:
   a. Responsibility:
      1) County 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 County.
   e. Testing agency shall submit test results to Contractor and Engineer within 24 hours of completion of test.
3. Correct defective Work by removing and replacing or correcting, as directed by Engineer.
4. Contractor shall pay for all corrections and subsequent testing required to confirm competence in the installation of post-installed mechanical anchors.
5. Testing agency shall submit test results to Contractor and Engineer within 24 hours of completion of test.

B. Manufacturer's Services:
   1. 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.

END OF SECTION 05051

PART 1 – GENERAL

1.01 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install structural steel framing, including surface preparation and shop priming.
   2. Structural steel framing is the Work defined in AISC 303, Section 2, and as shown or indicated in the Contract Documents. The Work also includes:
      a. Providing openings in and attachments to structural steel framing to accommodate the Work under this and other Sections, and providing for structural steel framing items such as anchorage devices, studs, 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 installation of items to be installed with or before structural steel framing Work.

C. Related Sections:
   1. Section 03600, Grouting.
   2. Section 05051, Anchor Systems.

1.02 REFERENCES

A. Standards referenced in this Section are:
   1. AISC 303, Code of Standard Practice for Steel Buildings and Bridges.
   2. AISC 325, Steel Construction Manual.
   3. AISC 360, Specification for Structural Steel Buildings.
   4. ASME B46.1, Surface Texture (Surface Roughness, Waviness and Lay).
   5. ASTM A6/A6M, Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
   6. ASTM A36/A36M, Specification for Carbon Structural Steel.
   7. ASTM A53/A53M, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   8. ASTM A108, Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
   9. ASTM A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
   10. ASTM A325, Specification for Structural Bolts, Steel, Heat-Treated, 120/105 ksi Minimum Tensile Strength.
   11. ASTM A490, Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
   12. ASTM A500/A500M, Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
   13. ASTM A563, Specification for Carbon and Alloy Steel Nuts.
   14. ASTM A572/A572M, Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
   15. ASTM A992/A992M, Specification for Structural Steel Shapes.
   16. ASTM E329, for Agencies Engaged in Construction Inspection, Special Inspection, or Testing Materials Used in Construction.
   17. ASTM F436, Specification for Hardened Steel Washers.
   18. ASTM F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
   19. ASTM F959, Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.

20. ASTM F1852, Specification for “Twist off” Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
21. AWS D1.1/D1.1M, Structural Welding Code-Steel.
22. CMAA 74, Specifications for Top Running & Under Running Single Girder Electric Traveling Cranes Utilizing Under Running Trolley Hoist.
23. ISO 2859-1, Sampling Procedures for Inspection by Attributes -- Part 1: Sampling Schemes Indexed by Acceptance Quality Limit (AQL) for Lot-by- Lot Inspection.
24. ISO 4017, Hexagon Head Screws -- Product Grades A and B.
25. RCSC Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts.

1.03 QUALITY ASSURANCE

A. Qualifications:
   1. Steel Fabricator:
      a. Structural steel fabricating plant shall possess current certificate from AISC stating that the fabrication facility complies with requirements for certification of “Standard for Steel Building Structures (STD)” of AISC’s quality certification program. Fabricating plant shall maintain this certification throughout time of fabrication for this Project.
   2. Welders and Welding Processes:
      a. Qualify welding processes and welding operators in accordance with AWS D1.1/D1.1M, Section 5, Qualification.
      b. Each welder employed on or to be employed for the Work shall possess current AWS certification in the welding process with which welder will be working. Certifications shall be current and valid throughout the Work.
   3. Surveyor:
      a. Engage a registered professional land surveyor legally qualified to practice in the same jurisdiction as the Site, and experienced in providing surveying services of the kind indicated.
      b. Responsibilities include but are not necessarily limited to:
         1) Performing or supervising performance of field survey work to check lines and elevations of concrete and masonry bearing surfaces, and locations of anchorage devices and similar devices, before steel erection proceeds.
         2) Notifying CONTRACTOR and ENGINEER in writing when surveyed Work does not comply with the Contract Documents.
         3) Submit to CONTRACTOR field survey reports.
   4. Testing Laboratory:
      a. OWNER shall retain the services of an independent testing laboratory to perform testing and determine compliance with the Contract Documents of the materials specified in this Section.
      b. Laboratory shall comply with ASTM E329.
      c. Testing laboratory shall be experienced in the types of testing required.
      d. Welding inspection and welding inspector qualifications shall be in accordance with AWS D1.1/D1.1M
      e. Selection of testing laboratory is subject to ENGINEER's acceptance

1.04 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Complete details and schedules for fabrication and shop assembly of members and details, schedules, procedures, and diagrams showing proposed sequence of erection. Shop Drawings shall not be reproductions of Contract Drawings.
      b. Include complete information for fabrication of the structure’s components, including but not limited to location, type, and size of bolts, details of blocks, copes and cuts,

connections, camber, holes, member sizes and lengths, and other pertinent data. Clearly indicate welds using standard AWS notations and symbols, and clearly show or indicate size, length, and type of each weld.

c. Setting drawings, templates, and directions for installing anchorage devices.

2. Product Data:
   a. Manufacturer's specifications and installation instructions for products listed below.
      1) High-strength bolts of each type, including nuts and washers.
      2) Welding electrodes and rods.
      3) Load indicator bolts and washers.
   b. Hollow structural section cavity connector manufacturer specifications, load tables, dimension diagrams, and acceptable base material conditions. Clearly indicate allowable strength design safety factors when ultimate load carrying capacities are submitted for approval.
3. Samples:
   a. Representative Samples of hollow section steel cavity connectors proposed for use. Review will be for type and finish only. Compliance with other requirements is CONTRACTOR's responsibility.

B. Informational Submittals: Submit the following:
   1. Certificates.
      a. Fabricator's AISC quality certification.
      b. Welders' certifications.
      c. Certified reports of laboratory tests on previously-manufactured, identical materials, and other data as necessary, to demonstrate compliance with the Contract Documents for the materials listed below:
         1) Structural steel of each type, including certified mill reports indicating chemical and physical properties.
         2) High-strength bolts of each type, including nuts and washers.
   2. Supplier Instructions:
      a. Installation data, handling, and storage instructions.
   3. Source Quality Control Submittals:
      a. When performed or when required by ENGINEER, submit results of source quality control testing and inspections performed at the mill or shop.
   4. Field Quality Control Submittals:
      a. Written field survey reports for all bearing surfaces surveyed, verifying tolerance requirements, areas out of tolerance, and corrective measures required.
   5. Qualifications Statements.
      a. Land surveyor.
      b. Testing laboratory.

1.05 DELIVERY, STORAGE AND HANDLING

A. Storage:
   1. Protect steel members and packaged materials from corrosion and deterioration.
   2. Do not store materials in or on the building or structure in manner that may cause distortion or damage to structural steel members, building, or supporting structures.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Steel Types:
   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/A500M, Grade B

4. Angles, Plates, and Bars: ASTM A36/A36M.
5. Steel Pipe: ASTM A53/A53M, Grade B.

B. Anchorages, Fasteners, and Connectors:
1. Anchorage Devices: Refer to Section 05051, Anchor Systems.
2. Headed Stud Type Shear Connectors: ASTM A108, Grades 1010/1020, complying with AWS D1.1/D1.1M, Section 7.
3. High-Strength Threaded Fasteners: Heavy hexagonal structural bolts, heavy hexagon nuts, and hardened washers, as follows:
   a. Unless otherwise indicated, fasteners shall be quenched and tempered medium-carbon steel bolts, nuts and washers, complying with ASTM A325, Type I, nuts complying with ASTM A563C, A563DH or A194/A194M 2H, and hardened washers complying with ASTM F436. Bolts, nuts and washers shall be hot-dip galvanized where shown or indicated.
   b. Use quenched and tempered alloy steel bolts, nuts and washers, complying with ASTM A490, only at locations where shown or indicated in the Contract Documents. ASTM A490 bolts shall not be galvanized.
   c. Tension control bolts, when used, shall comply with ASTM F1852.
   d. Compressible washer-type direct-tension indicators, when used, shall comply with ASTM F959, Type 325.
4. Hollow StructuralSection (HSS) Cavity Connectors: High-strength fastening system for hollow structural sections, as follows:
   a. General:
      1) Each connector shall be hexagon-headed, expansion anchor for connecting structural steel tubes.
      2) Use hollow structural section cavity connectors only in the sizes and at locations shown or indicated in the Contract Documents.
   b. Products and Manufacturers: Provide one of the following:
      1) Hollo-Bolt, by Lindapter International.
      2) BoxBolt, by Key Safety, Inc.
      3) Or equal.
   c. Materials:
      1) Body/shoulder and wedge manufactured from mild steel bars.
      2) Core bolt manufactured with high tensile steel ISO 4017.
      3) Finish: Hot-dip galvanized.
   d. Test bolts at time of manufacture in accordance with ISO 2859-1. Do not ship bolts that do not successfully pass the test.
5. Threaded Rod: Provide threaded rods with heavy hexagon nuts, and hardened washers, as follows:
   a. Interior and Dry Locations: Provide threaded carbon steel rods complying with ASTM A36, with heavy hex nuts complying with ASTM A563A, unless otherwise shown or indicated on the Drawings.
   b. Exterior, Buried, or Submerged Locations, or When Exposed to Wastewater: Provide stainless steel threaded rods complete with washers complying with ASTM F593, AISI Type 316, Condition A, with ASTM A194/A194M, Grade 8S (nitronic 60) stainless steel nuts. Other AISI types may be used when approved by ENGINEER.

C. Electrodes for Welding: E70XX complying with AWS D1.1/D1.1M.

2.02 FABRICATION

A. Shop Fabrication and Assembly:
1. General:
   a. Fabricate and assemble structural assemblies in the shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC 325, the Contract

Documents, and as shown on approved Shop Drawings. Provide camber in structural members as shown or indicated.

b. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize handling of materials for storage and minimize handling at the Site.

c. Where finishing is required, complete the assembly, including welding of units, before commencing finishing operations. Provide finish

surfaces of members exposed-to-view in the completed Work that are free of markings, burrs, and other defects.

B. Connections:

1. Shop Connections:
   a. Unless otherwise shown or indicated, shop connections may be welded or high-strength bolted connections. Welds shall be 3/16-inch minimum.
   b. Where reaction values of beam are not shown or indicated, connections shall be detailed to support one-half the total uniform load capacity tabulated in tables contained in AISC 325 for allowable loads on beams for the associated shape, span, and steel specified for the beam.
   c. Shop-welded connections shall be detailed to eliminate or minimize eccentricity in the connection.
   d. End-connection angles fastened to webs of beams and girders, and the thickness of angles, size, and extent of fasteners or shop welds, shall comply with tables of "Framed Beam Connections" in AISC 325. Connections shall be two-sided, unless otherwise shown or indicated.
2. Field Connections:
   a. Field connections, unless otherwise shown or indicated, shall be made with high-strength bolts, and shall be bearing-type connections.
   b. Use field welding only where shown or indicated or where approved by ENGINEER.
3. High-Strength Bolted Construction:
   a. Provide high-strength threaded fasteners in accordance with RCSC Specifications for Structural Joints using ASTM A325 or ASTM A490 Bolts.
   b. High-strength bolt design shear values shall be as specified in AISC 325 for bolts with threads in the shear plane for bearing type connections, or as specified in this Section for slip-critical connections.
   c. Bolted connections shown or indicated as "SC" shall comply with slip- critical connection requirements in RCSC Specifications for Structural Joints Using ASTM A325 or ASTM A490 Bolts.
      1) Faying surfaces shall have a Class A surface condition.
      2) Slip-critical bolts shall be fully pre-tensioned to 70 percent of minimum specified tensile strength of the bolt using one of the following methods:
         a) Turn of nut with matchmarking.
         b) Twist-off tension control bolt (ASTM F1852).
         c) Direct tension indicator washer (ASTM F959).
   d. Minimum bolt diameter shall be 3/4-inch, unless otherwise shown or indicated.
4. Welded Construction: Comply with AWS D1.1/D1.1M for procedures, appearance, and quality of welds, and methods used in correcting defective welding Work.
   a. Assemble and weld built-up sections by methods that produce true alignment of axes without warp.
5. Where rigid connections are required by stresses shown or indicated, provide web shear reinforcement and stiffeners in accordance with AISC 360.
6. Moment connections shown but not detailed on the Drawings shall be detailed for bending moments and shears indicated on the Drawings.

C. Bracing:

1. Bracing for which stress is not shown or indicated shall have minimum two- bolt connection, or shop-welded connection of equivalent strength.
2. Vertical bracing and knee braces connecting to columns shall be on the centerline of columns, unless otherwise shown or indicated.
3. Knee braces shall be at 45-degree angle, unless otherwise shown or indicated.
4. Gussets shall be not less than 3/8-inch thick, unless otherwise shown or indicated.

D. Columns: Column shafts shall have finished bearing surface roughness not greater than 500 micro-inch in accordance with ASME B46.1, and ends shall be square within tolerances for milled ends in accordance with ASTM A6/A6M at the base and at splice lines.

E. Structural Tubing: Properly seal structural tubing to protect internal surfaces.

F. Holes and Appurtenances for Other Work:
1. Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, as shown on the approved Shop Drawings. If large block-outs are required and approved, reinforce the webs to develop specified shears. Provide threaded nuts welded to framing and other specialty items as shown or indicated to receive other work.
2. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.

2.03 FINISHING

A. Surface Preparation and Shop Priming: Structural steel shall be primed in the shop.

2.04 SOURCE QUALITY CONTROL

A. Inspection and Testing at the Mill or Shop:
1. Perform fabricator's standard procedures for source quality control, including inspections and testing.
2. Materials and fabrication procedures shall be subject to inspection and tests in mill and shop, conducted by a qualified inspection laboratory. Such inspections and tests do not relieve CONTRACTOR of responsibility for providing the Work in accordance with the Contract Documents.

PART 3 – EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which the Work will be performed 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 are corrected.

3.02 ERECTION

A. General: Comply with AISC 303, AISC 360, and the Contract Documents.

B. Checking of Lines and Elevations: Before proceeding with structural steel erection, furnish services of a qualified surveyor to check lines and elevations of concrete and masonry bearing surfaces, and locations of anchorage devices and similar devices. Immediately report discrepancies to ENGINEER. Do not proceed with erection until defective Work that will support structural steel is corrected, including agreeing with ENGINEER upon compensating adjustments (if any) to structural steel Work.

C. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy-lines to achieve proper alignment of structures as erection proceeds.

D. Temporary Planking: Provide temporary planking and working platforms as necessary to effectively complete the Work. Provide sufficient planking to comply with Laws and Regulations, and provide tightly-planked substantial floor within two stories or 30 feet, whichever is less, below each tier of steel beams on which work is performed.

E. Anchorage Devices:
   1. Provide anchorage devices, including anchor bolts, and other connectors required for securing structural steel to foundations and other in-place construction.
   2. Provide templates and other devices necessary for presetting anchorage devices to accurate locations.
   3. Refer to Section 05051, Anchor Systems, for anchorage requirements.

F. Setting Bases and Bearing Plates:
   1. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.
   2. Set loose and attached base plates and bearing plates for structural members on steel wedges or other adjusting devices.
   3. Tighten anchorage devices after supported members are positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
   4. Place grout between bearing surfaces and bases or plates in accordance with Section 03600, Grouting. Finish exposed surfaces, protect installed materials, and allow to cure in accordance with grout manufacturer's instructions, and as otherwise required.
   5. Do not use leveling plates or wood wedges.

G. Field Assembly:
   1. Set structural frames accurately to the lines and elevations shown and indicated. Align and adjust the various members forming part of a complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   2. Level and plumb individual members of structure within tolerances as specified in AISC 325. For members requiring accurate alignment, provide clip angles, lintels, and other members, with slotted holes for horizontal adjustment at least 3/8-inch in each direction, or more when required.
   3. Splice members only where shown or indicated.

H. Erection Bolts: On exposed-to-view, welded construction, remove erection bolts, fill holes with plug welds, and grind smooth at exposed surfaces.

I. Connections:
   1. Comply with AISC 325 for bearing, adequacy of temporary connections, alignment, and the removal of paint on surfaces adjacent to field welds.
   2. Do not enlarge inadequate holes in members by burning or by using drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.
   3. Hollow Structural Section Cavity Connectors:
      a. Comply with manufacturer's written installation instructions and the following.
      b. Cavity Connectors shall be torqued in accordance with manufacturer's instructions.

J. Gas Cutting: Do not use gas-cutting torches for correcting fabrication defects in structural framing. Cutting will be allowed only on secondary members that are not under stress, as approved by ENGINEER. Finish gas-cut sections equal to a sheared appearance, when allowed.

K. Crane Runways:
   1. Provide crane stops and other required items. Set runway girders straight and level, and to tolerances specified in CMAA 74.

L. Touch-up Painting:
   1. Unless otherwise specified, comply with touch-up painting requirements in Section 09900, Painting.
   2. Immediately after erection, clean field welds, bolted connections, and damaged or abraded areas of shop-applied paint. Apply paint to exposed areas with the same paint or coating material applied in the shop. Apply by brush or spray to provide not less than the dry film thickness specified in Section 09900, Painting.

3.03 FIELD QUALITY CONTROL

A. Site Tests and Inspections: Materials and erection procedures shall be subject to inspection and tests at the Site conducted by qualified inspection laboratory. Such inspections and tests do not relieve CONTRACTOR of responsibility for providing the Work in accordance with the Contract Documents.
   1. OWNER will engage independent testing and inspection laboratory to inspect high-strength bolted connections and welded connections and to perform tests and prepare test reports.
      a. Testing laboratory shall conduct and interpret tests, prepare and state in each report of results whether test specimens comply with the Contract Documents and specifically indicate all deviations.
      b. High-strength Bolted Connections: Each high-strength bolted connection shall be visually inspected. Inspection shall identify whether the Work complies with Sections 2, 3, and 8 of RCSC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
         1) For connections that are slip-critical or subject to axial tension, inspector shall verify proper pre-tensioning.
         2) For connections that are not slip critical and not subject to direct tension, bolt does not need to be inspected for bolt tension, but shall be visually inspected to verify that plies of connected elements are in snug contact.
         3) Where bolts or connections are defective, correct defective workmanship, remove and replace, or correct as required defective bolts and connections. CONTRACTOR shall pay for correcting defective Work and tests required to confirm integrity of corrected Work.
      c. Welds: Each weld shall be visually inspected.
         1) Where visually defective welds are evident, further test welds using non-destructive methods. If welds are determined to be acceptable, OWNER will pay for non-destructive testing. When welds are defective, CONTRACTOR shall pay for non-destructive testing.
         2) Correct, or remove and replace, defective Work as directed by ENGINEER.
         3) CONTRACTOR shall pay for corrections and subsequent tests required to determine weld compliance with the Contract Documents.

END OF SECTION 05120

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. Furnish all equipment, labor, materials, and services required to provide all structural aluminum work in accordance with the Contract Documents. The term "structural aluminum" shall include items as defined in the Aluminum Association "Specifications for Aluminum Structures".

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05010 - Metal Materials

B. Section 05050 - Metal Fastening

C. Section 09900 - Painting

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of other requirements of the 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 time of the Bid.
   1. Building Code of New York State
   2. Aluminum Association "Specifications for Aluminum Structures"
   3. AWS D1.2 - "Structural Welding Code".

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01300, Submittals.
   1. Certified Mill Test Reports
   2. Affidavit of Compliance with grade specified
   3. Shop Drawings which include the following:
      a. Layout drawings indicating all structural shapes, sizes, and dimensions.
      b. Beam and column schedules.
      c. Detailed drawings indicating jointing, anchoring and connection details.

1.05 QUALITY ASSURANCE

A. Shop inspection may be required by the Owner at his own expense. The Contractor shall give ample notice to the Engineer prior to the beginning of any fabrication work so that inspection may be provided. The Contractor shall furnish all facilities for the inspection of materials and workmanship in the shop, and the inspectors shall be allowed free access to the necessary parts of the work. Inspectors shall have the authority to reject any materials or work which do not meet the requirements of these Specifications. Inspection at the shop is intended as a means of facilitating the work and avoiding errors, but is expressly understood that it will in no way relieve the Contractor from his responsibility for furnishing proper materials or workmanship under this Specification.

PART 2 -- PRODUCTS

2.01 MATERIALS

A. Structural aluminum shall comply with Section 05010, Metal Materials.

B. Fasteners for structural aluminum shall be in accordance with Section 05050, Metal Fastening.

C. Electrodes for welding shall be in accordance with Section 05050, Metal Fastening.

PART 3 -- EXECUTION

3.01 MEASUREMENT

A. The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of work. The Contractor shall review the Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

3.02 FABRICATION

A. Fabrication shall be in accordance with the Aluminum Association "Specifications for Aluminum Structures". Fabrication shall begin only after Shop Drawing approval.

B. Except where otherwise noted on the Drawings or in this Specification, all shop connections shall be welded.

C. All holes in structural aluminum members required for anchors, anchor rods, bolts, or other members or for attachment of other work shall be provided by the fabricator and detailed on the Shop Drawings.

D. All materials shall be properly worked and match-marked for field assembly.

3.03 DELIVERY, STORAGE AND HANDLING

A. Structural members shall be loaded in such a manner that they may be transported and unloaded without being over-stressed, deformed or otherwise damaged.

B. Structural aluminum members and packaged materials shall be protected from corrosion and deterioration. Material shall be stored in a dry area and shall not be placed in direct contact with the ground. Materials shall not be placed on the structure in a manner that might cause distortion or damage to the members or the supporting structures. The Contractor shall repair or replace damaged materials or structures as directed.

3.04 ERECTION

A. All temporary bracing, guys and bolts as may be necessary to ensure the safety of the structure until the permanent connections have been made shall be provided by the Contractor.

B. Structural members shall be set accurately to the lines and elevations indicated. The various members shall be aligned and adjusted to form a part of a complete frame or structure before being permanently fastened.

C. No cutting of structural aluminum members in the field will be allowed except by the written approval of the Engineer.

D. Bearing surfaces and other surfaces which will be in permanent contact shall be cleaned before assembly.

E. Field welding shall not be permitted unless specifically indicated in the Drawings or approved in writing by the Engineer. All field welding shall comply with Section 05050, Metal Fastening.

F. All bolted connections shall comply with Section 05050, Metal Fastening.

G. All field connections shall be accurately fitted up before being bolted. Drifting shall be only such as will bring the parts into position and shall not be sufficient to enlarge the holes or to distort the metal. All unfair holes shall be drilled or reamed.

H. Misfits at Bolted Connections
   1. Where misfits in erection bolting are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misfit for review by the Engineer. The Engineer will determine whether the remedy is acceptable or if the member must be refabricated.
   2. Incorrectly sized or misaligned holes in members shall not be enlarged by burning or by the use of drift pins. The Contractor shall notify the Engineer immediately and shall submit a proposed method of remedy for review by the Engineer.
   3. Where misalignment between anchor bolts and bolt holes in aluminum members are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misalignment for review by the Engineer.

I. Grouting of Base Plates and Bearing Plates
   1. The bottom surface of the plates shall be cleaned of all foreign materials, and concrete or masonry bearing surface shall be cleaned of all foreign materials and roughened to improve bonding.
   2. Accurately set all base and bearing plates to designated levels with steel wedges or leveling plates.
   3. Baseplates shall be grouted with non-shrink grout to assure full uniform bearing. Grouting shall be done prior to placing loads on the structure. Non-shrink grout shall conform to Section 03600, Grout.
   4. Anchor bolts shall be tightened after the supported members have been positioned and plumbed and the non-shrink grout has attained its specified strength.

J. Where finishing is required, assembly shall be completed including bolting and welding of units before start of finishing operations.

3.05 PAINTING

A. Painting shall be performed according to Section 09900, Painting.

B. Aluminum surfaces in contact with concrete or dissimilar metals shall be thoroughly protected with two coats of epoxy paint with a minimum total thickness of 16 mils or other approved isolating material in accordance with the requirements of Section 09900 - Painting.

END OF SECTION 05140

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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 miscellaneous metal fabrications including surface preparation and shop priming.
   2. The Work also includes:
      a. 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 05051, Anchor Systems.

1.02 REFERENCES

A. Standards referenced in this Section are:
   1. ANSI A14.3, Ladders – Fixed –Safety Requirements.
   2. ANSI Z359.1, Safety Requirements for Personal Fall Arrest Systems, Subsystems, and Components.
   3. ASTM A36/A36M, Specification for Carbon Structural Steel.
   4. ASTM A53/A53M, Specification for Pipe Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   5. ASTM A123/A123M, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   6. ASTM A153/A153M, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   7. ASTM A240/A240M, Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications.
   8. ASTM A384/A384M-02 Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
   9. ASTM A500, Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
   10. ASTM A572/A572M, Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
   11. ASTM A992/A992M, Specification for Structural Steel Shapes.
   12. ASTM B209, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
   13. ASTM B211, Specification for Aluminum and Aluminum-Alloy Bar, Rod and Wire.
   14. ASTM B308/B308M, Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
   15. ASTM B429, Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
   16. ASTM B632/B632M, Specification for Aluminum-Alloy Rolled Tread Plate.
   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.
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. When requested by ENGINEER, 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:
a. 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:
a. 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:
a. 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:
a. Mill test report that indicate chemical and physical properties of each type of material, when requested by Engineer.
2. Qualifications Statements:
a. Copies of welder's certifications, when requested by Engineer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling and Unloading:
1. 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 and Fittings: ASTM A 320/A 320M, Type 304L or Type 316 Stainless Steel.

E. Zinc-coated Hardware: ASTM A153/A153M.

2.02 MISCELLANEOUS METAL ITEMS

A. Shop Assembly:
1. 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. Aluminum Ladders:
1. Fabricate ladders for locations shown or indicated with dimensions, spacing, details, and anchorages as shown and specified. Comply with OSHA 29 CFR 1910 and ANSI A14.3, except as otherwise shown or specified.
   a. Unless otherwise shown, provide 1.5-inch diameter continuous side rails, spaced at least 1.5 feet apart.
   b. Provide extruded square rungs, spaced maximum of 12 inches on centers, with non-slip surface on top of each rung. Adhesive strips for non-slip surfaces are not acceptable.
2. Fit rungs in centerline of side rails, plug weld, and grind smooth on outer rail faces.
3. Support each ladder at top and bottom and at intermediate points spaced not more than five feet on centers.
4. Use welded or bolted brackets, designed for adequate support and anchorage, and to hold ladder clear of wall surface with minimum of seven inches between wall and centerline of rungs.
5. Unless otherwise shown or approved by Engineer, extend rails 3.5 feet above top rung, and return rails to wall or structure, unless other secure handholds are provided. If adjacent structure does not extend above top rung, goose-neck extended rails back to structure to provide secure ladder access.
6. Use extruded aluminum conforming to alloy and temper 6061-T6.

C. Aluminum Ladder Safety Cages:
1. Fabricate ladder safety cages from extruded flat bars, assembled by welding.
2. Unless otherwise shown or indicated, provide 1/2-inch by three-inch top, bottom and intermediate hoops spaced not more than five feet on centers; and 3/8-inch by two-inch vertical bars, secured to each hoop.
3. Space vertical bars approximately nine inches on centers.
4. Fasten assembled safety cage to ladder rails and adjacent construction as shown or indicated.

5. Grind welds, sharp edges, and projections smooth.
6. Comply with OSHA 29 CFR 1910 and ANSI A14.3.
7. Use extruded aluminum conforming to alloy and temper 6061-T6.

D. 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 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.

E. 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.

F. 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.
   a. Unless otherwise shown, provide ribbed abrasive filled type, using black abrasive filler.

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

3. Provide anchors for embedding in concrete, either integral or applied to treads, as standard with manufacturer.

G. Wheel Guards:
1. Manufacturers: Provide products of one of the following:
   a. R-4986-DG, by Neenah Foundry Company.
   b. Or equal.
2. Provide bolted-type wheel guards, 3/4-inch thick minimum, of hollow core gray iron casting, and of size and shape as shown.
3. Provide holes for countersunk anchorage devices and grouting.

4. Anchor wheel guards to concrete or masonry construction in compliance with manufacturer's instructions.
5. Fill cores solidly, using grout as specified in Section 03600, Grouting.
6. Armored-concrete type wheel guards are not acceptable.

H. Fall Prevention System:
1. Provide each ladder with a fall prevention system complying with 29 CFR 1910, ANSI A14.3, and ANSI Z359.1.
2. System shall consist of a carrier rail securely and permanently attached to ladder, over which travels a sleeve to which harness belt can be attached.
3. Products and Manufacturers: Provide products of one of the following:
   a. Saf-T-Climb by North Safety Products.
   b. Or equal.
4. Rail:
   a. Notched at six-inch intervals and constructed of galvanized steel.
   b. Provide ladder attachments/rail mounting brackets of same material as rail, and as required by Supplier.
   c. For all ladders, include provisions to secure safety sleeve to carrier rail at top of vertical ladder so that sleeve will not slide down rail when safety belt is unsnapped.
   d. Ladders Below Hatches: Rail for ladder shall extend from bottom of ladder to top of ladder. Provide telescoping safety post as specified in this Article.
   e. Ladders Not Below Hatches: Rail for ladder shall extend from bottom of ladder to above horizontal landing or roof at top of ladder, Provide removable extension section at top of ladder. Arrange rail to allow climber to land on landing or roof without unsnapping climber's safety harness
5. Accessories: Provide with each ladder the following, all furnished by fall prevention system Supplier:
   a. One safety sleeve compatible for use with the rail. Sleeve shall be cast bronze with five zinc-plated steel roller bearings. Sleeve shall travel smoothly on straight or curved rail.
   b. One safety harness that attaches to sleeve. Harness shall be of woven, high-strength nylon, with padded straps and forged steel buckles and rings. Harness shall distribute impact forces of a fall over climber's thighs, buttocks, chest, and shoulders.
   c. One shock-adsorbing Y-lanyard no longer than six feet, complying with ANSI Z359.1. Lanyard shall be 5/8-inch diameter nylon rope with double-locking snap hooks at each end.

I. Safety Post:
1. Provide safety post for each fixed access ladder located below an access hatch. Safety post shall be manufactured of high-strength structural material with telescoping tubular section that locks automatically when fully extended.
2. Products and Manufacturers: Provide products of one of the following:
   a. LadderUP Safety Post by Bilco Company
   b. Or equal.
3. Use upward and downward movement of post shall be controlled by stainless steel spring balancing mechanism.
4. Safety post shall be hot-dip galvanized steel.

J. 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.

K. Weir Plates:
1. Provide weir plates as shown on the Drawings. Use 3/8-inch aluminum.
2. Aluminum plate shall conform to alloy and temper 6061-T6.
3. Provided slotted holes for fasteners to allow weir plate to be leveled.
4. Fastening devices shall be Type 316 stainless steel in accordance with Section 05051, Anchor Systems.

L. Bollards:
1. 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.”

M. Safety Tie-Back Anchor:
1. Provide safety tie-back anchors as shown.
2. 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:
   a. Comply with OSHA 1910, Subpart F, Appendix C.
   b. Fall arrest force against fracture or detachment: 5,000 lbs.
3. 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.
4. Safety Anchor Eye Plate: Mild steel, Type 300W with 44 Ksi minimum yield strength, hot-dip galvanized to ASTM A123/A123M.
5. Plate: 0.875 inches diameter material with 2 inch eye opening.
6. Hollow Steel Section (HSS) Piers: Mild steel, Type 300W with 50 Ksi minimum yield strength, hot dipped galvanized to ASTM A123/A123M.

N. 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.

O. 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.
5. Finish: Anodized. Protect finish with factory-applied coating of manufacturer's standard lacquer coating, suitable for service on floor.

P. Fasteners and Hardware: Provide Type 316 stainless steel fasteners for aluminum fabrications and zinc-coated hardware for galvanized fabrications, unless otherwise shown or specified.

Q. 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.

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:
   1. Coat surfaces of aluminum that will contact dissimilar materials such as concrete, masonry, and steel.

END OF SECTION 05501

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. Pre-assembled modular aluminum cross-over stairs with nylon treads.
   2. Integral aluminum railings attached to metal stairs.

1.03 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design metal stairs, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
   1. Uniform Load: 100 lbf/sq. ft.
   2. Concentrated Load: 300 lbf applied on an area of 4 sq. in.
   3. Uniform and concentrated loads need not be assumed to act concurrently.
   4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
   5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch, whichever is less.

C. Structural Performance of Handrails and Railings: Handrails and railings shall withstand the structural loads required by ASCE 7 without exceeding the allowable design working stress of the materials for handrails, railings anchors and connections. Gravity loads and the following loads and stresses within the limits and under the conditions indicated:
   1. Handrails and Top Rails of Guards:
      a. Uniform load of 50 lbf/ ft. applied in any direction.
      b. Concentrated load of 200 lbf applied in any direction.
      c. Uniform and concentrated loads need not be assumed to act concurrently.
   2. Infill of Guards:
      a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..

D. Seismic Performance: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7Minimum Design Loads for Buildings and Other Structures": Section 9 "Earthquake Loads".
   1. Component Importance Factor is 1.5.

1.04 ACTION SUBMITTALS

A. Product Data: For metal stairs and the following:
   1. Nylon landing and stair treads.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified professional engineer.

1.06 Product Test Reports:

A. Based on evaluation of comprehensive tests performed by a qualified testing agency for stairs and railings.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Professional Engineer Qualifications: A Professional Engineer who is legally qualified to practice in the state in which the project is located and who is experienced in providing engineering services of the type indicated and required for this section of the work. Engineering services are defined as those performed for installations of Metal Stairs including handrails and railing systems, that are similar to those indicated for this project in material, design and extent.

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

1.08 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 anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

PART 2 - PRODUCTS

2.01 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.02 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Weld exposed corners and seams continuously unless otherwise indicated.
   5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

H. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.03 ALUMINUM ACCESS STAIRS AND RAILINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Kee Safety
   2. Safety Rail Source
   3. Approved Equal.

2.04 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal stairs after assembly.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

3.02 INSTALLING METAL STAIRS WITH GROUTED BASEPLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of baseplates.

B. Set steel stair baseplates on wedges, shims, or leveling nuts. After stairs have been positioned and aligned, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
   1. Use nonmetallic, non-shrink grout unless otherwise indicated.
   2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

END OF SECTION 05510

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Aluminum stair with frame of structural sections, open risers, toeplates, aluminum grate treads, and non-slip nosings.

B. Integral balusters and handrails.

1.02 REFERENCES

A. Aluminum Association – ASD-1 Aluminum Standards and Data.

B. ICC A117.1 - Buildings and Facilities Providing Accessibility and Usability for Physically Handicapped People.

C. AWS A2.4 – Standard Welding Symbols.

D. AWS D1.2/D1.2M – Structural Welding Code – Aluminum.

E. ASTM B26/B26M – Specification for Aluminum-Alloy Sand Castings.

F. ASTM B221 – Specification for Aluminum-Alloy Bars, Rods, Wires, Shapes and Tubes.

G. ASTM B483/B483M – Specification for Aluminum and Aluminum-Alloy Drawn Tubes for General Purposes Applications.

H. ASTM E84 – Test Method for Surface Burning Characteristics of Building Materials.

I. ASTM E894 – Standard Test Methods for Anchorage at Permanent Metal Railing Systems and Rails for Building.

J. ASTM E935 – Standard Test Methods for Anchorage at Permanent Metal Railing Systems and Rails for Buildings.

K. NFPA 101 – Life Safety Code.

1.03 DESIGN REQUIREMENTS

A. Fabricate stair and railing assembly to meet all applicable codes.

B. Conform to the following codes, regulations and requirements

C. New York State Building Code.

D. Occupational Safety & Health Act of 1970 (OSHA) regulations.

E. Stair assembly shall support 300 lb. concentrated load at any point and a uniform live load of 100 lb/sq. ft., non-simultaneously with deflection not to exceed 1/240 of span.

1.04 SUBMITTALS

A. Submit under provisions of Section 01300 - Submittals

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Shop drawings shall bear the seal and signature of a registered professional engineer licensed in the State of New York.

C. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

1.05 QUALIFICATIONS

A. Submit shop drawings prepared under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of New York. Shop drawings shall be affixed with signature and seal of a Professional Engineer licensed in the state of New York.

B. Welders' Certificates: Submit under provisions of Section 01300 - SUBMITTALS, certifying welders employed on the work, verifying AWS qualification within the previous 12 months.

1.06 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on submitted shop drawings.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Kee Systems Limited.

B. FS Industries.

C. W. S. Safety Technologies.

2.02 MATERIALS

A. Structure Sections and Plates: Aluminum 6061-T6 Alloy, tempered.

B. Bolts, Nuts and Washers: Stainless steel, Type 304.

C. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; consistent with design of stair structure.

D. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

E. Tread: Aluminum grating tread with 1 1/4 by 1 1/4 leg standard corrugated 90 degree angle nosing with carrier plates attached as manufactured by McNichols Co. or approved equal. Treads shall be GAL-150 (Swage-Locked); 1 1/2 inch by 3/16 inch grating by McNichols Co. or approved equal.
   1. Tread size: 12 1/8 inch x length indicated on the drawings.

F. Provide integral Toeplates as required by applicable building code limiting the riser openings to less than 4 inches.

G. Welds, Welding Metal: Aluminum.

H. Electrodes shall be suitable for the material, positions and other conditions of use as recommended by AWS or the manufacturer.

I. Equipment Roof Protection Pads: 1/4 inch Duo-Pro by W.R. Meadows or Engineer approved equivalent.

2.03 FABRICATION - GENERAL

A. Fabricate stair assembly to be self supporting and independent of adjacent wall construction.

B. Fit and shop assemble in largest practical sections, for delivery to site.

C. Fabricate components with joints tightly fitted and secured.

D. Continuously seal jointed pieces with continuous welds.

E. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush and hairline. Ease exposed edges to small uniform radius.

F. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

G. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

H. Accurately form components required for anchorage of stairs, landings and railings to each other and to building structure.

2.04 FABRICATION

A. Fabricate stair to meet design and OSHA requirements.

B. Form stringers with channels minimum 12 inches deep. Reinforce tread underside with angles welded to stringers.

C. Adhere 3/4 inch thick neoprene pad to the bottom of stair baseplates.

2.05 FINISHES

A. Clean surfaces of corrosion, scale, grease and foreign matter prior to finishing.

B. Clear anodize finish. Finish stair after fabrication.

C. Coat areas of aluminum to be in contact with dissimilar metals and concrete with (2) coats of bitumastic paint.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work. Verify dimensions and clearances of piping, conduit, structural elements adjacent to intended stair location prior to fabrication.

B. Beginning of installation means erector accepts existing conditions.

C. Coordinate and supply items required to be embedded in masonry and concrete with setting templates, to appropriate contractor(s) for their installation. Provide information regarding the installation requirements accordingly.

3.02 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects to meet design requirements.

B. Provide anchors, plates, angles, hangers and struts as required for connecting stairs to structure.

C. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

D. Field weld components indicated on approved shop drawings. Perform field welding in accordance with AWS D1.1.

E. Mechanically fasten joints butted tight, flush and hairline. Grind welds smooth and flush.

F. Obtain Engineer approval prior to site cutting or making adjustments not indicated on the drawings nor on the approved shop drawing.

G. After erection, prime welds, abrasions and surfaces not shop primed, except surfaces to be in contact with concrete.

3.03 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story.

B. Maximum Offset From True Alignment: 1/8 inch.

END OF SECTION

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. Provide firestop systems consisting of a material, or combination of materials installed to retain the integrity of fire resistance rated construction by maintaining an effective barrier against the spread of flame, smoke and/or hot gases through penetrations, fire resistive joints, and perimeter openings in accordance with the requirements of the Building Code for this project.

B. Firestop systems shall be used in locations including, but not limited to, the following:
   1. Penetrations through fire resistance rated floor and roof assemblies including both empty openings and openings containing penetrants.
   2. Penetrations through fire resistance rated wall assemblies including both empty openings and openings containing penetrants.
   3. Membrane penetrations in fire resistance rated wall assemblies where items penetrate one side of the barrier.
   4. Joints between fire resistance rated assemblies.
   5. Perimeter gaps between rated floors/roofs and an exterior wall assembly.

1.03 REFERENCES

A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2020.

B. ASTM E1399: Test Method for Cyclic Movement and Measuring Minimum and Maximum Joint Width.

C. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015 (Reapproved 2019).

D. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes; 2017.

E. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems; 2020a.

F. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus; 2020.

G. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2020.

H. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).

I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2019b.

J. FM 4991 - Approval Standard for Firestop Contractors; 2013.

K. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. UL Qualified Firestop Contractor Program.

M. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.

N. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.

O. UL 263 - Standard for Fire Tests of Building Construction and Materials; Current Edition, Including All Revisions.

P. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

Q. UL Fire Resistance Directory -Volume 2:
   1. Through-Penetration Firestop Devices (XHJI)
   2. Fire Resistive Ratings (BXUV)
   3. Through-Penetration Firestop Systems (XHEZ)
   4. Fill, Void, or Cavity Material (XHHW)

R. Omega Point Laboratories (OPL)
   1. Building Products, Materials & Assemblies - Volume II

1.04 ACTION SUBMITTALS

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

B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.

1.05 FIELD QUALITY CONTROL

A. Section 01660 - QUALITY CONTROL: Field inspection and testing.
   1. Inspect the installed firestopping after application and curing for integrity, prior to its concealment.
   2. Ensure that actual thicknesses, densities, and bond strengths meet requirements for specified ratings.
   3. Re-inspect the installed firestopping for integrity of fire protection, after installation of subsequent work.
   4. Provide written inspection report and certification to the Architect, indicating installation meets or exceeds requirements of contract documents.

1.06 FIELD MOCK-UP

A. Field Mock-up Installations: Prior to installing firestopping, erect mock-up installations for each type firestop system indicated in the Firestop Schedule to verify selections made and to establish standard of quality and performance by which the firestopping work will be judged by the Owner or Owner’s Representative. Obtain acceptance of mock-up installations by the Owner or Owner’s Representative before start of firestopping installation. Provide at least 72 hours notice to Owner or Owner’s Representative prior to inspection.

1.07 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

1.08 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

B. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

C. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
   1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
   2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
      a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
      b. Classification markings on penetration firestopping correspond to designations listed by the following:
         1) FM Global in its "Building Materials Approval Guide."
         2) UL Fire Resistance Directory.
            a) Firestop Devices (XHJI)
            b) Fire Resistance ratings (BXRH)
            c) Through Penetration Firestop Systems (XHEZ)
            d) Fill Voids or Cavity Materials (XHHW)
            e) Forming Materials (XHKU)

D. Preinstallation Conference: Conduct conference at Project site.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and UL label where applicable.

B. Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.

C. Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements.

D. Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.

E. Do not use damaged or expired materials.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilation's or, where this is inadequate, forced-air circulation.

1.11 COORDINATION

A. Do not use materials that contain flammable solvents.

B. Scheduling:
   1. Schedule installation of Cast in Place firestop devices after completion of floor formwork, metal form deck, or composite deck but before placement of concrete.
   2. Schedule installation of other firestopping materials after completion of penetrating item installation but prior to covering or concealing of openings.

C. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.

D. Weather Conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.

E. During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

F. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.

G. Coordinate sizing of sleeves, openings, core-drilled holes, Cast-in place sleeves or cut openings to accommodate penetration firestopping.

H. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.

I. Coordinate sizing of sleeves, openings, core-drilled holes, Cast-in place sleeves or cut openings to accommodate penetration firestopping.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hilti, Inc.
   2. 3M Fire Protection Products.
   3. STI Firestop
   4. Tremco, Inc.; Tremco Fire Protection Systems Group.

5. USG Corporation.

2.02 PENETRATION FIRESTOPPING

A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
   1. Fire-resistance-rated walls include fire walls fire-barrier walls smoke-barrier walls and fire partitions.
   2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
   1. Horizontal assemblies include floors floor/ceiling assemblies and ceiling membranes of roof/ceiling assemblies.
   2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
   3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.

D. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.
   1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at 0.30-inch wg at both ambient and elevated temperatures.

E. W-Rating: Provide penetration firestopping showing no evidence of water leakage when tested according to UL 1479.

F. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.

G. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   1. Sealants: 250 g/L.
   2. Sealant Primers for Nonporous Substrates: 250 g/L.
   3. Sealant Primers for Porous Substrates: 775 g/L.

H. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
   1. Permanent forming/damming/backing materials, including the following:
      a. Slag-wool-fiber or rock-wool-fiber insulation.
      b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
      c. Fire-rated form board.
      d. Fillers for sealants.
   2. Temporary forming materials.

3. Substrate primers.
4. Collars.
5. Steel sleeves.

I. Identification Labels:
1. Furnished by fire stopping manufacturer of suitable material for permanent field identification of through-penetration firestops.
2. Identify the following:
   a. Warning Wording
   b. Manufacturer Name.
   c. Product Catalog number.
   d. Tested System number.
   e. F-rating.
   f. T-rating, if applicable.
   g. Firestop Contractor name.
   h. Firestop Contractor Contact Number.
   i. Firestop Inspection Date & Inspector Initials.
3. Field fabricated labels are not acceptable.

2.03 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
1. Hilti CP 680 M or P Cast-In-Place Firestop Device
   a. Add Aerator adapter when used in conjunction with aerator ("sovent") system.
2. Hilti CP 681 Tub Box Kit for use with tub installations.
3. Specified Technologies Inc. CID cast-in devices.

B. Sealants, caulking materials or foams for use with non-combustible items including items including steel pipe. copper pipe, rigid steel conduit and electrical metallic tubing (EMT), the following products are acceptable:
1. Hilti FS-ONE MAX Intumescent Firestop Sealant.
2. Hilti CP 604 Self-leveling Firestop Sealant.
3. Hilti CP 620 Fire Foam
4. Hilti CP 606 Flexible Firestop Sealant
5. Hilti CP 601s Elastomeric Firestop Sealant.

C. Sealants, caulking materials or foams for use with sheet metal ducts the following products are acceptable:
1. Hilti FS-ONE MAX Intumescent Firestop Sealant.
2. Hilti CP 606 Flexible Firestop Sealant
3. Hilti CP 601s Elastomeric Firestop Sealant:

D. Firestop Joint Spray: sprayable fire-rated mastic for deck flutes and joints where greater movement is expected:
1. Hilti Firestop Joint Spray CFS-SP-WB.

E. Mineral Wool plugs for filling steel deck flute and wall gap openings:
1. Hilti CP 777 Friction Fit sized and cut to depth for deck flute openings as recommended by the manufacturer.
2. Hilti CP 767 continuous filler strip for filling continuous gaps at top of walls.

F. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
   1. Hilti FS-ONE MAX Intumescent Firestop Sealant
   2. Hilti CP 620 Fire Foam
   3. Hilti CP 601s Elastomeric Firestop Sealant
   4. Hilti CP 606 Flexible Firestop Sealant.

G. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.

H. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
   1. Hilti FS-ONE MAX Intumescent Firestop Sealant
   2. Hilti CP 604 Self-leveling Firestop Sealant

I. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with steel lining on one side.
   1. Hilti CP 643N Firestop Collar
   2. Hilti CP 644 Firestop Collar.
   3. Hilti CP 645 / 648 E Wrap Strips.

J. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
   1. Acceptable materials are "BIO FIRESHIELD "Novasit K-10".

K. Pillows/Bags / Pads: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
   1. Hilti CP 617 Firestop Putty Pad

L. Foams, intumescent sealants, or caulking materials for use with flexible cable or cable bundles, the following products are acceptable:
   1. Hilti FS-ONE MAX High Performance Intumescent Firestop sealant
   2. Hilti CP 620 Fire Foam
   3. Hilti CP 601s Elastomeric Firestop Sealant.
   4. Hilti CP 606 FS Flexible Firestop Sealant.

M. Sleeves: Re-penetrable cable management device for electrical and telecommunication cabling and cable bundles for use with appropriate Firestopping sealant, fill mortar, putty or other devices and materials. Concrete assemblies up to 3 hour and Gypsum Board assemblies up to 4 hour.
   1. Hilti CP 653 Speed Sleeve.

N. Non-curing, re-penetrable intumescent putty or foam materials for use with flexible cable or cable bundles, the following products are acceptable:
   1. Hilti CP 618 Firestop Putty Stick
   2. Hilti CP 658T Firestop Plug.

O. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
   1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening

conditions.

P. Non-curing, re-penetrable materials used for large openings and complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable.
   1. Hilti FS 657 Fire Block
   2. Hilti CP 675T Firestop Board / Brick

Q. Materials used for large openings and complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes. electrical busways in raceways, the following products are acceptable:
   1. Hilti FS 637 Trowelable Firestop Compound.

R. Mineral Fiber Fire Safing insulation:
   1. Provide insulation as manufactured by USG INTERIORS, INC. Product "Thermafiber Safing", CAFCO INDUSTRIES LTD., FIBREX INC. or approved equal. Density shall be 4 pcf with thickness to suit condition
      a. Provide 20 gauge minimum metal plate where required for fire safing support to comply with fire ratings
      b. Do not use fibrous safing insulation unless it is in conjunction with a compatible smoke seal as specified herein.

S. Mineral Wool
   1. Loose mineral wool, rated noncombustible when tested according to ASTM E136, free of asbestos and glass fiber, and suitable for stuffing into metal deck flutes to an in place density of 6 to 12 pcf.

2.04 MIXING

A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

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

3.02 PREPARATION

A. Verification of Conditions: Examine areas and conditions under which Work is to be performed and identify conditions detrimental to proper or timely completion.

B. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:
   1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
   2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable

of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.

3. Remove laitance and form-release agents from concrete.

C. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

D. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping seal with substrates.

3.03 INSTALLATION

A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

4. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.

C. Install fill materials for firestopping by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.04 IDENTIFICATION

A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. Identify the following:
   a. "WARNING - FIRESTOP MATERIAL - DO NOT DISTURB. NOTIFY BUILDING MANAGEMENT OF ANY DAMAGE".
   b. Manufacturer Name:_____.
   c. Product Catalog number:_____.
   d. Tested System number:_____.
   e. F rating:_____.
   f. T rating, if applicable.
   g. Firestop Contractor name:_____.
   h. Firestop Contractor Contact Number:_____.
   i. Firestop Inspection Date & Initials:_____.
   j. T-rating, if applicable.
   k. Firestop Contractor name.
   l. Firestop Contractor Contact Number.
   m. Firestop Inspection Date & Inspector Initials.

3.05 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

FIRESTOP SCHEDULE

Project No:	Contractor Name and Address:	Date Submitted:
Project Title:	Supplier/Installer Name and Address: Manufacturer Name and Address:	Company Field Advisor Name and Address:

Manufacturer's Product Reference Numbers and/or Drawing Numbers	U.L., FM, Warnock Hersey or Omega Point Lab Penetration Design Nos.	Penetrating Item: Material, Size, Insulated, Combustible, Joint, Perimeter, etc. Description:	Maximum Allowable Annular Space or Maximum Size Opening	Wall type Construction		Floor Type Construction	Fire Resistance Rating of Wall or Floor (Hourly)	F Rating	T Rating (floors Only)	L Rating (if available)	W Rating (if available)
				DES.	CONST.						
Example No. 1 DCFSS-130	UL #130	Maximum 4" Steel Pipe Non-Insulated		P4	6" CMU	N.A.	1 Hour	1 Hour	N.A	.	
Example No. 2 5300-ICF88.01	UL #591	Maximum 4" PVC Pipe		N.A.	N.A.	UL # D916	3 Hour	1 Hour	2 Hour		
Example No. 3	CW-S-2006	Curtain Wall/Perimeter	6" to 12"	NA	NA	4 ½" Reinforced LW concrete	2 Hour	2 Hour	NA	1 CFM/ Lin Ft.	

END OF SECTION 078413

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PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Vault Access Hatch and related items.

B. Clearwell access door and related items.

1.02 RELATED SECTIONS

A. Section 03300 - CAST-IN PLACE CONCRETE.

1.03 SUBMITTALS

A. Submit under provisions of Section 01300 - SUBMITTALS.

B. Indicate on shop drawings plan layout, construction details and required clearances.

C. Shop Drawing of unit and all accessory installations.

1.04 WARRANTY

A. Manufacturer's warranty: Materials shall be free of defects in material and workmanship for a period of Ten (10) years from the date of installation. Should a part fail to function in normal use within this period, the manufacturer shall furnish a new part at no charge.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. BILCO COMPANY, New Haven, CT.

B. HALLIDAY PRODUCTS, Orlando, FL.

C. U.S.F. Fabrication, Inc.

D. Approved equal.

2.02 VAULT ACCESS HATCH

A. Hatch with automatic hold-open and operating arm, as manufactured by the BILCO Company, New Haven, CT (203) 934-6363, or approved equal. Doors and accessories shall be factory fabricated. Size as shown on the drawings.
   1. Cover: Shall be ¼" aluminum diamond pattern plate [, reinforced for a minimum of 300 psf (live load) and H-20 wheel loading.
   2. Frame: Channel frame shall be ¼ inch extruded aluminum with bend down anchor tabs around the perimeter. A continuous EPDM gasket shall be mechanically attached to the aluminum frame to create a barrier around the entire perimeter of the cover and significantly reduce the amount of dirt and debris that may enter the channel frame.
   3. Doors shall open to 90° and lock automatically in that position. Provide stainless steel pins
   4. Hinges: Shall be specifically designed for horizontal installation and shall be through bolted to the cover with tamperproof Type 316 stainless steel lock bolts and shall be through bolted to the frame with Type 316 stainless steel bolts and locknuts.
   5. Drain Coupling: Provide a 1-1/2" (38mm) drain coupling located in right front corner of the channel frame.

6. Lifting mechanisms: Manufacturer shall provide the required number and size of compression spring operators for easy operation. Provide a vinyl grip handle to release the cover enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward motion of the cover when closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe fastened to a formed 1/4" gusset support plate.
7. A removable exterior turn/lift handle with a spring loaded ball detent shall be provided to open the cover and the latch release shall be protected by a flush, gasketed, removable screw plug.
8. Hardware: Shall be anticorrosion throughout.
    a. Hinges: Heavy forged aluminum hinges, each having a minimum 1/4" (6.3 mm) diameter Type 316 stainless steel pin, shall be provided and shall pivot so the cover does not protrude into the channel frame.
    b. Cover shall be equipped with a hold open arm which automatically locks the cover in the open position.
    c. Cover shall be fitted with the required number and size of compression spring operators. Springs shall have an electro-coated acrylic finish. Spring tubes shall be constructed of a reinforced nylon 6/6 based engineered composite material.
    d. A Type 316 stainless steel snap lock with fixed handle shall be mounted on the underside of the cover.
    e. Compression spring tubes shall be an anti-corrosive composite, all hardware and fasteners shall be Type 316 stainless steel material. Springs shall have an electro-coated acrylic finish for corrosion resistance
9. Factory finish shall be mill finish aluminum with bituminous coating applied to the exterior of the frame.

B. Fall Protection Grating:
1. Grating panel(s) shall be fiberglass, molded in one piece, with load bearing bars in both directions to allow for use without continuous side support.
2. Panel shall be designed to support a 300 PSF live load and be high visibility safety yellow in color.
3. Torsion rod lift assistance shall be provided for ease of operation and a hold open arm shall be included to automatically lock the panel in the fully open 90-degree position.
4. A release handle shall be provided to close the grating panel and there shall be a provision to lock the panel to prevent unauthorized access.
5. Hold open arm shall be aluminum with a stainless-steel release handle.
6. All other hardware, including mounting brackets, hinges, torsion rod, padlock loop, and fasteners, shall be type 316 stainless steel.
7. Manufacturer shall provide a twenty-five-year warranty against defects in material and workmanship.

C. Ladder Safety Post
1. Post shall be high strength, type 304 stainless steel tubing, and mill finish, with a pull-up loop at its upper end.
2. All hardware, including mounting brackets, hinges, torsion rod, padlock loop, and fasteners, shall be type 316 stainless steel.
3. Up and down movement shall be controlled by a stainless-steel balancing spring mechanism.
4. Post shall lock automatically when extended, and a release lever must be activated to disengage the post to permit the return to the lowered position.

2.03 CLEARWELL ACCESS HATCH

A. Access Hatch shall be prefabricated ready for installation and use.

B. Door Construction:
   1. Cover: Shall be ¼" aluminum diamond pattern plate[, reinforced for a minimum of 625 psf (live load), and capable of holding up to 10 ft. head of water. Manufacturer to provide structural calculations stamped by a registered professional engineer.
   2. Frame: Shall be 3/8" thick aluminum angle. Angle shall include a horizontal leg and 9/16" diameter mounting holes for bolting to concrete top slab. Frame to include a U-shaped neoprene gasket riveted to the frame to minimize water intrusion.
   3. Locks: Shall be 316 stainless steel nut and bolt pressure locks, with exterior staple for padlock. Locks shall be spaced so as to provide an adequate seal to prevent the intrusion of water up to the rated depth.
   4. Hinges: Shall be aluminum lugs with 316 stainless steel pins.

C. Accessories & Options:
   1. Hatch shall be provided with an anodized finish.
   2. Provide standard open vertical compression spring operators for ease of operation.
   3. Provide bituminous coating system, applied to frame surface in contact with concrete, as per manufacturer's instructions.
   4. Provide retro-fitted anodized aluminum Hatch Safety Grate as a fall-through prevention system, designed for live loads up to 300 psf. Grating shall not be colored (USF standard is OSHA safety orange). Hardware components of the safety grating shall be stainless steel. Submit grate opening size options to Engineer for review.

D. Door Operation:
   1. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
   2. Operation of the cover shall not be affected by temperature.
   3. Cover and grating shall be operated separately and shall automatically lock in the full open position.
   4. The access door may not be closed without first closing the safety grate.
   5. The safety grating shall be operated and reinforced independently of the access hatch. If the grating is damaged or removed, the access door shall continue to operate at the specified load and deflection requirements.

2.04 FABRICATION

A. Fabricate components free of visual distortions and defects. Weld corners and joints.

B. Provide for removal of condensation occurring within components or assembly.

C. Fit components for weather-tight assembly.

D. Apply bituminous paint on surfaces of units to be in contact with cementitious materials or dissimilar metals.

2.05 QUALITY ASSURANCE

A. Guarantee access doors against defects in material and workmanship for a period of ten (10) years.

PART 3 - EXECUTION

3.01 DELIVERY AND STORAGE

A. Delivery of materials to the site shall be made in unopened cartons with the name of the manufacturer clearly visible on the carton.

B. Materials shall be stored in a safe, dry place.

3.02 INSTALLATION

A. Install access doors in accordance at location indicated on the drawings and according to manufacturer's instructions. Set flush in top slab and square and parallel to foundation/vault walls. Set plumb to top slab/floor.

B. Install hatch in accordance with OSHA regulations.

C. Installer shall supply and install mechanical fasteners compatible with the roof deck and the hatch.

D. Manufacturer shall furnish fasteners necessary for ladder safety post installation.

E. Install ladder safety post in accordance with the manufacturer's installation instructions.

END OF SECTION 08310

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Requirements to supply labor, materials, equipment and services necessary to paint all required surfaces.

B. Paint before installation of equipment and piping
   1. Only touch-up painting will be allowed after the installation of: equipment, pipes, grating, handrails, furnishings, panels, conduit, electrical boxes, electrical equipment, conduits, HVAC duct, HVAC equipment, plumbing and plumbing accessories, and the like.
   2. Interior doors, wall louvers, and windows shall not be installed until after all painting is completed in an area.

C. The following items shall be painted:
   1. Ferrous metals.
   2. Access doors and panels (miscellaneous trim and surfaces not pre-finished).
   3. Small diameter pipes, fittings and valves regardless of pipe material.
   4. Exposed process pipes, valves, and fittings (large diameter piping) except stainless steel.
   5. Miscellaneous mechanical and electrical equipment as specified herein.
   6. Products specified to be painted in other Technical Specification Sections.

D. Items not scheduled for painting include:
   1. Buried concrete walls and other surfaces.
   2. Anodized aluminum surfaces and grating.
   3. Motors and equipment, such as pumps, motors, motorized valve actuators, etc. furnished in final coats by the factory.
   4. Stainless steel.

E. Pre-finished surfaces Painting shall be scheduled and coordinated, through the Engineer, and shall not begin until other work and/or job conditions are completed to the satisfaction of the Engineer.

1.02 RELATED SECTIONS

A. Section 01300 – Submittals

B. Section 03300 – Cast-in-Place Concrete

1.03 REFERENCES

A. New York State Department of Environmental Conservation for VOC Compliance.

B. The Society for Protective Coatings (SSPC) Volume 2
   1. Chapter 2 - Surface Preparation
   2. Chapter 5 - Paint Application Specifications

1.04 QUALITY ASSURANCE

A. The paint shall be furnished by one single Supplier (Paint Manufacturer).

B. Consideration will only be given to Suppliers who can demonstrate that their paint system complies with these specifications having had successful and documented experience of the size, quality, performance and reliability to that specified, and who can successfully demonstrate this criteria to the Engineer.

C. The brand name products specified were chosen based on past performance, and constitute a standard for quality and performance for the specific purpose for which they are 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.
   2. If an alternate paint system is proposed, 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 Documentation” shall be hand delivered directly to the Engineer at least twenty one (21) calendar days prior to the date set for the bid opening. The pre-bid “Evaluation Documentation” shall consist of the following:
      a. Data substantiated by certified tests, conducted at no expense to the Owner, to demonstrate that the quality of the proposed product is equal to the requirements contained herein for each paint listed in the attached schedule.
      b. Technical data sheets for the proposed products and manufacturer’s standard color chart showing availability of all coatings listed in the attached schedule.
      c. Two (2) paper chip samples, illustrating range of colors available for each surface-finishing product listed in the attached schedule.
      d. Descriptive technical information for the proposed product(s) highlighted to show the differences between the proposed the specified product. Descriptive technical information shall include volume solids, dry film thickness, curing time, storage temperature, coverage rates, pot life, and surface preparation requirements.
      e. 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.
      f. The documentation shall include a statement that Supplier is in compliance with each and all Sections of the Specifications. Any variance from the specified system shall be listed and a description of each variance must be in letter form.

D. Facsimile transmissions will not be accepted.

E. Failure to submit the above listed information twenty (20) calendar days prior to the date set for the bid opening shall be cause for non-evaluation and the paint system 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.

1.05 WARRANTY

A. Provide a warranty certificate typed on company letterhead and signed by an officer of the paint applicator. The certificate shall be witnessed by a notary public in the state in which the company headquarters is located.

B. The applicator shall guarantee the paint system to be free from any defect for a period of two (2) year commencing on the date of substantial completion.

C. During the guarantee period, if the paint system fails to perform or shows signs of a defective application, the applicator shall repaint such defective surfaces free of any and all charges. The

cost of labor and all other expenses resulting from the repainting shall be borne solely by the paint applicator. The application of the paint system shall be covered under the Contractor's maintenance bond.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with the requirements contained in Section 016500 - Product Delivery, Storage and Handling.

B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability. Deliver application instructions to the Engineer.

C. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

D. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

E. Cover all building openings to achieve specified temperatures. Furnish and install temporary heaters and electric feed to maintain room temperatures. The use of propane heaters will be allowed when approved by the Engineer.

1.07 FIELD SERVICES

A. Supply and credit to the Owner the costs for field services as specified in Section 014500 - 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. One (1) days totaling one (1) trip for providing storage, preparation and application instruction to the Contractor' applicator. At this time, the preparation of the surfaces, the application requirements and the temperature / environmental requirements shall be discussed with the Engineer, Contractor, and applicator.
   2. One (1) day to inspect the completed application.

1.08 SUBMITTALS

A. Comply with the requirements contained in Section 01300 - Submittals. The following documents shall be submitted:
   1. Technical data sheets for each paint specified.
   2. Color charts showing availability of each paint specified in the attached schedule.
   3. Two (2) paper chip samples, illustrating range of colors available for each paint specified in the schedule.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The requirements listed in this specification are based on paint provided by Tnemec Co., Inc. and are provided as a basis of the bid.

2.02 MATERIALS

A. Refer to the attached schedule for a listing of the appropriate surfaces for each paint material. The following are the types of materials that shall be used:

1.	V69 Epoxoline II	Hi-build polyamidoamine cured epoxy
2.	73 Endura-Shield III	Hi-build aliphatic polyurethane
3.	280 Tneme-Glaze	100% solids, hi-build amine epoxy (orange peel finish)
4.	46H-413 Hi-Build Tneme Tar	Hi-build coal tar epoxy
5.	201 Epoxoprime	100% solids clear epoxy primer
6.	1 Omnithane	Aromatic urethane primer with MIOX
7.	1028 Enduratone	Water-based acrylic polymer

B. Colors shall be as selected by the Engineer

2.03 MIXING

A. Mixing or tinting shall be done at the factory.

B. Site mixing shall be prohibited.

2.04 ACCESSORY MATERIALS

A. Provide all required ladders, scaffolding, drop cloths, mask-ings, scrapers, tools, sandpaper, dusters, cleaning solvents, and miscellaneous equipment as required to perform the work and achieve the results specified herein.

2.05 MISCELLANEOUS MATERIAL

A. Furnish the following in accordance with the requirements contained in Section 016500:
   1. One (1) gallons of each color, type, and surface texture used on the project regardless of the quantity actually applied. Store this spare paint where directed by the Engineer. Label each container with color, type, texture, and room location, in addition to the manufacturer's label.
   2. This material shall be turned over to the Engineer/Owner prior to substantial completion.

PART 3 EXECUTION

3.01 ENVIRONMENTAL REQUIREMENTS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

C. Apply exterior paint only when temperature exceeds 50 degrees F or as otherwise required by manufacturer and drying conditions are good and predicted to remain so for at least 24 hours.

D. Apply interior paint only when inside space and surface temperatures exceed 60degrees F, or as required by manufacturer, and will be maintained above that point until paint has dried.

E. Provide and maintain application temperatures for all finishes.

F. Contractor to provide adequate light, heat and ventilation for proper application and cure of all coatings.

3.02 EXAMINATION

A. Before painting is started in any area, the area shall be cleaned and excessive dust shall be removed from all areas to be painted. After painting operations begin in a given area, clean only with commercial heavy-duty vacuum cleaning equip-ment.

B. All steel joists and ceiling deck shall be high pressure washed with a solvent to remove all factory oils.

C. All concrete shall be finished as specified prior to paint application.

D. Adequate illumination and ventilation shall be provided in all areas where painting operations are in progress.

E. Verify the surfaces are ready to receive the work as required by the product manufacturer.

F. Before starting any work, surfaces to receive paint finish shall be examined carefully for defects which cannot be corrected by the procedures specified herein and which might prevent satisfactory painting results. Work shall not proceed until such damages are corrected.

G. The commencing of work in a specific area only shall be construed as acceptance of the surfaces, and thereafter the Contractor's applicator shall be fully responsible for satisfactory work as required herein.

H. Test shop applied primer for compatibility with subsequent cover materials.

I. Do not begin work until surfaces to receive paint are dry, firm, sound, clean and free of defects or blemishes, which would adversely affect the quality or appearance of the finished work.

J. Beginning of work means the installer accepts existing surface conditions.

K. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Masonry and concrete unit masonry: 12 percent.
   2. Concrete floors and walls: 8 percent.
   3. Interior and Exterior Wood: 15 percent, measured in accordance with ASTM D4442

3.03 PREPARATION - GENERAL

A. All surfaces shall be prepared as specified in the attached schedule. Surface preparation of steel shall be in accordance with SSPC - Chapter 2 - Surface Preparation Specifications.

B. Galvanized surfaces: Remove surface contamination and oils and wash with solvent. Abrade by abrasive blasting or power tools to provide a rough surface as described in coating schedule.

C. Uncoated ferrous surfaces: Remove scale by power wire brushing and wash clean with solvent. Prime paint after repairs.

D. Concrete: All exposed concrete shall be installed with the intent that it will be painted. All bug holes and honeycombed areas shall be patched as specified in Section 033000.

E. Surface appurtenances: If allowed by the Engineer, remove or mask electrical plates, hardware, light fixture trim, escutcheons, fittings, and all other surfaces to be protected from paint prior to preparing surfaces or finishing.

F. Surfaces: Correct defects and clean surfaces, which affect work of this Section. Remove or repair existing coatings that exhibit surface defects.

G. Aluminum Surfaces receiving Bitumastic Paint: Remove surface contamination and oils and wash with solvent.

H. Follow manufacturer's recommendations for preparing surfaces to be primed and painted.

I. Clean and sand surfaces to be painted.

J. Mask, cover, or remove surfaces to be protected from paint. Protect electrical and mechanical equipment and systems not to be painted.

K. Do not paint over UL Labels, manufacturer installed equipment nameplates, factory installed nameplates and equipment identification plates.

L. Clean and remove scale, oil or grease from ferrous metal surfaces

3.04 APPLICATION

A. Apply paint in accordance with SSPC - Chapter 5 - Paint Application Specifications.

B. It is the intent that the above brand names and types of mate-rial will give complete coverage with uniform appearance. If any additional coat is necessary for complete coverage and appearance, it shall be done at no additional cost.

C. All paints shall be new stock, delivered to the site unopened. Prepare sur-faces properly for receiving paint; protect adjacent surfaces not to be painted.

D. Use of sprays may be permissible, upon prior approval by Engineer.

E. All work shall be carefully done by skilled painters. Finished surfaces to be uniform in coverage, gloss, finish, and color, and free from brush marks. All coats shall be thoroughly dry before applying succeeding coats.

F. Apply products in accordance with manufacturer's instructions.

G. Do not apply finish coats until paintable sealant is applied.

H. Do not apply sealant or primer until surfaces are properly prepared.

I. Spray, roller and/or brush may be used as appropriate for the various conditions, but the specified dry film thicknesses must be provided.

J. Thicknesses listed in the Schedule for High Build Coatings can be obtained in one coat by spray, but not necessarily by brush or roller.

K. The specified DFT shall hold precedence over whatever recommendations are made for other supplier's products.

L. Minimum air and surface temperature for application of epoxy coatings shall be maintained at 55 degrees F. unless otherwise noted on the manufacturer's product data sheet.

M. Minimum air and surface temperature for 100% solids by volume epoxy coatings, such as 280 Tneme-Glaze, etc. shall be 60 degrees F. Optimum temperature of unopened 100% solids epoxy shall be 75 degrees F. Minimum temperature of unopened 100 solids epoxy shall be 60 degrees F.

N. Heat shall be supplied by equipment that delivers clean, warm air into the space to be coated. Heat shall not be supplied by devices that give off exhaust fumes such as carbon dioxide or carbon monoxide into the area to be coated. The purpose of this requirement is to prevent the coatings from yellowing during application and cure.

O. Sand surfaces lightly between coats to achieve required finish.

P. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

Q. Where clear finishes are required, tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.

R. Prime concealed surfaces of interior and exterior woodwork with primer paint.

S. Apply materials to obtain:
   1. Owner’s satisfaction and approval.
   2. Smooth uniform appearance.
   3. Complete coverage.
   4. Match with approved color sample.
   5. Work free of runs, sags and skips.
   6. Sharp, clean edges where finishes or colors change.
   7. Surfaces free of defects and damage at time of acceptance.

T. Paint PVC pipe in accordance with recommendations of the paint manufacturer and apply primer.

3.05 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

A. Paint shop primed equipment.

B. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

C. Prime and paint insulated and exposed process pipes, fittings, valves, hangers, brackets, collars and supports, except where items are shop finished.

D. Paint both sides and edges of plywood backboards of electrical and telephone equipment before installing equipment.

E. Color code equipment, piping, conduit, and exposed ductwork in accordance with other Sections, as shown or noted on the Drawings or as directed by the Engineer

3.06 ACCEPTANCE OF COATINGS

A. The appearance of all coatings shall be subject to comparison to the submitted paper chip samples. Acceptance of finish shall be made by the Engineer based on these comparisons

3.07 CLEAN UP

A. Comply with the requirements contained in Section 01710 - Cleaning.

B. Collect waste material, which may constitute a fire hazard, place in closed metal containers, and remove daily from site.

C. Install finished items removed by this Section. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

D. Remove masking and protective covering.

E. Leave factory finish surfaces clean and free of paint.

3.08 SCHEDULE

A. Ferrous Metals, Interior, Non-Submerged (including, but not limited to, structural steel, miscellaneous steel and process ductile iron piping, valves and fittings)
   1. Surface Preparation - SSPC-SP6, Commercial Blast Cleaning, 2-mil anchor pattern.
   2. Shop Primer - #1 Omnithane, 2.5-3.5 mils DFT
   3. Field Touch Up - V69 Epoxoline II, 3-5 mils in finish color.
   4. Finish - V69 Epoxoline II, Hi-Build (to color), 4-6 mils DFT, or 2 coats @ 2-3 mils by brush and/or roller.
   5. Notes:
      a. Color code process pipes then apply mechanical identification.
      b. Coordinate the work such that the prime coat specified for process piping - See Section 221000.
      c. Paint piping before insulation is installed. Paint all air pipe insulation in addition to painting all piping.

B. Ferrous Metals, Interior and Exterior, submerged or intermittently submerged in liquids (raw sewage or potable water applications).
   1. Surface Preparation - SSPC-SP10, Near While Metal blast cleaning, 1-2 mil anchor pattern.
   2. Shop Primer - #1 Omnithane at 2.5 to 3.5 mils DFT
   3. Touch Up - #1 Omnithane at 2.5 to 3.5 mils DFT. All primer shall be abraded if finish is not applied within 14 days.
   4. Finish - V69 Epoxoline II (to color) 2 coats 4-6 mils DFT per coat or V140 Pota-Pox Plus 2 coats 4-6 mils DFT per coat.
   5. Notes:
      a. Includes, but is not limited to, process piping, valves, and fittings.

C. Hollow Metal Work, Interior
   1. Surface Preparation - SSPC-SP2 Hand Tool Cleaning
   2. Shop Primer – Manufacturer's standard primer, 2.0 to 3.0 mils DFT
   3. Field Intermediate: 1028 Enduratone (to color), 2.0 to 3.0 mils DFT
   4. Finish – 1028 Enduratone (to color) 2.0 to 3.0 mils DFT

D. Ferrous Metals, Exterior, Non-submerged
   1. Surface Preparation - SSPC-SP6 Commercial Blast cleaning, 1-2 mil anchor pattern
   2. Shop Primer - #1 Omnithane, 2.5 to 3.5 mils DFT
   3. Field Intermediate - V69 Epoxoline II (to color) 3.0 to 5 mils DFT
   4. Field Finish - 73 Endura-Shield III, 2.0 to 3.0 mils DFT
   5. Notes:

a. Includes process piping, valves, and fittings.

E. Galvanized and Aluminum Surfaces, Exterior
1. Surface Preparation - SSPC-SP-1 Solvent Cleaning
a. Abrasive blasting per ASTM D6386, Standard Method for Preparing Galvanizing. When not possible to blast, use SSPC-SP2 Hand Tool Cleaning and sanding for all rust spots (white rust or aluminum oxide) and to roughen all surfaces.
2. Primer - V69 Epoxoline II (to color) 2.0 to 3.0 mils DFT
3. Finish - 73 Endura-Shield III, 2.0 to 3.0 mils DFT
4. Notes:
a. Includes structural members/shapes/angles, and galvanized members/shapes/ angles.
b. Excludes grating and aluminum equipment components.

F. Hollow metal work, Exterior
1. Surface Preparation - SSPC-SP2 Hand Tool Cleaning
2. Shop Primer – Manufacturers standard compatible with epoxy or urethane field coats, 2.0 to 3.0 mils DFT
3. Field Intermediate – 73 Endura-Shield (to color) 2.0 to 3.0 mils DFT
4. Finish - 73 Endura-Shield, 2.0 to 3.0 mils DFT

G. Ferrous Metals, Buried, Exterior (including structural steel, and miscellaneous steel)
1. Surface Preparation - SSPC-SP10 Near White Metal Blasting, 1-2 mil anchor pattern.
2. Shop Primer - V69 Epoxoline II, Hi-Build, Apple Red, 3-5 mils DFT
3. Field Finish - 46H-413 Hi-Build Tneme-Tar, 14 to 20 mils DFT

H. Concrete Walls and Ceilings, Interior, Poured and Precast, non-submerged
1. Surface Preparation - Allow to cure 28 days, if new. Remove all oil, grease, loose mortar, mortar splatter, and all loose foreign matter. Moisture level to be below manufacturer's requirements. Lightly brush blast to provide surface profile.
2. Primer - 201 Epoxoprime, clear at 5-6 mils DFT. 201 with 211 filler can be used to fill air holes simultaneous with priming.
3. Finish - 280 Tneme-Glaze (to color) one coat at 8.0 - 10.0 mils DFT

I. Concrete Wet Well Interior (raw sewage or potable water applications).
1. Surface Preparation - Allow to cure 28 days, if new. Remove all oil, grease, loose mortar, mortar splatter, and all loose foreign matter. Moisture level to be below manufacturer's requirements. Lightly brush blast to provide surface profile.
2. Primer – Series 66 Hi-Build Epoxoline
3. Finish – Series 66 Hi-Build Epoxoline, 2.0 – 6.0 mils DFT
4. Notes:
a. Includes, but is not limited to interior concrete surface of wet well.

J. Small diameter PVC Piping, Interior & Exterior
1. Surface Preparation - Sand lightly and wipe clean
2. Primer - V69 Epoxoline II (to color), 2-3 mils DFT
3. Finish - V69 Epoxoline II (to color), 2-3 mils DFT

END OF SECTION 09100

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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. Contractor is responsible for all piping system drain downs and associated work, equipment and services. Refer to section 15015 for detailed requirements.

F. Refer to specification section 15112 for detailed pipe testing, filling and water treatment, and section 15950 for system balancing requirements.

G. Do not install pipe or conduit through ductwork.

H. 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.

I. 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
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 or Corrosion Engineers
26.	ASSE	American Society of Sanitary Engineers
27.	International Building Code	
28.	International Fire Code	
29.	International Existing Building Code	
30.	International Fuel Gas Code	
31.	International Plumbing Code	
32.	International Energy Conservation Code	
33.	International 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
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.

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 no 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.
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. Remove all scale, loose materials to expose bare, virgin surface. Degrease surfaces per primer manufacturer instructions. Prime paint all bare supplemental steel, supports and hangers required for the installation of Division 15 Work in with corrosion inhibiting primer. Touch up welds of galvanized surfaces with galvanizing primer. Apply two coats of corrosion inhibiting paint, suitable for the location of construction. All painting work shall be done in appropriate weather conditions to ensure proper paint adhesion and curing. Match paint color to existing/adjacent surfaces, and submit paint selection to CM for approval prior to application.

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
   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.

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 2002 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.

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.
      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.
The representative shall perform a minimum of 5 site visits throughout the construction of the system.
3. 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.
4. 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
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 15010

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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. Piping System Draining and Disposal Plan

C. Inspection Report of Underground Piping Systems

D. Fire Watch Procedures

E. 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. Obtain written approval from CM prior to shutting down / isolating any piping systems.

B. Perform draining operations so that damage to existing building components does not occur.

C. Contractor is responsible for draining of piping, collecting water, storing, hauling, disposal and associated fees and costs, including providing all fittings, hoses, pump trucks, containment, spill control, site monitoring, etc. All work shall be done to applicable codes and regulations. Any hazardous materials shall be identified by the contractor prior to proceeding with work. Any spills or environmental hazards created by the contractor is the responsibility of the contractor to remove and remediate.

D. Do not torch cut ductwork.

E. Torch cutting of other mechanical equipment will be permitted only with the specific written approval of the Architect/Engineer.

F. 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..

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.

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.

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 15015

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The Work covered under this Section consists of the furnishing of all necessary labor, supervision, materials, equipment, and services to completely execute the pipe hanger and supports as described in this Specification. Size hangers and supports to fit the outside diameter of the pipe.

B. For information pertaining to outdoor structural framing systems for pipe supports refer to structural specifications and drawings.

C. Pipe hangers and associated hardware, accessories and attachments inside buildings with non-corrosive atmosphere shall be provided with galvanized steel (or copper) components.

D. Pipe hangers and associated hardware, accessories and attachments on site, exposed to outdoors, or in pipe tunnels shall be provided with stainless steel components. Galvanized steel or cast iron/steel (with corrosion inhibiting coating) maybe used only where stainless steel is not available.

1.02 REFERENCES

A. FS A-A-1192 – Federal Specification for Pipe Hangers

B. MSS SP58 - Manufacturers Standardization Society: Pipe Hangers and Supports- Materials, Design, and Manufacture

C. MSS SP69 - Manufacturers Standardization Society: Pipe Hangers and Supports- Selection and Application

D. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices

1.03 QUALITY ASSURANCE

A. Provide hangers and supports used in fire protection piping systems listed and labeled by Underwriters Laboratories.

B. Steel pipe hangers and supports shall have the manufacturer’s name, part number, and applicable size stamped in the part itself for identification.

C. Design and manufacture hangers and supports in conformance with MSS SP 58.

1.04 SUBMITTALS

A. Delegated-Design Submittal: For areas where pipe supports are not specifically called out on Structural drawings, provide comprehensive engineering analysis signed and sealed by a qualified professional engineer. Submittal shall include:
   1. Design calculations: Calculate requirements for designing the pipe supports. Hangers and supports for HVAC piping and equipment shall be capable of supporting the combined weight of supported systems and the system contents.
   2. Shop drawings which detail fabrication and assembly of pipe supports.

B. Submit product data on all hanger and support devices, including shields and attachment methods. Include as a minimum as part of product data materials, finishes, approvals, load ratings, and dimensional information.

C. Submit Pipe Hanger and Support Application Schedule.

PART 2 - PRODUCTS

2.02 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with these specifications, provide pipe hanger and support systems manufactured by:
   1. Anvil International, Inc.
   2. Elcen
   3. B-Line, Inc.
   4. Unistrut Corporation
   5. Or Equal

2.03 PIPE HANGERS AND SUPPORTS

A. Hangers
   1. Uninsulated pipes 2 inch and smaller:
      a. Adjustable swivel ring (band type), J or clevis hanger
   2. Uninsulated pipes 2-1/2 inch and larger:
      a. Adjustable clevis hanger
      b. Pipe roll with sockets
      c. Adjustable yoke pipe roll
   3. Insulated pipe- Hot piping:
      a. 2 inch and smaller pipes: use adjustable steel clevis with metal shield
      b. 2-1/2 inch and larger pipes
         1) Adjustable yoke pipe roll with pipe covering protection saddle
         2) Pipe roll with sockets with pipe covering protection saddle
   4. Insulated pipe- Cold or chilled water piping:
      a. 5 inch and smaller pipes: use adjustable steel clevis with metal shield
      b. 6 inch and larger pipes:
         1) Pipe roll with sockets with pipe covering protection saddle
         2) Adjustable steel yoke pipe roll with pipe covering protection saddle

B. Pipe Clamps
   1. When flexibility in the hanger assembly is required due to horizontal movement, use pipe clamps with weldless eye nuts. For insulated lines use double bolted pipe clamps.

C. Multiple or Trapeze Hanger
   1. Construct trapeze hangers from 12 gauge roll formed structural steel channel, 1-5/8 inch by 1-5/8 inch minimum.
   2. Mount pipes to trapeze with 2 piece pipe straps sized for outside diameter of pipe
   3. For pipes subjected to axial movement:
      a. Strut mounted roller support. Use pipe protection shield or saddles on insulated lines.
      b. Strut mounted pipe guide

D. Wall Supports
   1. Pipes 4 inch and smaller:
      a. Steel hook or J-hanger
   2. Pipes larger than 4 inch:
      a. Welded strut bracket and pipe straps.
      b. Welded brackets with roller chair or adjustable yoke pipe roll. Use pipe protection shield or saddles on insulated lines.

E. Floor Supports
   1. Hot piping under 6 inch and all cold piping:
      a. Steel adjustable pipe saddle and nipple attached to steel base stand sized for pipe elevation. Screw or weld pipe saddle to appropriate base stand.
   2. Hot piping 6 inch and larger:
      a. Adjustable Roller stand with base plate
      b. Adjustable roller support and steel support sized for elevation

F. Pipe Supports Between Anchors and Pipe Expansion Loops
   1. Provide supports between pipe anchors designed to cause minimal resistance to piping movement. Provide roller hanger supports or slide plates between anchors.
   2. Provide supports near the L bends of pipe thermal expansion loops. No more than 12 inches from either side of the horizontal elbow.

2.04 UPPER ATTACHMENTS

A. Beam Clamps
   1. Use beam clamps where piping is to be suspended from building steel. Select clamp type on the basis of load to be supported, and load configuration.
   2. Use center loaded beam clamps where specified. For steel clamps provide B-Line B3050, or B3055. For malleable iron or forged steel beam clamps with cross bolt provide B-Line B3054 or B3291-B3297 Series as required to fit beams.
   3. Steel beam clamps shall be of malleable iron and conform to MSS SP 58 Type 28.

B. Concrete Inserts
   1. Concrete inserts shall be MSS SP 58 malleable Type 18.
   2. Provide stainless steel expansion anchors inside pipe tunnels and buildings unless noted otherwise on structural drawings.

2.05 ACCESSORIES

A. Hanger Rods shall be threaded both ends or continuous threaded rods of circular cross section. Use adjusting locknuts at upper attachments and hangers. No wire, chain, or perforated straps are allowed.

B. Provide shields that are 180 degree sheet metal, 12 inch minimum length, 18 gauge minimum thickness, designed to match outside diameter of the insulated pipe.

C. Pipe protection saddles shall be formed from steel, 1/8 inch minimum thickness, sized for insulation thickness. Saddles for pipe sizes greater than 12 inch shall have a center support rib.

D. Inserts for Pipe Insulation:

   1. Insulated pipe, larger than 1-1/2-inches in diameter, shall be supported by a rigid insert to protect the insulation. A steel metal saddle of sufficient gauge to carry the weight of the pipe and its fluid without deforming shall extend 2-inches minimum on each side of the rigid insert. The joints between insert and insulation shall be sealed before saddle is installed. Sizes up to 6-inches IPS shall be MSS SP 58, Type 40, and for sizes over 10-inches shall be MSS SP 58, Type 39.

2.06 FINISHES

A. Indoor Finishes
   1. Coat hangers and clamps for support of bare copper piping with copper colored epoxy paint, B-Line Dura-Copper®. Use additional PVC coating of the epoxy painted hanger where necessary.

2. Zinc plate hangers for other than bare copper pipe in accordance with ASTM B633 OR provide an electro-deposited green epoxy finish, B-Line Dura-Green®.
3. Provide pre-galvanized strut channels in accordance with ASTM A653 SS Grade 33 G90 or provide an electro-deposited green epoxy finish, B-Line Dura-Green®.

B. Outdoor and Corrosive Area Finishes
1. Provide hangers and strut manufactured of type 316 stainless steel with stainless steel hardware where located outdoors or in corrosive areas.
2. Zinc plated hardware is not acceptable for outdoor or corrosive use.

PART 3 - EXECUTION

3.01 PIPE HANGERS AND SUPPORTS

A. Adequately support pipe by pipe hanger and supports specified in PART 2 - PRODUCTS. Allow for forces imposed by expansion joints, satisfy structural requirements and maintain proper clearances with respect to adjacent piping, equipment and structures. Size hangers for insulated pipes sized to accommodate insulation thickness.

B. Keep the different types of hangers to a minimum and provide hangers that are neat, without complicated bolting and with the number of parts of each hanger and its anchor kept to a minimum.

C. Make accurate weight balance calculations to determine the required supporting forces at each hanger or support location and the pipe weight load at each equipment connection.

D. Provide pipe hangers capable of supporting the pipe in all conditions of operation selected to allow free expansion and contraction of the piping and prevent excessive stress resulting from transferred weight being induced into the pipe or connected equipment.

E. Painted or shop prime all hangers and supports that are not galvanized.

F. Support horizontal steel piping in accordance with MSS SP-69 Tables 3 and 4, excerpts of which follow below:

NOMINAL PIPE SIZE (INCHES)	ROD DIAMETER (INCHES)	MAXIMUM SPACING (FEET)
1/2 to 1-1/4	3/8	6
1-1/2	3/8	9
2	3/8	10
2-1/2	1/2	11
3	1/2	12
3-1/2	1/2	13
4	5/8	14
5	5/8	16
6	3/4	17
8	3/4	19
10	7/8	22
12	7/8	23
14	1	25
16	1	27

Do not leave any pipe length unsupported between any two coupling joints.

G. Provide means of preventing dissimilar metal contact such as plastic coated hangers, copper colored epoxy paint, or non-adhesive isolation tape- B-Line Iso-pipe. Galvanized felt isolators sized for copper tubing may also be used, B-Line B3195CT.

H. Install hangers to provide a minimum of 1/2 inch space between finished covering and adjacent work.

I. Place a hanger within 12 inches of each horizontal elbow.

J. Support vertical piping independently of connected horizontal piping. Support vertical pipes at every floor. Wherever possible, locate riser clamps directly below pipe couplings or shear lugs.

K. Where several pipes can be installed in parallel and at the same elevation, provide trapeze hangers as specified in section 2.02 C. Space trapeze hangers according to the smallest pipe size, or install intermediate supports according to schedules in this Section.

L. Do not support piping from other pipes, ductwork or other equipment that is not building structure.

M. Where horizontal piping movements are greater than ½ inch, or where the hanger rod angularity from the vertical is greater than four degrees from the cold to hot position of the pipe, offset the hanger pipe and structural attachments in such a manner that the rod is vertical in the hot position.

N. In any part of the building which is steel-framed, attach hangers to the building structural steel beams. Where hangers do not correspond with the building structural steel beams, provide supplemental steel members continuously welded or bolted to the building structural steel beams. Provide two (2) coats of primer on the supplemental steel. In any parts of the building, which is a concrete structure, attach hangers to the concrete structure by installing anchors into the concrete.

3.02 CONCRETE INSERTS

A. Secure pipe hangers attached to concrete structure and slabs with embedded inserts, 316 stainless steel anchor bolts or concrete fasteners. Use a safety factor of 5 in selection of all inserts and expansion bolts unless there are seismic requirements (See “Seismic Restraint” specification if applicable). In which case, the larger of the two loadings shall govern the design.

B. Provide inserts for placement in formwork before concrete is poured.

C. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

D. Where concrete slabs form finished ceilings, provide inserts to be flush with slab surface.

E. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inch.

END OF SECTION 15061

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. Steam Trap Schedule - Submit steam trap schedules listing proposed steam trap number, location, type, sizes and service.

C. Valve Schedules - Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Samples - Submit samples of tags, attachments, labeled and identified.

E. Equipment Schedules - Submit mechanical equipment schedules, listing proposed equipment numbers, and their location and function.

F. 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.

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.

2.05 DUCT WORK IDENTIFICATION

A. Provide full air distribution system identification at each side of a wall penetration, in a mechanical room, at all changes in direction and at no more than 50 foot intervals. Provide arrows identifying direction of flow.

B. Fire damper or Smoke damper access points shall be permanently identified on the exterior by a label having letters not less than 0.5 inch in height reading: SMOKE DAMPER or FIRE DAMPER.

C. Identification shall be preprinted labels.

D. Letter Size: 1-1/2 inches in height.

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 15075

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PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This section describes the insulation, jackets and accessories for field-erected piping as scheduled in Part 3 of this Section and as shown on the Drawings.

1.02 RELATED REQUIREMENTS

A. Section 078413 - Firestopping

B. Section 15112 - Pipe, Valves, and Fittings

1.03 REFERENCES

A. National Fire Protection Association (NFPA):
   1. NFPA 255 - Surface Burning Characteristics of Building Materials.

B. Greenguard

C. 2020 International Energy Conservation Code

D. 2020 International Mechanical Code

E. Underwriters Laboratories, Inc. (UL):
   1. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

F. American Society for Testing and Materials (ASTM):
   1. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
   2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
   3. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
   4. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
   5. ASTM C335 - Standard Test Method for Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.
   6. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
   7. ASTM C518 - Standard Test Method for Steady-State Heat Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
   8. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
   9. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
   10. ASTM C547 - Standard Specification for Mineral Fiber Preformed Pipe Insulation.
   11. ASTM C 552 - Standard Specification for Cellular Glass Thermal Insulation
   12. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
   13. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
   14. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing.
   15. ASTM C 591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.

16. ASTM C 610 - Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation.
17. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
18. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
19. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
20. ASTM D1056 - Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
21. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics.
22. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
23. ASTM E96 - Standard Test Method for Water Vapor Transmission of Materials.

1.04 DEFINITIONS

A. Greenguard: Greenguard Environmental Institute

B. IAQ: Indoor Air Quality

C. EPA: Environmental Protection AgencyA

D. WHO: World Health Organization

E. ASJ: All Service Jacket

F. SSL: Self-Sealing Lap

G. FSK: Foil-Scrim-Kraft; jacketing

H. PSK: Poly-Scrim-Kraft; jacketing

I. PVC: Polyvinyl Chloride

J. FRP: Fiberglass Reinforced Plastic

K. Cold Service Piping/ Surfaces: Pipes or surfaces where the normal operating temperature is 60 degrees F or lower.

L. Hot Service Piping/ Surfaces: Pipes or surfaces where the normal operating temperature is 105 degrees F or higher.

1.05 SUBMITTALS

A. Product data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

B. Manufacturer’s Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.06 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer: Company specializing in manufacturing products specified with minimum 3 years documented experience.

2. Installer: Company specializing in performing the Work of this Section with minimum 3 years documented experience.

B. Materials:
1. Flame spread/smoke developed rating of 25/50 or less in accordance with ASTM E84, NFPA 255 and UL 723.
2. Insulation for duct, pipe and equipment for above grade exposed to weather outside building shall be certified as being self-extinguishing for 1" thickness in less than 53 seconds when tested in accordance with ASTM D1692.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

B. Follow manufacturer's recommended storage and handling practices.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient conditions required by manufacturers of each product (tapes,

B. adhesives, mastics, cements, insulation, etc.).

C. Maintain temperature before, during, and after installation for a minimum of 24 hours.

D. Supply fiberglass products that assure excellent IAQ (Indoor Air Quality) performance through Greenguard Certification.

E. Mold: Carefully inspect any insulation that has been exposed to water. If it shows any sign of mold growth remove it from the Site. If the material is wet but shows no sign of mold, dry rapidly and thoroughly. If it shows signs of facing degradation from wetting remove it from the Site.

PART 2 - PRODUCTS

2.01 FIBER GLASS INSULATION

A. Approved Manufacturers:
1. Knauf Insulation
2. Johns Manville Corporation
3. Owens Corning Corporation
4. CertainTeed Corporation

B. Fiber glass insulation meeting ASTM C547, ASTM C585, and ASTM C795; rigid molded, noncombustible.

C. Factory applied vapor barrier jacket: ASJ/SSL conforming to ASTM C1136 Type I and ASTM E96, secured with self-sealing longitudinal laps and butt strips.

2.02 FIBER GLASS INSULATION JACKETS AND ACCESSORIES

A. Field-Applied Jackets and Fitting Covers
1. PVC - 25/50 or Indoor/Outdoor, UV-resistant fittings, jacketing and accessories, white or colored. Fitting cover system consisting of pre-molded, high-impact PVC materials with fiber glass inserts. Approved Manufacturer: Proto Corporation.
a. Thickness: 10 mil.

b. Closures: stainless steel tacks, matching PVC tape, or PVC adhesive per manufacturer's recommendations.

2. ASTM B209 formed aluminum, 0.016-inch thick in smooth, corrugated, or embossed finish with factory-applied moisture barrier. Approved Manufacturer: Childers.
   a. Overlap: 2-inch minimum.
   b. Fittings: 0.016-inch thick die-shaped with factory-applied moisture barrier.
   c. Metal jacket bands: 3/8-inch wide, 0.015-inch thick aluminum or 0.010-inch thick stainless steel.
3. ASTM A666, Type <<302; 304; 316>> stainless Steel, 0.010-inch thick in smooth, corrugated, or embossed finish with factory-applied moisture barrier. Approved Manufacturer: Childers.
   a. Overlap: 2-inch minimum.
   b. Fittings: 0.016-inch thick die-shaped with factory-applied moisture barrier.
   c. Metal jacket bands: 3/8-inch wide, 0.010-inch thick stainless steel.
4. Laminated Self-Adhesive Water and Weather Seals - Permanent acrylic self-adhesive System; weather resistant, high puncture and tear resistance; meeting or exceeding requirements of UL 723; applied in strict accordance with manufacturers' recommendations.

B. Fitting Insulation
   1. Pre-formed fiberglass, preformed perlite, mitered fiberglass, mitered perlite or calcium silicate in lieu of PVC systems. Protect fittings with field-applied fitting covers.

C. Tapes
   1. Vapor barrier type, self-sealing, non-corrosive, fire-retardant. Approved Manufacturer: Compac Corporation

2.02 HIGH DENSITY JACKETED INSULATION INSERTS FOR HANGERS AND SUPPORTS

A. For use with Fiberglass Insulation:
   1. Cold Service Piping:
      a. Polyurethane Foam: Minimum density 4 pcf, K of 0.13 at 75 degrees F, minimum compressive strength of 125 psi.
   2. Hot Service Piping:
      a. Calcium Silicate: Minimum density 15 pcf, K of 0.50 at 300 degrees F; ASTM C 533.
      b. Perlite: Minimum density 12 pcf, K of 0.60 at 300 degrees F; ASTM C610.

B. For Use with Flexible Elastomeric Foam Insulation: Hardwood dowels and blocks, length or thickness equal to insulation thickness, other dimensions as specified or required.

2.03 ELASTOMERIC INSULATION

A. Approved Manufacturers:
   1. Armacell LLC
   2. K-Flex USA, Inc.

B. Flexible, tubular (Type 1) or sheet/roll form (Type 2) closed-cell elastomeric insulation complying with ASTM C534 <<Grade
   1. Standard (temperature range -297°F to 220°F); Grade
   2. High Temperature (to 350°F); Grade 3 - Contains no halogens>>; use molded tubular material wherever possible.

2.04 ELASTOMERIC INSULATION ACCESSORIES

A. Adhesives:

1. Air dried, waterproof vapor barrier contact adhesive, compatible with insulation for joining of seams and butt joints.

B. Finishes:
1. Provide a weather and UV resistant protective finish for outdoor applications in accordance with the manufacturer's recommendations.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that all piping is tested and approved prior to insulation installation.

3.02 Verify that all surfaces are clean, dry and without foreign material before applying insulation materials. INSTALLATION (GENERAL)

A. Install all materials using skilled labor regularly engaged in this type of work. Install all materials in strict accordance with manufacturer's recommendations, building codes, and industry standards.

B. Locate insulation and cover seams in the least visible location. Extend all surface finishes in such a manner as to protect all raw edges, ends and surfaces of insulation.

C. On cold surfaces where a vapor retarder must be maintained, apply insulation with a continuous, unbroken moisture and vapor seal. Insulate and vapor seal all hangers, supports, anchors, or other projections secured to cold surfaces to prevent condensation.

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. For hot piping conveying fluids <<140°F>> or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

F. For hot piping conveying fluids over <<140°F>>, insulate flanges and unions at equipment.

G. Maintain continuous pipe insulation through walls, ceiling or floor openings, or sleeves except where firestop or firesafing materials are required.

H. Install insulation neatly, accurately and without voids, in accordance with manufacturer's instructions and NIAC National Commercial and Industrial Insulation Standards.

I. Insulate fittings, valves and flanges using premolded covers with precut insulation inserts.

J. Insulate piping using insulation of type and thickness scheduled in this Section.

K. Install metal shields between hangers or supports and the piping insulation. Install rigid insulation inserts as required between the pipe and the insulation shields. Fabricate inserts to be of equal thickness to the adjacent insulation and vapor seal as required. Insulation inserts shall be no less than the following lengths:

1½" to 2½" IPS	10" long
3" to 6" IPS	12" long
8" to 10" IPS	16" long
12" and over IPS	22" long

L. Pipe exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor) to be finished with PVC jacket and fitting covers, aluminum jacket, or stainless steel jacket.

M. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Coordinate insulation installation with heat-tracing installation and testing. Insulate piping after tracing or heat distribution tape has been installed and tested for continuity.

3.03 INSTALLATION (FIBER GLASS)

A. Provide a continuous vapor retarder on piping operating below ambient temperatures. Seal all joints, seams and fittings.

B. Firmly butt and secure ends with appropriate butt-strip material. On high-temperature piping, double layering with staggered joints when recommended by the insulation manufacturer. When double layering, the inner layer should not be jacketed.

C. 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.

D. 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 adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

E. Cold Piping Insulation:
   1. On below freezing applications and in high abuse areas protect the ASJ jacket with a PVC vapor retarding outer jacket. Seal exposed ends of the insulation with a vapor retarder mastic installed per the manufacturer's recommendations. Apply vapor seals at butt joints at every fourth pipe section joint and at each fitting to isolate any water incursion.
   2. On chilled water systems operating in conditions of: RH of 90% and above, follow the same guidelines as described above for below freezing applications.

3.04 INSTALLATION (ELASTOMERIC)

A. Piping:
   1. Install pipe insulation by slitting tubular sections and applying onto piping or tubing. Alternately, slide unslit sections over the open ends of piping or tubing. Adhere and seal all seams and butt joints using adhesive.
   2. Push insulation onto the pipe, never pull. Stretching of insulation may result in open seams and joints.
   3. Tape the ends of the tubing before slipping the insulation over the new pipes to prevent dust from entering the pipe.
   4. Clean cut all edges. Do not leave rough or jagged edges of the insulation. Use proper tools such as sharp non-serrated knives.
   5. On cold piping, adhere insulation directly to the piping at the high end of the run using a two-inch strip of adhesive on the inner diameter of the insulation and on the pipe. Coat all

exposed end cuts of the insulation with adhesive. Adhere all penetrations through the insulation and termination to the substrate to prevent condensation migration.

6. Use sheet insulation on all pipes larger than 6-inch diameter. Do not stretch insulation around the pipe. On pipes larger than 12-inch diameter, adhere insulation directly to the pipe on the lower 1/3 of the pipe. On pipes greater than 24-inch diameter, completely adhere insulation.
7. Stagger seams when applying multiple layers of insulation.

B. Valves, Flanges and Fittings:
1. Insulate all fittings with the same insulation thickness as the adjacent piping. Adhere all seams and mitered joints with adhesive. Sleeve screwed fittings and adhered with a minimum 1” overlap onto the adjacent insulation.
2. Insulate valves, flanges, strainers, and Victaulic couplings using donuts covered with sheet or oversized tubular insulation.

C. Hangers:
1. Support piping system using high density inserts with sufficient compressive strength. Apply elastomeric foam insulation with the same or greater thickness than the pipe insulation to pipe supports. Seal all joints with adhesive.
2. Standard and split hangers - Insulate piping supported by ring hangers with the same insulation thickness as the adjacent pipe. Seal all seams and butt joints with adhesive. Sleeve ring hangers using oversized tubular insulation. On cold piping, extend insulation up the hanger rod a distance equal to four times the insulation thickness. Insulation tape may be used to a thickness equal to the adjacent insulation thickness.
3. Clevis hangers or other pipe support systems - Install saddles under all insulated lines at unistrut clamps, clevis hangers, or locations where insulation may be compressed due to the weight of the pipe. Insert and adhere wooden dowels or blocks of a thickness equal to the insulation to the insulation between the pipe and the saddle.
4. Pre-insulated pipe hangers can be used to prevent compression of insulation at standard split, clevis hangers or other pipe support systems. Adhere a pair of non-skid pads to the clamps to minimize the movement. In addition, to prevent loosening of the clamps, use an antivibratory fastener, such as a nylon-locking nut.

D. Exterior Applications:
1. Paint all outdoor exposed piping with two coats of UV resistant finish. Prior to applying the finish, wipe the insulation with denatured alcohol. Do not tint the finish.
2. Locate seams for all outdoor exposed piping on the lower half of the pipe.

3.05 PIPING INSULATION MATERIAL SCHEDULE

SYSTEM OR SERVICE	LOCATION	INSULATION TYPE	JACKET
Heating Hot Water	Inside	Fiber Glass	All Service Jacket
Heating Hot Water	Outside	See Spec #15510	See Spec #15510
Heating Hot Water	Valve Chamber	Elastomeric	-
Chilled Water	Inside	Cellular Glass	All Service Jacket
Chilled Water	Outside	See Spec #15510	See Spec #15510
Chilled Water	Valve Chamber	Elastomeric	-

3.06 MINIMUM PIPING INSULATION THICKNESS (IN.)

FLUID OPERATING TEMP RANGE (°F)	SYSTEMS IN TEMP RANGE	INSUALATION CONDUCTIVITY		NOMINAL PIPE OR TUBE SIZE (IN.)				
		CONDUCTIVITY BTU*IN./(H*SQ. FT.*°F)	MEAN RATING TEMP (°F)	<1	1 TO < 1-1/2	1-1/2 TO < 4	4 TO < 8	=8
> 350		0.32-0.34	250	4.5	5.0	5.0	5.0	5.0
251-350		0.29-0.32	200	3.0	4.0	4.5	4.5	4.5
201-250		0.27-0.30	150	2.5	2.5	2.5	3.0	3.0
141-200		0.25-0.29	125	1.5	1.5	2.0	2.0	2.0
105-140		0.21-0.28	100	1.0	1.0	1.5	1.5	1.5
40-60		0.21-0.27	75	0.5	0.5	1.0	1.0	1.0
< 40		0.20-0.26	50	0.5	1.0	1.0	1.0	1.5

END OF SECTION 15081

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This Section describes the pipe, valves, fittings, and joining materials for use with any field erected piping systems described in this Section and as shown on the Drawings. For Pre-Manufactured pipe specifications see “15510-Pre-Engineered HVAC Piping Systems.”

1.02 RELATED DOCUMENTS

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

B. Section 15061 - Pipe Hangers and Supports

C. Section 15075 - Mechanical System Identification

D. Section 15081 - Pipe Insulation

E. Section 15430 - Piping Specialties

1.03 ABBREVIATIONS

A. The following are standard abbreviations:
   1. CWP: Cold working pressure.
   2. EPDM: Ethylene-propylene-diene-terpolymer rubber.
   3. NRS: Nonrising stem.
   4. OS&Y: Outside screw and yoke.
   5. PTFE: Polytetrafluoroethylene plastic.
   6. SWP: Steam working pressure.
   7. TFE: Tetrafluoroethylene plastic.
   8. NPS: Nominal Pipe Size

1.04 SUBMITTALS

A. Product Data: For each type of valve indicated: Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

B. Product data on pipe, fittings, gaskets, and bolts. Include dimensions, specifications, and manufacturer. Provide pipe and valve application schedule.

C. Provide product data, including but not be limited to dimensions, specifications, manufacturer, installation and operation instructions, temperature and pressure ratings, end connections, and required clearances on piping specialties included in this Specification.

D. Welder Certifications - Furnish the names of pipe welders and welding operators employed by the Contractor to perform the Work who have been qualified to use the welding procedures which have been qualified in accordance with the specified pressure piping codes or AWS or NFPA standards.

E. Shop Drawings
   1. Where deviations from the Drawings and Specifications are proposed for any reason, submit shop drawings identifying proposed deviations showing layout of all piping, fittings,

materials, dimensions, and fabrication and installation details. Submit a comparison table of the specified features and ratings of the specified item and those of the proposed deviation to allow a direct comparison.

2. The review of deviations will be for pressure drop only. The review will not address clearances or accessibility. No dimensional or coordination check will be made.
3. The Contractor has the sole responsibility to review the Drawings, coordinate piping 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 piping.
4. Submit all layout shop drawings on not less than ¼ inch equals 1 foot scale drawings.

1.05 REFERENCES

A. Division 1 - Quality Control: Requirements for references and standards.

B. AGA Z21.22 - Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems.

C. ANSI C111 - Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings

D. ASME B16.3 - Malleable Iron Threaded Fittings.

E. ASME B16.5 - Steel Pipe Flanges and Flanged Fittings

F. ASME B16.9 - Factory-Made Wrought Steel Buttwelding Fittings

G. ASME B16.15 - Cast Bronze Threaded Fittings

H. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.

I. ASME B16.22 - Wrought Copper and Bronze Solder Joint Pressure Fittings.

J. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV.

K. ASME B16.24 - Cast Copper Alloy Pipe Flanges and Flanged Fittings.

L. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.

M. ASME B16.39 - Pipe Unions, Malleable Iron Threaded

N. ASME-B31.1 - Power Piping.

O. ASME B31.2 - Fuel Gas Piping.

P. ASME B31.5 - Refrigeration Piping.

Q. ASME B31.9 - Building Service Piping.

R. ASME B36.10M - Welded and Seamless Wrought Steel Pipe

S. ASME SEC IV - Construction of Heating Boilers.

T. ASME SEC IX - Welding and Brazing Qualifications.

U. ASTM A47 - Ferritic Malleable Iron Castings

V. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

W. ASTM A74 - Cast Iron Soil Pipe and Fittings.

X. ASTM A105 - Forgings, Carbon Steel, for piping components.

Y. ASTM A126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings

Z. ASTM A181 - Forgings, Carbon Steel, for General Purpose Piping

AA. ASTM A197 -Cupola Malleable Iron

BB. ASTM A234/A234M - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

CC. ASTM A307 - Carbon Steel Bolts and Studs, 60,000 psi Tensile AD. ASTM B32 - Solder Metal.

DD. ASTM B42 - Seamless Copper Pipe.

EE. ASTM B62 - Composition Bronze or Ounce Metal Castings AG. ASTM B75 - Seamless Copper Tube

FF. ASTM B88 - Seamless Copper Water Tube.

GG. ASTM B306 - Copper Drainage Tube (DWV).

HH. ASTM B584 - Copper Alloy Sand Castings for General Applications

II. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

JJ. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.

KK. AWS A5.8 - Specification for Brazing Filler Material

LL. AWWA C651 - Disinfecting Water Mains

MM. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves.

NN. NFPA 30 - Flammable and Combustible Liquids Code

OO. NFPA 54 - National Fuel Gas Code.

PP. NSF 61 - Domestic Water Pipe, Valves, and Fittings.

QQ. Mechanical Code of New York State-Latest Edition

RR. Plumbing Code of New York State-Latest Edition

SS. Fuel Gas Code of New York State-Latest Edition

TT. FM - Factory Mutual Compliance

UU. UL - Underwriter’s Laboratory Compliance

1.06 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set angle, gate, and globe valves closed to prevent rattling.
   4. Set ball and plug valves open to minimize exposure of functional surfaces.
   5. Set butterfly valves closed or slightly open.
   6. Block check valves in either closed or open position.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points.

D. Protect all flange faces with wood, plastic or soft metal to prevent damage to parts.

E. Protect all pipe threads from damage with plastic plugs or caps.

F. Mark and identify all piping materials in accordance with the Reference Standards specified herein.

PART 2 - PRODUCTS

2.01 GENERAL

A. When two or more valves of the same type are used in the same service, furnish all valves of this type from the same manufacturer.

B. Specific manufacturer's model numbers are cited in the following Piping Material Schedules to establish the desired quality and performance for each type valve or material. Equivalent products by other approved manufacturers are also acceptable. Approval shall be subject to review by the Architect/Engineer.

2.02 ABOVE GRADE PIPING INSIDE BUILDINGS

Item	Pipe Size	Description	Manufacturer/ Model No.
Pipe	2 inches and smaller	Type L, hard drawn copper tubing, ASTM B88	Mueller Industries
	2 ½ inches and larger	Schedule 40, seamless steel, ASTM A 53 Grade B	Wheatland
Joints	2 inches and smaller	Lead-free solder, ASME B32; Water Soluble Flux, ASTM B-813	J.W.
	2 ½ inches and larger	Welded Connections	Harris-Bridgit
Fittings	2 inches and smaller	Cast copper alloy or wrought copper ASME B16.18 or ASME B16.22	Nibco
	2-1/2 inches and larger	Standard Weight, Seamless steel, butt welded, ASTM A234	Weldbend
Flanges	2-1/2 inches and larger	150#, forged steel, weld neck, bore to	Weldbend

Item	Pipe Size	Description	Manufacturer/ Model No.
		match pipe ID, ASTM A181	Anvil
Bolts	All Sizes	Stainless Steel, Hex Head Bolts and Nuts, ASME B18.2.1	
Unions	2 inches & smaller	Wrought copper, solder unions, ASME B16.22	Nibco Elkhart
Dielectric	2-1/2 inches & smaller	Dielectric Type, Copper to Steel	Watts Regulator Series 3000 Capitol MNF Co.
Gaskets	All Sizes	Spiral wound metallic gaskets	Flexitallic Style LS/LSI

2.03 HEATING HOT WATER AND CHILLED WATER SITE PIPING

Item	Pipe Size	Description	Manufacturer/ Model No.
Gaskets	All Sizes	Spiral wound metallic gaskets	Flexitallic Style LS/LSI
Ball Valves	2 inches & smaller	Two-piece, full-port, soldered ends, bronze body, type 316 stainless-steel vented ball and stem, reinforced TFE seats, 150 psig SWP and 600-psig CWP ratings. MSS SP-110, ASTM B 584 Alloy C84400, ASME B1.20.1	Nibco S-585-70-66 Conbraco Industries, Inc.
Check Valves	2 inches & smaller 2 ½ inches & larger	Class 125, Y-pattern swing type, soldered connections, bronze body with TFE seat disc. MSS-SP80, ASTM B 62 Class 125, swing-type, flanged connections, cast iron body with bronze trim, non asbestos gasket. MSS-SP71, ASTM A-126 Class B	Nibco S413-Y Nibco F918-B
Butterfly Valves	2 ½ inches & larger	Full-lug type with ductile-iron body, one-piece Type 416 stainless-steel stem, copper bushing, aluminum-bronze disc, and molded-in EPDM seat. Valve sizes 2 ½" through 6" shall have lever lock operator; valve sizes 8" and larger shall have weatherproof gear operator. MSS SP-67	Nibco LD-2000-3/5 Centerline Valves
Butterfly Valves in Valve Chambers	2 1/2 inches & larger	Full-lug type with 316 stainless steel body, stainless steel stem, stainless steel disc, energizer encapsulated RTFE seat. Valve sizes 2 ½" through 6" shall have lever lock operator; valve sizes 8" and larger shall have weatherproof gear operator. MSS SP-67	Bray High Performance Butterfly Valve Cooper Cameron Valves
Balancing Valves	All Sizes	Valve shall be of cast iron construction with 125 psi ANSI flanged connections suitable up to 175 psi working pressure. Valves 2-1/2"-3" pipe shall have a brass ball with glass and carbon filled TFE seat rings. Valves 4"-12" shall be fitted with a bronze seat, replaceable bronze disc with EPDM seal insert, and stainless steel stem. Valves to have	Bell and Gossett Circuit Setter Armstrong Pumps, Inc.

Item	Pipe Size	Description	Manufacturer/ Model No.
		memory stop feature to allow valve to be closed for service and then reopened to set point without disturbing balance position. All valves to have calibrated nameplate to assure specific valve setting. Valves to be leak-tight at full rated working pressure. Design pressure and temperature shall be 175 psig at 250 deg F	

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Unless otherwise shown, route piping in the most direct manner parallel to building lines in accordance with the Drawings. Group piping whenever practical at common elevations.

B. Accurately align, support and connect piping without forcing.

C. Locate piping so that access to and clearance around equipment, and minimum piping headroom of 7 feet is maintained, except where otherwise shown.

D. Space piping so that insulation and flanges, if any, have at least 1 inch clearance after maximum movement.

E. Where pipe elevations are not shown, pitch supply and return lines to positive drain points and/or coils.

F. Provide accessible flanges or union connections on the supply and return connections of terminal equipment and other items which must be disconnected for maintenance. Where unions are furnished as an integral part of the equipment, additional unions are not required unless required for access to or removal of components. Arrange equipment piping connections so that maintenance can be made without removing large sections of pipe or relocating the equipment.

G. In Domestic Water Systems, connect branch lines to the top of the line. For all other liquid systems, connect branch lines to the bottom or lower half of the line, preferably the bottom.

H. Connect branch lines in steam service and compressed air to the top or upper half of the line, preferably the top.

I. Use fittings for all changes of direction. Bending of steel pipe is not permissible.

J. Clean all piping materials before installation to remove grease, loose dirt, mill scale and other foreign matter.

K. Provide air vents at all high points of water piping, and valved drains at all low points of water piping for complete venting, draining and flushing of the piping system. Locate and provide air vents at multiple high points that are necessary to prevent air binding in the piping system. Install additional air vents and drains if directed by the Architect/Engineer, at no cost to the Owner. As a minimum provide drains and air vents
   1. In each section of piping separated by valves.
   2. On all coils.

3. For each riser, where riser or runout to riser has a valve installed.
4. In low point of piping to each down fed convector or radiator.

L. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Provide loops, pipe offsets and anchors.

M. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

N. Install gate or ball valves for shut-off and to isolate equipment, parts of systems, or vertical risers.

O. Sleeve pipes passing through partitions, walls and floors.

P. Identify piping under provisions of “Mechanical System Identification” Specification.

Q. Provide escutcheons at all locations where piping installed exposed to view penetrates wall, partitions, floors and ceilings.

R. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

S. Install flexible connectors at inlet and discharge connections of pumps and other vibration producing equipment.

T. Install strainers on the supply side of each control valve, pressure regulating valve, solenoid valve, trap, and elsewhere as indicated.

U. For pressurized liquid piping systems installed horizontally make reductions in pipe sizes using eccentric reducer fitting installed with the level side up to allow air venting.

V. For all nipples up to and including six inches in length provide extra-heavy shoulder type. For all nipples over six inches in length provide corresponding material, quality and thickness as the pipe on which they are used. Do not use close nipples. Provide nipples with designation mark of the manufacturer conforming to the ASTM pipe specifications for system served.

W. Make connections to all cooling and heating units with single or multiple cooling or heating coils in accordance with the manufacturer’s instructions and labeling on equipment

X. For pressures over 15 psig, use nipples and caps instead of plugs for permanent closures. Plugs in equipment provided by equipment manufacturers are acceptable.

Y. Do not install piping above electrical panels. Route piping around panels.

3.02 THREADED CONNECTIONS

A. Ream pipe ends to remove burrs.

B. Use only standard ANSI taper threads. Threads shall be full, sharp, clean, and free of fins and burrs.

C. Apply joint sealing tape or paste to male threads only. Do not use paste on compressed air lines. When sealing fuel oil piping, use a thread-sealing compound suitable for oil when making up joints. When sealing natural gas piping, use a thread-sealing compound suitable for natural gas when making up joints.

D. Do not use close or short nipples of a size where the length of unthreaded pipe is less than the width of a pipe wrench.

E. Thredolets or similar code-approved fittings may be used for branch connections.

F. Provide unions at all threaded valve locations to facilitate the removal of the valve.

G. Joint Sealing Compound; Hercules, RectorSeal or approved equal.

3.03 WELDED CARBON STEEL CONNECTIONS

A. Perform welding using qualified welders and procedures following specified reference standards.

B. Do not use mitered welds for elbows.

C. Welded branch connections may be used in place of welding tees provided that requirements of the applicable ASME Code for pressure piping, B31.1 and/or B31.9 are met.

D. Weldolets or similar code-approved fittings may be used for branch connections.

E. Qualifications of welders, welding procedures, performance of welders and welding operators are required complying with the requirements of ASME B31.9 and ASME Boiler and Pressure Vessel Code, Section IX. Keep records and certifications required by code on file and available for inspection.

F. Whenever welding is done close to walls, floors or building structure, thoroughly clean the surfaces of weld splatter. Remove weld splatter from the surface of all welds, pipe and pipe supports.

G. Provide long radius pattern for welding elbows unless otherwise shown on the Drawings.

H. Examine and inspect welded pipe joints as follows:
   1. Visually examine all welded pipe joints for imperfections using qualified representatives. Submit qualifications to the Architect/Engineer.
   2. Make available to the Architect/Engineer records of visual examinations upon request.
   3. Remove weld defects by grinding or chipping and repair or replace joints in accordance with approved procedures.
   4. Make shop and field welded joints available to the Owner for nondestructive inspection and examination upon request.

3.04 COPPER TUBING CONNECTIONS

A. Provide soldered or brazed in accordance with Part 2 of this Section.

B. Make soldered and brazed connections in accordance with the procedures in the current edition of the Copper Tube Handbook of the Copper Development Association.

C. Qualifications of brazers, brazing procedures, and performance of brazers and brazing operators are required in compliance with the requirements of ASME B31.1, ASME B31.9, and the Boiler and Pressure Vessel Code, Section IX. Keep records and certifications required by the code on file and available for inspection.

D. Make solder joints on all copper water piping with 95/5 solder. Absolutely no lead-based solder will be accepted.

E. Clean joints thoroughly before soldering.

F. Remove excess solder and flux with a cloth or brush to leave a uniform clean fillet.

G. For refrigeration copper tubing connections, comply with ASME B31.5. Make brazed joints on all refrigeration piping.

3.05 CONNECTIONS OF DISSIMILAR METALLIC MATERIALS

A. Isolate connections between dissimilar metallic materials using dielectric connections. Use dielectric unions or flanges that provide a complete isolation of the two ends, including bolts for flanges, using materials suitable for the design pressure, temperature and fluid contained.

3.06 VALVES

A. Provide valves of the same size as the pipe in which they are installed, unless shown otherwise on the Drawings. At pumps, match valve size to pipe size and not pump connection size.

B. Install valves with the stem on or above the horizontal. Install valves with the stem horizontal if requirements of headroom, access or chain operation must be met.

C. Pack valves and adjust glands before final acceptance.

D. Install valve extension stems or chain operators where the center of valve hand wheels is more than 6 feet-6 inches above the floor and valve is 2 ½" and larger. Prove chain hooks where required to prevent fouling of chains on equipment and to clear walkways. Terminate chains approximately 3 feet-6 inches above the floor. Provide worm gear operators or impact hand wheels for all valves 6 inches and larger.

E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation and a protective sleeve that allows operation of the valve without breaking the vapor seal or disturbing the insulation.

F. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

G. Locate valves for easy access and provide separate support where necessary.

H. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Lift Check Valves: With stem upright and plumb

I. Install butterfly valves with stems horizontal to allow support for the disc and the cleaning action of the disc.

J. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

K. Install balancing valves with lengths of straight pipe upstream and downstream of valve as per manufacturer's instructions such that calibrated accuracy is maintained As a minimum provide straight lengths as per the following table;

REQUIRED STRAIGHT LENGTHS		
Valve Size	**Upstream (In Pipe Diameters)**	**Downstream (In Pipe Diameters)**
½"-3"	3	1

4”-12”	5	2

L. Chain wheel Actuators- Valve actuation assembly with sprocket rim, brackets, and chain.
   1. Sprocket rim with Chain guides: Ductile Iron (Aluminum for applications exposed to weather), of type and size required for valve.
   2. Brackets: Type, number, size, and fasteners required to securely mount actuator on valve.
   3. Chain: Stainless steel, of size required to fit sprocket rim.
   4. Manufacturers:
      a. Babbitt Steam Specialty Co.
      b. Roto Hammer Industries

3.07 CONTROL VALVE INSTALLATION

A. Install all control valves so that the stem position is not more than 60 degrees from the vertical up position.

B. Install valves in accordance with the manufacturer's recommendations.

C. Install control valves so that they are accessible and serviceable, and such that actuators may be serviced and removed without interference from structure or other pipes, ducts and/or equipment.

D. Install isolation valves at control valves such that control valve body may be serviced without draining the supply/return side piping system. Install unions at all connections to screwed type control valves.

3.08 HOT TAPPING

A. Provide a hot tapping tool for cutting holes in piping under pressure without interrupting system operation and without release or loss of fluid.

B. Provide hot taps to permit new tie-ins to existing piping systems, insertion of flow meters, and permanent or temporary bypasses.

C. Hot tap rating, ½ through 48 inch line size: 1500 psig maximum operating pressure at 100 degrees F and 750 degrees F maximum operating temperature at 700 psig.

D. Provide the following information on the line to be tapped to the hot tap vendor before starting the Work:
   1. Line size, wall thickness, and pipe material.
   2. Fluid in line, and operating pressure and temperature.
   3. Dimensional information and restrictions, if any.
   4. Tap size and orientation (if other than 90 degrees perpendicular to run of the pipe, give full details).

E. Provide the services of a company specializing in hot taps to perform the Work. Submit to the Architect/Engineer evidence that the company has performed this work for at least 5 years.

F. Approved Manufacturer’s:
   1. Topaz, Inc.
   2. Pro Tapping, Inc.

3.09 PRESSURE TESTING, FLUSHING AND CLEANING

A. Pressure test piping systems in accordance with applicable codes and as described herein.

B. Pressure testing - Schedule pressure testing so that it may be witnessed by the Architect/Engineer, Owner, or their representative. Perform tests in accordance with the following procedures:
   1. Before testing, complete the installation of each pipe line, including final supports, hangers and anchors. Perform testing before insulation or paint is applied for examination during the test. Clean piping and equipment of metal cuttings and foreign matter as they are installed.
   2. Codes - Pressure test piping to assure integrity of material and workmanship in accordance with the applicable ASME Code for pressure piping (B31) and New York State Code.
   3. Protection of Equipment - Protect equipment, instruments and piping specialties which are not included in the test by either disconnecting from the piping and blanking off the end of the pipe with a blind flange, plug or cap, or isolating by insertion of a line blind or spool piece as required. Disconnect pneumatic control lines and close all openings.
   4. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
   5. Piping may be tested in sections or circuits as required for the progress of the work.
   6. Provide all systems to be pressurized with the appropriate gauges, certified calibrated by the manufacturer, and pressure-relieving devices.
   7. Install relief valve set at a pressure no more than 1/3 higher than the test pressure, to protect against damage by expansion of liquid or other source of overpressure during the test. Do not allow test pressure to exceed maximum pressure for any vessel, pump, valve, or other component in system under test.
   8. Records - Provide records of all tests showing line designation, test pressure, ambient temperature, date of test, retests and signature of witness.

C. Hydrostatic Test Procedures - Perform hydrostatic testing in accordance with ASME B31.9.
   1. Perform test using the pressure indicated under “Pressure Testing Schedule”
   2. After hydrostatic test pressure has been applied for at least two hours, examine piping, joints, and connections for leakage while maintaining test pressure. Repeat hydrostatic test until there are no leaks.
   3. Repair leaks as specified under “Repair of Line Leaks”

D. Service Testing - Perform service testing in accordance with ASME B31.9.
   1. For gases and steam and condensate service not over 15 psig, and for nontoxic, noncombustible, nonflammable liquids at pressures not over 100 psig and temperatures not over 200 degrees F a system test with the service fluid is acceptable. This exemption does not apply to natural gas piping.
   2. Bring the piping system up to operating pressure gradually with visual examination at a pressure between one-half and two-thirds of design pressure. Make a final examination at operating pressure.
   3. Repair leaks as specified under “Repair of Line Leaks”
   4. Repeat service test until there are no leaks.

E. Repair of Line Leaks - Comply with the following procedures for repair of leaks. In each case retest after repairs are made.
   1. Soldered/Brazed Joints - Remove solder/brazing alloy and reapply with proper flux.
   2. Flanged Joints - Check to determine flange end alignment and that all bolts are uniformly tightened with the required torque. If leak persists, depressurize the line, remove gasket, examine flange end face, and insert new gasket.

3. Threaded Joints - Tighten joint to a required torque. If leak does not stop, replace pipe and/or fittings. Do not use pipe dope, cement or seal weld to stop pipe leaks.
4. Gasketed Joints - Remove existing gasket and insert new gasket.
5. Welded Steel Joints - Repair pipe in accordance with applicable ASME B31 code.
6. Leaks in Material - Leaks located in pipe or fitting material require the replacement of that section of pipe or fitting and a repeat of the entire system using the complete procedure required for that system. Caulking, welding or epoxy is not permitted. Repair all damage caused by leaks.

F. Flushing - Complete pressure testing requirements prior to flushing. Performance of the flushing may be witnessed by the Architect/Engineer, Owner, or their representative, provide ample notification to all parties in advance of flushing any system. Perform system flushing in accordance with the following procedures:
1. Flush all main and branch steam and liquid piping systems after pressure testing is complete with new potable water while draining the system at all low points. Isolate all connected equipment and flush individually.
2. Flushing for piping and equipment will be considered complete when water samples taken at all low points indicate clear discharge-with no visible solids. If not clear, continue flushing and sampling until discharge is clear.

G. Cleaning - Complete flushing requirements prior to cleaning. Performance of the cleaning may be witnessed by the Architect/Engineer, Owner, or their representative, provide ample notification to all parties in advance of cleaning any system. Perform system cleaning in accordance with the following procedures:
1. Clean all steam and condensate lines by blowing them out with live steam. Discharge steam and condensate from each main and branch safely to atmosphere for a minimum of five minutes.
2. Clean all compressed air, instrument air, and fuel oil lines with oil-free dry compressed air at design pressure through each section so that they are blown free of dirt and debris.
3. Clean domestic water lines by flushing with water until effluent is visibly as clean as the flushing medium.
4. Clean hot water/chilled water lines as described below:
   a. When flushing discharge is clear, fill piping systems with water and sufficient approved alkaline cleaning material to remove dirt, oil and grease. Include all connected equipment in the cleaning.
   b. Vent system and place in operation, with automatic controls operating at set point temperature or an operating temperature designated by the Architect/Engineer. Circulate the solution through the system for a minimum of 4 consecutive hours.
   c. After 4 hours, drain system and flush with clean water until the pH at the farthest drain matches the clean water input. Keep strainers unplugged during the cleaning operations. Refill system with clean water.
5. Clean temporary pump strainers and strainers at coils, etc. every 2 hours periodically during cleaning procedures. Do not remove temporary strainers until all cleaning steps are completed and the operation of the system indicates that the system is free of all foreign matter.
6. Blow out all piping and equipment after cleaning and final flushing is completed and the system is drained with clean dry instrument air for a minimum of 15 minutes or until all water is expelled from the system. Upon completion seal the system by closing all drains and vents.
7. Following the Architect/Engineers approval of the above flushing and cleaning procedures, immediately fill each system and chemically treat and monitor in accordance with the “Chemical Treatment Systems” specifications.

H. Pressure Testing Schedule:

	Test Type	Design Operating Pressure (PSIG)	Test Pressure (PSIG)
Heating Hot Water & Chilled Water Supply & Return	Hydrostatic	80	1.5x maximum working pressure, but not less than 100 PSI

3.10 FILLING, COMISSIONING AND BALANCING

A. The contractor shall proceed with system filling only after providing written evidence of successful pressure test, completed flushing and cleaning and after written approval from CM.

B. The contractor shall supply the services of a water treatment provider to determine the recommended refill formulation of water, corrosion and rust inhibitors, etc. and supply to the site premixed in a tanker truck in order to expedite refilling and provide proper water chemistry. For smaller segments the sections maybe refilled by 55 gallon drums, etc.

C. The water treatment provider shall retest the system after one week of bringing the new work sections on line to verify system water chemistry and provide the report to the owner.

D. The contractor shall provide the above services at completion of every work phase.

E. Interim water treatment during construction, but not associated with system refilling is the responsibility of the owner.

F. The contractor shall proceed with system balancing for the associated buildings of the phase of work only after successful system filling and water quality results have been obtained and approved.

END OF SECTION 15112

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. Section 078413, Firestopping
   3. 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:
      a. 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.
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

b. Material of construction shall be Type 316 stainless steel.

D. Link Seals:
1. General Use: Provide link type 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. 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:
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.

END OF SECTION 15121

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PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This section describes the thermometers and pressure gauges for monitoring liquids and gases in mechanical equipment and systems to be provided as part of the Work.

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's catalog sheets and specifications.

B. Certification - Submit certified accuracy for all products specified.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

A. Subject to compliance with the specifications, provide products from the following manufacturers.
   1. Weksler Instruments
   2. H.O. Trerice Co.
   3. Taylor Instrument Co.
   4. Moeller Instrument Co.

2.02 THERMOMETERS FOR MEASURING LIQUID TEMPERATURE

A. Thermometer Scale Ranges: Provide thermometers, with scale range 1-1/2 times the actual working temperature required for the particular application, as approved. Provide maximum of 2 degrees between graduations and 10 degrees between numerals. When scale ranges are in excess of 100 degrees, the maximum range between numerals may be 20 degrees, or as otherwise approved for the particular application.

B. Thermometers: Provide red reading or magnified column industrial type, with wide angle of vision. Thermometers containing mercury are not permitted. Design and materials as follows:
   1. Case: Heavy one piece cast aluminum or extruded brass construction, with a clear acrylic plastic or glass lens. (Adjustable Angle)
   2. Scale: White enamel background with bold black figures and graduations. Provide 7 inch scale length for installation in piping and 9 inch length for installation in tanks and similar equipment.
   3. Separable Thermowell: Provide thermometers with matching brass (for water service) or stainless steel (for steam service) separable socket thermometer wells in accordance with manufacturer’s recommendations.
   4. Stem: Swivel neck design.
   5. Locking Device: Adjustable case locknut and adjusting screw function independently to provide full 360 degree positioning of thermometer case and stem to provide optimal visibility.

2.03 PRESSURE GAUGES

A. Provide pressure gauges with 4½" dial size with a flangeless stainless steel case, stainless steel friction ring and acrylic window. Provide brass movement with a bronze bourdon tube and brass socket.

B. Dial face: white with black figures; pointer with zero adjustment screw.

C. Accuracy: ±1% of scale range, ASME B40.1 Grade 1A.

D. Approved manufacturers: Trerice No. 620 or approved equal.

E. Provide stainless steel needle valves for all pressure gauges, Trerice or approved equal.

F. Provide steel coil siphons for gauges on steam service, Trerice No. 885 or approved equal.

G. Provide pressure snubbers for gauges on any service where pressure surges or pulsations are possible, Trerice No. 872 or approved equal.

2.04 RANGES FOR TEMPERATURE AND PRESSURE GAUGES

Thermometer	Hot Water	60° to 250°F
Pressure Gauges	Hot Water	0 to 60 psi
Thermometer	Chilled Water	30° to 100°F
Pressure Gauges	Chilled Water	0 to 60 psi

Note: Select the proper range so that the average operating pressure and temperature falls approximately in the middle of the scale selected. It is the Contractor's responsibility to determine the average operating range and select the scale appropriately.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Thermometers:
1. Install thermometers, of type and scale range as required for the particular application, at locations indicated on the Drawings or as required by the Specifications.
2. Install thermometers of type, scale range, and with case style, as required for the particular application, at locations indicated on the Drawings or Specified. Angle each thermometer so that it can be easily read from a standing position at floor level.
3. Where thermometers are installed in piping with insulation 2 inches thick or greater, provide thermometer wells with extension necks. Omit extension necks where thermometers are used on bare pipe or pipe with insulation less than 2 inches thick.
4. Where thermometer wells are installed in piping 2 ½ inches and smaller, increase the pipe size by a minimum of one pipe diameter to avoid restricting the flow in the pipe or install thermometers at elbows such that the stems protrude into the flowing medium.

B. Pressure Gauges:
1. Install gages, of type and scale range as required for the particular application, at locations indicated on the Drawings or as required by the Specifications.
2. For measuring liquid pressure, install gauges complete with stop cocks and drain cocks.
3. Install siphon loops on pressure gauges when installing in steam lines.

C. Pressure Snubbers and Impulse Dampers:
1. Install "pressure snubbers" in the piping connections to all gages installed in the suction and discharge piping connections to close coupled and base mounted circulating pumps driven by motors under 10 HP.

END OF SECTION 15130

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This section describes the pipe specialties for piping systems including, but not limited, to the following:
   1. Drain Valves
   2. Strainers
   3. Air Vents
   4. Externally Pressurized Expansion Joints
   5. Flexible Stainless Steel Hoses

1.02 REFERENCES

A. ASME - Boilers and Pressure Vessel Codes, SEC 8-D-Rules for Construction of Pressure Vessels.

B. Expansion Joint Manufacturer’s Association, Inc. (EJMA)

C. Expansion Joint Manufacturer’s Association Standards, Tenth Edition.

1.03 SUBMITTALS

A. Product Data: Submit product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes and finishes. Include produce description, model and dimensions.

B. Submit manufacturer's instructions for maintenance and repair.

C. Submit a valve and specialty application schedule.

1.04 OPERATION AND MAINTENANCE DATA

A. Maintenance Data: Include installation instructions, assembly views, lubrication instructions and replacement parts list.

1.05 RELATED WORK

A. Section 15112 - Pipe, Valves and Fittings

1.06 QUALIFICATIONS

A. Companies specializing in making products specified with at least 5 years of experience and products that have been on the market for at least 3 years.

PART 2 - PRODUCTS

2.01 DRAIN VALVE

A. Provide drain valves, ball type with ¾ inch hose connector, at all low points of water systems, on strainers, and in all locations as shown on the Drawings. Provide minimum 1 inch drain size. Provide caps or plugs with chain at all drain and fill valves.

2.02 STRAINERS

A. General:
   1. Provide strainers ahead of all pumps, automatic control valves, as specified for piping installations, as shown on the Drawings, and as required for proper functioning of equipment.

B. Manufacturers:
   1. Mueller Steam Specialty.
   2. Metraflex

C. Water Strainers
   1. “Y” type or “Basket” type, as shown on the Drawings.
   2. Provide a strainer screen blow down valve the full size of the blow-off tapping for each strainer. Provide gate valves for steam service and ball valve with ½ inch hose end for water service.
   3. Stainless steel strainer screens with perforations as follows:

Pipe Size (Inches)	Water Service Perforations (Inches)	Steam Service Perforations (Inches)
Thru 4	1/16 (except at cooling tower pumps shall be 1/8)	1/32
Over 4	1/8	3/64

   4. Select the length of the nipple connecting the blow-off valve to the strainer basket flange so that the blow-off valve is clear of the insulation.
   5. Select strainers with bodies compatible with connected piping from the following schedule for the service intended.

Size	Manufacturer	Strainer Type	Model No.	Description
2 inches & smaller	Mueller Steam Specialty	Y	11M	Cast iron body, threaded ends, ANSI Class 250
2 inches & smaller	Mueller Steam Specialty	Y	358S	Bronze body, soldered ends, ANSI Class 125, for copper pipe
2 ½ inches & larger	Mueller Steam Specialty	Y	758	Cast iron body, flanged ends, ANSI Class 125
2 inches & smaller	Mueller Steam Specialty	Basket	125	Cast iron body, screwed ends, ANSI Class 125
2 inches & smaller	Mueller Steam Specialty	Basket	125B	Bronze body, screwed ends, ANSI Class 150, for copper pipe
2 ½ inches & larger	Mueller Steam Specialty	Basket	166	Cast iron body, flanged ends, ANSI Class 250

2.03 AIR VENTS

A. Automatic Air Vents:
   1. Float actuated high capacity air vent designed to purge free air from the system and provide shutoff at pressures up to 150 psig at a maximum temperature of 250 degrees F. Design to prevent air from entering the system if system pressure drops below atmospheric pressure and to purge free air at pressures up to 150 psig during normal system operation.
   2. Cast iron and fitted with components of stainless steel, brass, and EPDM.

3. Provide a shutoff ball valve before the automatic air to isolate the air vent from the system.
4. Approved Manufacturers:
   a. ITT Bell & Gossett
   b. Taco

B. Manual Air Vents:
1. ½ inch ball valves with ½ inch hose ends.

2.04 EXTERNALLY PRESSURIZED EXPANSION JOINTS:

A. GENERAL
1. Provide expansion joints as required to accommodate any axial thermal expansion or contraction of the piping system.
2. Expansion joints to be of the packless, externally pressurized type where system line pressure is external to the bellows to minimize squirm.
3. Externally pressurized bellows expansion joints shall not be utilized to compensate for lateral, angular or rotational movements.
4. All materials of construction, pressure ratings, and end fittings shall be appropriate for the application. Guiding and anchoring per EJMA recommendations and guidelines.
5. Delegated-Design Submittal: Provide analysis signed and sealed by a qualified professional engineer. Submittal shall include:
   a. Design Calculations: Calculate requirements for thermal expansion of piping systems and criteria for selecting and designing expansion joints, hard-pipe loops, and swing connections.
   b. Schedule and drawings: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and locations for each expansion joint, anchor and guide.
   c. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions, methods of assembly, and attachment to building structure.
   d. Alignment Guide Details: Detail field assembly and attachment to building structure.

B. PRODUCTS
1. Manufacturer:
   a. Inline Expansion joints shall be **"**MetraGator**"** as manufactured by The Metraflex Company®, Chicago, IL.
   b. Flexicraft or Approved Equal
2. Expansion joints shall conform to ASTM F-2934 and MIL–E–17813H
3. Pressure rating.
   a. Expansion joints shall be pressure rated for 150 psi @ 500º F.
   b. Expansion joints shall be pressure rated for 300 psi @ 500° F.
4. Test pressure for 150 PSI joints shall be 225 PSI at 70º F, Test pressure for 300 PSI joints shall be 450 PSI at 70º F.
5. Movement capabilities:
   a. for single joints shall be 4", 6", or 8" axial compression,
   b. For double joints movement capabilities shall be 8", 12" or 16" axial compression.
   c. As required by calculation.
6. Construction: All welded construction with stainless steel bellows, steel shroud, integral guide rings, and internal liner.
7. Bellows: Bellows shall be 2 ply, low corrugation style manufactured from T 304 stainless steel. The number of corrugations and overall length of the expansion joints shall be determined by the thermal expansion requirements, system design engineer, and manufacturer's recommendations based on EJMA (Expansion Joint Manufacturers Association) standards.
8. End connections shall be:
   a. Weld End.

9. Traveling end of expansion joint shall be equipped with a O-Ring debris shield to inhibit debris from entering expansion joint.
10. All joints to be provided with drain connection and lifting lug. Double end joints shall have anchor base to act as intermediate anchor.

2.05 FLEXIBLE STAINLESS STEEL HOSE

A. Stainless steel braid and carbon steel fittings.

B. End connections: Sizes 2 ½ “and smaller, threaded male nipples. Sizes 3" and larger, flanged.

C. Minimum lengths as tabulated below:

SIZE (INCHES)	MINIMUM SIZE (INCHES)	SIZE (INCHES)	MINIMUM LENGTH (INCHES)
1/2	9	4	15
3/4	10	6	20
1	11	8	22
1 1/4	12	10	26
1 1/2	13	12	28
2	14	14	30
2 1/2	18	16	32
3	14		

D. Approved Manufacturers:
1. Type BSS as manufactured by Mason Industries, Inc.
2. Flexicraft or Approved Equal.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

A. Install work in accordance with manufacturer’s instructions and as shown on the Drawings.

B. Furnish and connect to all valves, brass tags, polished or lacquered, with stamp lettering or numbers filled in with black paint. Identify each zone.

C. See “Pipe, Valve and Fitting” Specification for more information.

D. Secure escutcheons to the pipe or insulation and flush with the building surface. Clean the valves and place them in final operating position

3.02 STRAINER INSTALLATION

A. Installed strainers so they are readily accessible

B. Remove start-up strainer screen from suction diffusers and strainers and install permanent screens prior to balancing water systems.

3.03 AIR VENT INSTALLATION

A. Provide automatic air vents with ¼ inch copper drip lines to the nearest floor or roof drain.

B. Install air vents where shown on the Drawings and at the high points of all systems and at other locations as required to allow complete venting of air from the system.

3.04 EXTERNALLY PRESSURIZED EXPANSION JOINT INSTALLATION

A. Guiding: Pipe guides adjacent to the expansion joint shall be in accordance with EJMA guidelines based on design pressure and line size. Alternative guiding may be acceptable after design review by manufacturer, calculations with qualified design professional's signature and seal shall be submitted.

B. When installed in vertical pipe runs expansion joint shall be installed with the traveling end on top to facilitate drainage of the expansion joint.

C. Drain: Expansion joint shall be installed so that the drain connection is on the low end of the joint.

D. Installation shall be in accordance with manufacturers printed instructions.

E. Standard joints are supplied set for pipe expansion in hot systems. Purchaser shall specify If joint is to be installed for contraction in a chilled system.

3.05 FLEXIBLE CONNECTOR INSTALLATION

A. Install flexible Connectors at all locations where piping connects to cooling towers, chillers, air handlers, pumps, or compressors and other places shown on the Drawings.

B. Install Flexible Rubber Connectors only in equipment rooms. Where flexible connectors are required in ceilings or other construction away from equipment rooms and when temperatures exceed 250 degrees F, install Flexible Stainless Steel Hoses.

C. Where Flexible Rubber Connectors can not be installed due to temperature and pressure limitations install Flexible Stainless Steel Hoses.

D. Install connectors the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible.

E. Install expansion joints in piping gaps equal to the length of the expansion joints under pressure.

END OF SECTION 15430

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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 pre-engineered HVAC piping systems complete and operational with accessories.
   2. The Work shall comply with vibration, seismic, and wind control requirements in Section 15050, Vibration, Seismic, and Wind Controls.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the pre- engineered HVAC piping systems Work.
   2. Notify other contractors in advance of the installation of the pre-engineered HVAC piping systems to provide them with sufficient time for the installation of items included in their contracts that must be installed with, or before, the pre-engineered HVAC piping systems work.

C. Related Sections:
   1. Section 15075, Mechanical System Identification.
   2. Section 15061, Pipe Hangers and Supports.
   3. Section 15950, Balancing of Hydronic Systems.
   4. Section 02200, Earthwork

1.02 REFERENCES

A. American National Standards Institute (ANSI).

B. American Society of Mechanical Engineers (ASME).
   1. ASME/ANSI B16.5 – Pipe Flanges and Flanged Fittings.
   2. ASME/ANSI B16.9 – Factory-Made Wrought Steel Butt welding Fittings.
   3. ASME/ANSI B16.18 – Cast Copper Alloy Solder Joint Pressure Fittings.
   4. ASME/ANSI B16.22 – Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

C. American Society for Testing and Materials (ASTM).
   1. ASTM A53/A53M – Standard Specification for Pipe, Steel, Black and Hot- Dipped, Zinc-Coated, Welded and Seamless.
   2. ASTM A106/A106M – Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
   3. ASTM A123/A123M – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   4. ASTM A153/A153M – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   5. ASTM A312/A312M – Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
   6. ASTM A653/A653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   7. ASTM B32 – Standard Specification for Solder Metal.
   8. ASTM B88 – Standard Specification for Seamless Copper Water Tube.
   9. ASTM B313/B313M – Standard Specification for Aluminum and Aluminum- Alloy Round Welded Tubes.

10. ASTM B813 – Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube.
11. ASTM B828 – Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
12. ASTM C518 – Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
13. ASTM C547 – Standard Specification for Mineral Fiber Pipe Insulation.
14. ASTM D1248 – Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
15. ASTM D1784 – Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
16. ASTM D1785 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
17. ASTM D1929 – Standard Test Method for Determining Ignition Temperature of Plastics.
18. ASTM D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
19. ASTM F876 – Standard Specification for Crosslinked Polyethylene (PEX) Tubing.
20. ASTM F877 – Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems.
21. ASTM F1807 – Standard Specification for Metal Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing.
22. ASTM F1960 – Standard Specification for Cold-Expansion Fittings with PEX Reinforcing Rings for Use with Cross-Linked Polyethylene (PEX) Tubing.
23. ASTM F2080 – Standard Specification for Cold-Expansion Fittings with Metal Compression-Sleeves for Cross-Linked Polyethylene (PEX) Pipe.
24. ASTM F2098 – Standard Specification for Stainless Steel Clamps for Securing SDR9 Cross-linked Polyethylene (PEX) Tubing to Metal Insert and Plastic Insert Fittings.
25. ASTM F2159 – Standard Specification for Plastic Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing.

D. American Welding Society (AWS).
   1. AWS B2.1 – Specification for Welding Procedure and Performance Qualification.
   2. AWS B2.2 – Specification for Brazing Procedure and Performance Qualification.
   3. AWS B2.3 – Specification for Soldering Procedure and Performance Qualification.

E. National Sanitation Foundation International (NSF).
   1. NSF 14 – Plastics Piping System Components and Related Materials. 1.03

1.03 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer:
      a. Minimum of five years of experience producing substantially similar materials and able to show evidence of at least five installations in satisfactory operation for at least five years in the continental United States.
      b. Materials shall be manufactured in the United States.
   2. Professional Engineer:
      a. A registered professional engineer legally qualified to practice in New York and experienced in providing engineering services of the kind indicated.
      b. Submit qualifications data.
      c. Responsibilities include but are not necessarily limited to:
         1) Carefully reviewing system 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 the preparation of design calculations and related drawings, Shop Drawings, testing plan development,
4) test-result interpretation and a comprehensive engineering analysis verifying compliance of the system with the requirements of the Contract Documents.
5) Signing and sealing all calculations and design drawings, and Shop Drawings.
6) Certifying that:
   a) it has performed the design of the system in accordance with the performance and design criteria stated in the Contract Documents, and
   b) the said design conforms to all applicable local, state and federal codes, rules and regulations, and to the prevailing standards of practice.

3. Installer:
   a. Engage an experienced installer to perform the work of this Section who has specialized in installing pre-engineered HVAC piping systems similar to that required for this Project and who is acceptable to manufacturer.
   b. Submit name and qualifications to Engineer along with the following information on a minimum of three successful projects:
      1) Names and telephone numbers of owners, architects or engineers responsible for projects.
      2) Approximate contract cost of the pre-engineered HVAC piping systems.
      3) Amount of area installed.
4. Welding, Brazing, and Soldering:
   a. Qualify processes and operators in accordance with AWS B2.1, B2.2, and B2.3 as appropriate for material to be welded, brazed, or soldered.
   b. Provide certification that operators 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.

B. Regulatory Requirements:
   1. National Electrical Code (NEC).
   2. National Fire Protection Association (NFPA).
   3. Plastics Pipe Institute (PPI).
   4. Underwriters Laboratories Inc. (UL).
   5. Local and State Building Codes and Ordinances.
   6. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.

C. Mock-Ups:
   1. Installer of field closures or end seals shall demonstrate acceptable installation techniques to the satisfaction of the manufacturer's representative. Perform demonstrations on Contractor supplied sample materials prior to any field installations.

D. Field Testing: As listed in Section 3.0

1.04 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Drawings showing fabrication methods, assembly, accessories, and installation details, including end seals, supports, expansion joints, guides and anchors.
      b. 1/4-inch scale piping layouts, dimensioned to show length of runs, sizes, support spacing and expansion provisions.
      c. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.
   2. Product Data:

a. Manufacturer's literature, illustrations, specifications, weight, dimensions, required clearances, materials of construction, and performance data for all materials.
b. Complete component list.
c. Detailed description of each component.
d. Catalog cut sheets for each component.
e. Deviations from Contract Documents. Any exceptions to the Contract Documents must be clearly defined. Contractor shall be responsible for any additional expenses that may occur due to any exception made.
f. Other technical data related to specified material and equipment as requested by Engineer.

3. Delegated Design Submittals:
   a. 1/4-inch scale piping layouts, dimensioned to show length of runs, with all expansion joints, alignment guides, anchors and appurtenances required for proper control of piping forces. The drawings shall include all forces acting on the pre-engineered HVAC piping system and the corresponding reactions of the compensation and anchor devices provided.
   b. All drawings, design calculations, and a letter indicating that the expansion compensation system has been properly designed shall be signed and sealed by a registered professional engineer legally qualified to practice in New York.
4. Testing Plans, Procedures, and Testing Limitations:
   a. Plan for performing required field testing.

B. Informational Submittals: Submit the following:
1. Certificates:
   a. Independent certification reports.
   b. Affidavit, signed by the manufacturer's field advisor and notarized, certifying that the system meets the contract requirements and is operating properly.
2. Manufacturer Instructions:
   a. Instructions and recommendations for handling, storing, protecting the materials. Installation Data.
   b. Instructions for handling, start-up, and troubleshooting.
3. Field Quality Control Submittals:
   a. Written report presenting results of required field testing.
4. Supplier Reports:
   a. Submit written report of results of each visit to Site by Supplier's service personnel, including purpose and time of visit, tasks performed, and results obtained. Submit within two days of completion of visit to the Site.
5. Qualifications Statements:
   a. Manufacturer, when requested by Engineer.
   b. Professional Engineer, when requested by Engineer.
   c. Installer, when requested by Engineer.
   d. Welding, Brazing, and Soldering, when requested by Engineer.

C. Closeout Submittals: Submit the following:
1. Record Documentation:
   a. During progress of the Work keep an up-to-date set of the Drawings showing field and Shop Drawing modifications. Immediately upon completion of the Work, submit "pdf" of CADD drawings showing the actual in place installation of all pre-engineered HVAC piping systems and equipment installed under this Section at a scale satisfactory to the Owner. The drawings shall show all piping on plans and in sections, with all reference dimensions and elevations required for complete Record Drawings of the systems. Two paper prints shall also be furnished. The prints and electronic copies of the CADD files shall be furnished no later than 30 days after completion of the Contract and prior to final payment.

1.05 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:
   1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
   2. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of the Work.

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. Store all materials in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.
   3. Acceptance at Site: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 materials or components. Replace lost materials or components and repair damage to new condition, in accordance with manufacturer's instructions.

1.06 SITE CONDITIONS

A. Existing Conditions:
   1. The Contract Documents show the general arrangement and extent of the Work to be completed. The exact location and arrangement of all parts shall be determined as the Work progresses. The exact location of all parts of the Work must be governed by the general building plans and the actual building conditions.
   2. The Drawings are intended as an indication of the arrangement of equipment and piping and are as nearly correct as can be determined in advance of the actual construction of the Work. Equipment, piping and appurtenances found to interfere with the construction of the building, plumbing apparatus and piping, electrical wiring or other obstructions, etc., must be changed in location to clear such obstructions.

PART 2 – PRODUCTS

2.01 MANUFACTURERS:

A. Thermacor Process Inc.

B. Insul-tek

2.02 UNDERGROUND HOT WATER SYSTEM:

A. General
   1. Pre-insulated Piping: Furnish a complete system of factory pre-insulated steel piping for the specified service. The system shall be a combination of a drainable, dryable, testable type conduit system, suitable for all ground water and soil conditions, site Classification "A" (Federal Construction Guide Spec. 02695), with an external covering of polyurethane insulation and an HDPE jacket. The jacket throughout the entire system shall incorporate electric fusion, butt fusion, or extrusion welding at all fittings, joint closures, or other points of connection. This shall create a jacket that is seamless throughout the entire system with the exception of anchors, whose water shed rings are sealed with a Raychem Dirax or Canusa GTS-65 wrap prohibiting the ingression of water. All pre-insulated pipe, fittings, insulating materials, and technical support shall be provided by the pre-insulated piping system manufacturer. The system shall be provided as specified below and shown on the drawings.

2. The pre-insulated pipe manufacturer shall make a complete layout of the system showing anchors, expansion provisions, and building entrance details. Means for expansion must be made in pipe offsets or loops unless this is compensated for integrally in the system.

B. The system shall be Duo-Therm “505” as manufactured by Thermacor Process, L.P., of Fort Worth, Texas.Piping
1. The conduit shall be 10 gauge, welded, smooth-wall black steel conforming to ASTM A-139, A-134 and A-135. Conduit shall be tested at the factory to insure air and watertight welds prior to any fabrication or application of coating. No internal coating of conduit.
2. Conduit closures shall be 10-gauge steel, furnished with the conduit at a ratio of one closure for each fabricated item or length. Closures shall be field welded over adjacent units after pipe insulation.
3. Piping in the conduit shall be carbon steel, ASTM A-106, Grade B seamless. Hot Water lines shall be standard weight (Schedule 40 up thru 10. Pipe joints shall be welded in accordance with the Pressure Piping Code, ASME B 31.1.
4. The Class “A” pipe insulation shall be mineral wool applied to the following thickness; 2.5” / 2” pipe – 1.5” MW.
5. Prefabricated ells, loops and tees shall be furnished and installed where shown on plans and shall consist of pipe, insulation, and conduit conforming to the same specification as hereinbefore stated for straight runs. Expansion loops shall be designed in accordance with the stress limits as dictated by the Power Piping Code, ASME/ANSI B31.1. Loop piping shall be installed in conduit suitably sized to handle indicated pipe movement.
6. Terminal ends of conduits inside manholes, pits or building walls shall be equipped with end seals consisting of a ½” steel plate welded to the pipe and conduit, followed by the 16” steel sleeve, and with a 2” overlap of the heat shrink sleeve. End seals shall be equipped with drain and vent openings. Terminate all conduits 2” beyond the inside face of manhole or building walls.
7. Prefabricated anchors shall be furnished and installed where shown on plans and shall consist of a steel plate, welded to pipe and conduit. The steel anchor plate shall be ½” thick and shall be 5” larger horizontally and 2” larger vertically than the HDPE jacket outer diameter. Raychem Dirax or Canusa GTS-65 wrap shall be used to seal the overlap of the anchor water shed ring over the HDPE jacket.
8. A concrete anchor block shall be cast over the anchor plate and conduit, large enough for firm anchorage into undisturbed trench sidewalls and/or bottom. The concrete block shall be at least 36” in length and extend a minimum of 12” beyond the top and bottom of the anchor plate.
9. Wall sleeves with leak plates shall be provided at all building and manhole entries to provide an effective moisture barrier. The wall sleeve and leak plate shall be electrically isolated from building rebar. The space between the conduit and wall sleeve shall be made watertight by use of Link-Seal or equal assemblies, which will also provide electrical isolation.
10. Jacketing material shall be extruded, black, high density polyethylene (HDPE), having a minimum wall thickness of 200 mils, for all minimum jacket sizes: 2.5” pipe – 11” HDPE, 2.0” pipe – 11” HDPE. The jacket throughout the entire system shall incorporate electric fusion, butt fusion, or extrusion welding at all fittings, joint closures, or other points of connection. This shall create a jacket that is seamless throughout the entire system with the exception of anchors, whose water shed rings are sealed with a Raychem Dirax or Canusa GTS-65 wrap prohibiting the ingression of water. The inner surface of the HDPE jacket shall be oxidized by means of corona treatment, flame treatment (patent pending), or other approved methods. This will ensure a secure bond between the jacket and foam insulation preventing any ingression of water at the jacket/foam interface.
11. Straight run joints are jacketed with a pressure testable joint closure, either anelectro-fusion welded split sleeve HDPE joint closure, Canusa Supercase, or Raychem Rayjoint. The joint shall be pressure tested at 5 psi for 5 minutes while simultaneously soap tested at the joint closure’s seams for possible leaks. After passing the pressure test, joints are

insulated using polyurethane foam and a closure patch is welded (as per specified joint closure instructions) over the foam holes. All joint closures and insulation shall occur at straight sections of pipe.

12. Conduit fittings are factory pre-fabricated and pre-insulated with urethane to a minimum thickness of 1”, and jacketed with a seamless molded, extrusion welded, or butt fusion welded PE jacket. No taping or hot air welding shall be allowed. All fitting jackets/covers shall be connected to the straight lengths of pipe by electro fusion, butt fusion, or extrusion welding.
13. The system shall be leak detection ready by means of manufacturing into the system a copper wire through each piece of pre-insulated pipe and fittings. The piping system manufacturer shall install the wire in a manner that has the wire embedded in the outer polyurethane foam insulation and not touching the steel conduit. The Contractor shall connect the wire together at each field joint with a recommended crimping tool. After crimping the wire at the joint, the Contractor shall check the joined pieces for continuity of the wire and electrical isolation from the conduit by use of a standard analog volt ohmmeter. This check shall be repeated after each crimp, until the entire system is connected. After the piping system is installed, the Owner at any time may check the system for a conduit leak by using a standard volt ohmmeter. If a leak is detected (a leak is signaled by a drastic drop in the electrical resistance of the circuit), the Owner should contact the system manufacturer for a TDR instrument to determine the location of the leak.

2.02 UNDERGROUND CHILLED WATER PIPING SYSTEM:

A. General:
1. Pre-insulated Piping - Furnish a complete system of factory pre-insulated polyethylene piping for the specified service. All pre-insulated pipe, fittings, insulating materials, and technical support shall be provided by the Pre-insulated Piping System manufacturer.
2. The system shall be POLYCOR HDPE manufactured by Thermacor Process Inc. of Fort Worth, Texas.

B. Piping:
1. Carrier pipe shall be high density polyethylene (HDPE), conforming to ASTM D-3350 and the specification standards listed below. Pipe and fittings are manufactured from extra high molecular weight polyethylene compound and fabricated to Standard Dimensional Ratio (SDR) wall thickness in standard IPS sizes. Available pressure ratings range from 50 psi (SDR-32.5) to 255 psi (SDR-7.3) at 73°F, with operating temperatures from -50°F and lower, to +140°F by applying an appropriate design factor. Basis of design shall be SDR-11.
2. Insulation shall be polyurethane foam either spray applied or injected with one shot into the annular space between carrier pipe and jacket with a minimum thickness of one inch. Insulation shall be rigid, 90-95% closed cell polyurethane with a 2.0 to 3.0 pounds per cubic foot density and coefficient of thermal conductivity (K- Factor) of 0.16 and shall conform to ASTM C-591. Maximum operating temperature shall not exceed 250°F. Insulation thickness shall be specified by calling out appropriate carrier pipe and jacket size combinations and shall not result in less than 1" thickness.
3. Jacketing material shall be extruded, black, high density polyethylene (HDPE), having a minimum wall thickness of 100 mils for pipe sizes equal to or less than 12”, 125 mils for jacket sizes greater than 12” to 24”, and 150 mils for jacket sizes greater than 24”. The inner surface of the HDPE jacket shall be oxidized by means of corona treatment, flame treatment (patent pending), or other approved methods. This will ensure a secure bond between the jacket and foam insulation preventing any ingression of water at the jacket/ foam interface.
4. Straight run joints consisting of pipe and jacket are butt fusion welded and field insulated using urethane foam to the thickness specified and jacketed with a heat shrinkable sleeve over the HDPE sleeve mold. Joints can be made beside the trench or inside the trench.

5. Carrier pipe fittings of the same material and pressure rating shall be heat fusion butt-welded to adjacent pipe sections. Fittings that are butt fusion welded are to be field insulated or, at engineer's option, factory insulated. If fittings are factory manufactured, fittings are pre-insulated using factory PE fitting covers welded to the jackets.
6. The system shall be leak detection ready by means of manufacturing into the system a copper wire through each piece of pre-insulated pipe and fittings. The piping system manufacturer shall install the wire in a manner that has the wire embedded in the outer polyurethane foam insulation and not touching the steel conduit. The Contractor shall connect the wire together at each field joint with a recommended crimping tool. After crimping the wire at the joint, the Contractor shall check the joined pieces for continuity of the wire and electrical isolation from the conduit by use of a standard analog volt ohmmeter. This check shall be repeated after each crimp, until the entire system is connected. After the piping system is installed, the Owner at any time may check the system for a conduit leak by using a standard volt ohmmeter. If a leak is detected (a leak is signaled by a drastic drop in the electrical resistance of the circuit), the Owner should contact the system manufacturer for a TDR instrument to determine the location of the leak.

2.03 ABOVE GROUND HOT AND CHILLED WATER PIPING SYSTEM:

A. GENERAL:
1. Pre-insulated Piping - Furnish a complete system of factory pre-insulated steel piping for the specified service. All pre-insulated pipe, fittings, insulating materials, and technical support shall be provided by the Pre-insulated Piping System manufacturer.
2. The system shall be SPIRAL-THERM manufactured by Thermacor Process Inc. of Fort Worth, Texas.

B. PIPING:
1. Carrier pipe shall be steel ASTM A-53, Grade B., ERW (Type E) or seamless (Type S), standard weight for sizes 2" and larger, and shall be ASTM A-106/ A-53, seamless, standard weight for sizes 1-1/2" and smaller (Std. Wt. is the same as Sch. 40 through 10"). When practical, piping shall be provided in 40-foot double-random lengths. All carbon steel pipe shall have ends cut square and beveled for butt-welding. Straight sections of factory insulated pipe shall have 6" of exposed pipe at each end for field joint fabrication.
2. Insulation shall be polyurethane foam high pressure injected with one shot into the annular space between carrier pipe and jacket. Insulation shall be rigid, 90-95% closed cell polyurethane with a 2.0 to 3.0 pounds per cubic foot density and coefficient of thermal conductivity (K- Factor) of 0.18 and shall conform to ASTM C-591. Maximum operating temperature shall not exceed 250 °F. Insulation thickness shall be specified by the Engineer with a minimum of 1-1/2".
3. Jacketing material shall be internal lock seal, 24 gauge, spiral wound, stainless steel with a rubber "o" ring formed in the seam, formed into steel tubes.
4. Straight run joints are insulated using poured urethane or sectional urethane foam to the thickness specified, covered with a metal sleeve, sealed with mastic or silicon, and held in place with two 1/2" stainless steel bands.
5. Fittings are factory pre-fabricated and pre-insulated jacketed with a metal fitting cover and insulated with injected urethane to the specified thickness. Carrier pipe fittings shall be butt-welded, except sizes smaller than 2" shall be socket-welded. If required by project specifications, welds shall be radiographically inspected. Fittings include expansion loops, elbows, tees, reducers, and anchors. (At the Engineer's option, fittings may be field insulated with liquid urethane foam insulation, jacketed with a metal fitting cover after being sealed with mastic.)
6. Expansion/ contraction compensation will be accomplished utilizing factory pre-fabricated and pre-insulated expansion elbows, Z-bends, expansion loops, and anchors specifically designed for the intended application.

7. The system shall be leak detection ready by means of manufacturing into the system a copper wire through each piece of pre-insulated pipe and fittings. The piping system manufacturer shall install the wire in a manner that has the wire embedded in the outer polyurethane foam insulation and not touching the steel conduit. The Contractor shall connect the wire together at each field joint with a recommended crimping tool. After crimping the wire at the joint, the Contractor shall check the joined pieces for continuity of the wire and electrical isolation from the conduit by use of a standard analog volt ohmmeter. This check shall be repeated after each crimp, until the entire system is connected. After the piping system is installed, the Owner at any time may check the system for a conduit leak by using a standard volt ohmmeter. If a leak is detected (a leak is signaled by a drastic drop in the electrical resistance of the circuit), the Owner should contact the system manufacturer for a TDR instrument to determine the location of the leak.
8. Above ground chilled Spiral-Therm chilled water piping shall contain one, 3/4” EMT heat trace tube embedded in the system to allow for the installation of heat trace cable in the field.

2.04 SYSTEM PERFORMANCE

A. System Description:
1. Pre-engineered HVAC piping systems shall be completely factory assembled and tested for aboveground or below ground installation. Piping systems shall consist of a single carrier pipe with insulation jacketing with containment for conveying hot water and chilled water.
2. The Drawings show the general arrangement of all systems. Should local conditions necessitate rearrangement of one or more of the systems, Contractor, before proceeding with the Work, shall prepare and submit complete drawings showing all details of the proposed rearrangement for written approval.
3. The connections shown to the various units are intended as an indication only. The actual connections at the time of installation to be made and arranged to suit the requirements of each case and adequately provide for expansion and circulation and minimize the amount of space required for the same.
4. The Drawings do not show all offsets, fittings, accessories and details, which may be required. Contractor shall carefully examine all of the General Construction, Electrical, Mechanical, Structural and other Drawings and the respective Specifications for conditions which may affect the installation of the Work, and shall arrange the Work accordingly, furnishing all required items to meet such conditions which are not specified as work “by others,” to complete the systems to the true extent of the Contract Documents.

B. Design Criteria:
1. Design Pressures and Temperatures:
   a. Hot Water: 125 psi (250 degrees F). Chilled Water: 125 psi (40 degrees F).
2. Steel Pipes:
   a. Steel piping shall conform and be certified to the latest editions of ASTM Standards A53/A53M or A106/A106M.
   b. Steel fittings shall conform and be certified to the latest editions of ASME/ANSI Standards B16.5 or B16.9.

2.05 MANUFACTURERS

A. Manufacturer: Provide product of one of the following:
1. Thermacor Process, Inc. Series Duo-Therm 505 BG for below ground hot water, Polycor BG for chilled water and Spiral-Therm AG for above ground hot water and chilled water.
2. Rovanco Piping Systems.

3. Perma-Pipe, Inc.
4. Or equal.

2.06 DETAILS OF MATERIALS

A. Carrier Pipe:
   1. Steel:
      a. Schedule 40, black seamless steel pipe with plain end finish.
      b. Joints:
         1) All straight joints and fitting joints shall be welded and insulated using material supplied by manufacturer.
         2) All changes in direction shall be made with bent or weld fittings.
         3) All fittings shall be the same wall thickness as adjacent piping.

B. Insulation:
   1. Closed cell polyurethane foam. Insulation shall have a maximum thermal conductivity (K-factor) of 0.17 Btu-in/hr-ft^2-degree F at 75 degrees F mean temperature when tested in accordance with ASTM C518. Foam insulation shall have a minimum density of 2 lb/ft^3 and shall be tested in accordance with ASTM D1929 for a minimum flash ignition temperature of 610 degrees F.
   2. Aerogel insulation. Insulation shall have a maximum thermal conductivity (K-factor) of 0.19 Btu-in/hr-ft^2-degree F at 200 degrees F. Manufactured by Aspen Aerogels, Series Pryogel X-TE or equal.
   3. Molded mineral wool. Insulation shall have a maximum thermal conductivity (K-factor) of 0.31 Btu-in/hr-ft^2-degree F at 200 degrees F mean temperature when tested in accordance with ASTM C518. Mineral wool insulation shall have a minimum thickness of 1-inch and shall be in conformance with ASTM C547, Classes 1, 2, and 3.

C. Jacketing:
   1. Metal:
      a. Spiral wound, lock-seamed,Type 316L stainless steel, 24 gauge.
   2. PVC:
      a. Glossy, high-impact, UV-resistant PVC jacketing for all above ground fittings and piping.
      b. Jacketing shall be applied over the stainless steel, spiral wound jacketing provided with the piping from Thermacor.
      c. Color to be approved by owner and shall be determined in each specific piping location.
      d. Refer to Specification Section 15081, 2.02 for additional product information.

D. Containment Casing:
   1. Steel:
      a. Smooth-walled black steel pipe conduit with minimum 10 gauge thickness.
      b. Exterior surface of pipe shall be shot blasted to clean bright metal and be factory coated with a fusion bonded epoxy system.
      c. Minimum coating system thickness shall be 20 mils and 20 mils Field applied at all joints after welding.
      d. Conduit shall be provided with inner carrier pipe supports to allow for direct bearing of carrier pipe. Pipe supports shall be designed to permit drainage and free air passage. Maximum pipe support spacing shall not exceed 10 feet.

E. End Seals:
   1. Each length of insulated piping shall be fitted with a watertight end seal at jacketing.
   2. All field cuts shall be sealed with a field applied end seal. 2.0

2.07 PIPING SCHEDULE

A. Refer to materials above for specifications on piping system components listed in this schedule. Materials of piping system from inside out.

B. Below Ground Hot Water Piping:
   1. Schedule 40 Black Steel
   2. Mineral wool insulation
   3. 10 gauge steel conduit coated with 20 mils FBE
   4. 1-inch polyurethane foam insulation
   5. HDPE jacket

C. Below Ground Chilled Water Piping:
   1. Schedule 40 Black steel piping
   2. Polyurethane insulation
   3. HDPE jacketing

D. Above Ground Outdoor Hot Water Piping:
   1. Schedule 40 Black steel piping
   2. Polyurethane insulation
   3. Type 316L stainless steel jacket

E. Above Ground Outdoor Chilled Water Piping:
   1. Schedule 40 Black steel piping
   2. Polyurethane insulation
   3. Type 316L stainless steel jacket

2.08 ACCESSORIES

A. Building and Manhole Penetrations:
   1. Terminal ends of conduits inside building wall and pipe tunnel shall be furnished with gland seals consisting of a packed stuffing box and gland follower mounted on a steel plate.
   2. Gland seals shall be furnished with a wall sleeve and leak plate, the annular air space between the wall sleeve and the conduit shall be provided with a hydrostatic seal consisting of mechanical link seals. Calking or other types of seals are not acceptable.
   3. Gland seals shall be equipped with drain and vent openings located diametrically opposite on the vertical centerline of the plate and shall be shipped to the Site with plugs in place. Terminate all conduits a minimum of 12-inches beyond the inside face of walls to protect any exposed piping insulation from damp wall condensation.

B. Expansion Loops, Joints, Guides, and Anchors:
   1. Contractor shall provide a system of expansion joints, alignment guides, anchors, and appurtenances as required to absorb thermal expansion within the piping system. Cold springs shall not be used as expansion joints.
   2. Expansion joints, guides, anchors, and appurtenances shall be constructed of Type 316 stainless steel.
   3. Expansion joints, alignment guides, and anchors are not shown. Contractor shall provide the services of the expansion joint manufacturer to design a system of expansion compensation for all piping systems. Expansion compensation design for all piping systems shall be signed and sealed by a registered professional engineer legally qualified to practice in the jurisdiction where the Project is located.
   4. Pipe anchors shall be spaced to divide pipe into sections. Anchors shall be located at valves, changes in direction of piping, and major branch

connections as required to control stresses in piping due to expansion. Anchors shall be of a type recommended by the pipe manufacturer and approved by the Engineer.

5. Anchors shall be made of structural materials of heavy cross section and securely fastened directly or indirectly to the building construction.
6. A concrete block shall be cast over the plate and conduit and shall be large enough for firm anchorage into undisturbed trench sidewalls and/or bottoms. The concrete block is to be at least three feet on length and at least one-foot wider than the plate on each end and in accordance with the manufacture's recommendations.

C. Mechanical Link Seals:
   1. Refer to specification section 15121-"Wall Pipes, Floor Pipes and Pipe Sleeves."

D. Sleeves and Wall Pipes:
   1. Sleeves:
      a. Refer to specification section 15121-"Wall Pipes, Floor Pipes and Pipe Sleeves."
   2. Wall Pipes:
      a. Refer to specification section 15121-"Wall Pipes, Floor Pipes and Pipe Sleeves."

E. Drip Pans:
   1. Provide 16-gauge Type 316 stainless steel drip pans under all hydronic piping installed over electrical equipment and motors.
   2. Route drainage to nearest approved floor drain, gutter, or other drainage system with 3/4-inch pipe. All construction shall be liquid tight. Pitch the drain pan uniformly toward the drainpipe at a slope not less than 1/8-inch per lineal foot.

F. Hardware:
   1. All bolts, nuts, washers, and other fastening appurtenances shall be constructed of Type 316 stainless steel.
   2. Hardware shall be provided in accordance with the manufacturer's recommendations for type, size, and torque value.

G. Structural Supports:
   1. Contractor shall provide and install all hangers, rods, supports, bolts, nuts, washers, inserts, and appurtenances as required to mount all pre-engineered HVAC piping systems.
   2. All hangers, rods, supports, bolts, nuts, washers, inserts, and appurtenances shall conform to Section 15061, Pipe Hangers and Supports.

2.09 IDENTIFICATION

A. Each length of piping and fittings shall be legibly printed or identified with the name of the manufacturer.

B. All piping and equipment identification shall be provided in accordance with Section 15075, Mechanical System Identification.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine conditions under which materials and equipment will 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 are corrected.

B. Take field measurements where required prior to installation to ensure proper fitting of Work.

3.02 PREPARATION

A. Protection of Surrounding Areas/Surfaces:
   1. Openings and penetrations shall be capped to protect the building from outside conditions.
   2. Properly plug or cap the open ends of all piping at the end of each day's Work or other stopping point through construction. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.

3.03 INSTALLATION

A. General:
   1. Install the piping and equipment in accordance with the Contract Documents and by manufacturer's instructions and recommendations. Obtain written interpretation from Engineer in the event of conflict between manufacturer's instructions and recommendations and the Contract Documents.
   2. Install in accordance with Laws and Regulations.
   3. Do not modify structures to facilitate installation of piping, unless specifically approved by Engineer.
   4. Installation shall conform to requirements of all local and state codes.
   5. Contractor shall provide all labor, tools, materials, and equipment necessary for installation of the piping system. All piping shall be installed in accordance with the Contract Documents in a neat workmanlike manner and shall be set for accurate line and elevation. All piping shall be thoroughly cleaned before installation, and care shall be taken to keep the piping clean throughout the installation.
   6. Before setting wall sleeves, pipes, castings and pipes to be cast-in-place, Contractor shall coordinate with the Drawings and Figures, which may have a direct bearing on the pipe locations. Contractor shall be responsible for coordinating the proper location of the pipes and appurtenances during the construction with all trades.
   7. Piping shall be attached to pumps, valves, equipment, etc., in accordance with the respective manufacturer's recommendations.
   8. Piping shall not run above motor control centers, control panels or other electrical equipment, unless directed by the Engineer, in writing. Piping which must run above electrical equipment shall be provided with suitable drip pans.
   9. Piping shall be installed free of traps and with sufficient slope so that all of the various piping systems may be drained to one or several points. In the event that it is impossible to drain to a common point due to structural obstructions and finished ceiling heights, furnish and install all additional drain valves that may be required to completely drain piping systems. Location of all drain valves shall be approved by Engineer prior to installation.

B. Provide all excavation, backfilling, compaction, and site restoration in accordance with specification 02200 "Earthwork."

C. Provide 6 inches of sand bedding all around conduit for entire length of trench.

D. Excavate sufficiently to provide a minimum of 3 feet of cover from top of jacketing or containment casing to finished grade.

E. Piping Layout in Building:
   1. Water shall circulate freely with no evidence of trapping or air binding.
   2. Runouts to units above the main shall be taken off top of main.
   3. Runouts to units below the main shall be taken off bottom of main.
   4. Low points of piping shall have ball drain valves.

5. Threaded end unions or bolted end flange connections shall be provided for removal of each piece of equipment or device without major dismantling.
6. Allow clearances for expansion and contraction of piping.
7. Provide flexible connectors for each pipe passing through building expansion joints.
8. Do not block openings or passageways with piping.
9. Install straight runs true to building line.
10. Install vertical pipe truly plumb in all directions.
11. Install piping parallel or perpendicular to building walls. Piping at odd angles and 45 degrees runs across corners shall not be accepted.

F. Provide automatic air vents with isolation ball valves at all high points of water lines and where shown.

G. Provide all supporting steel, brackets, etc. as required to support all equipment in an approved manner.

H. Provide mechanical link seals with sleeves or wall pipes at all piping penetrations through wall, roof and floor slabs.

I. Escutcheon plates shall be provided for all exposed piping penetrations.

J. All connections between ferrous and non-ferrous piping materials shall be made with dielectric unions or nipples.

K. Wherever changes in sizes of piping occur, changes shall be made with concentric reducing fittings. The use of bushings is not permitted, unless shown otherwise.

L. POLYCOR UNDERGROUND PIPING INSTALLATION:
1. Field-engineered piping systems shall be fabricated from factory insulated sections of straight pipe and fittings. When practical, piping shall be provided in 40-foot double-random lengths. All HDPE piping shall have ends cut square in preparation for butt fusion welding.
2. Carrier pipe joining shall be accomplished using an authorized butt fusion welding machine preheated to the correct pipe temperature for fusion welding. All heating surfaces shall be clean and free of dirt and residue before applying to ends of pipe to be joined. After heating, the softened ends are pressed together by the machine and held until the joint has hardened. Improperly accomplished, uneven, or joints with questionable appearance shall be cut out and re-accomplished. Transitions to other piping materials shall be accomplished using suitable flanged or mechanical adapters.
3. Underground systems shall be buried in a trench of not less than two feet deeper than the top of the pipe and not less than eighteen inches wider than the combined O.D. of all piping systems. A minimum thickness of 24 inches of compacted backfill over the top of the pipe will meet H-20 highway loading.
4. Trench bottom shall have a minimum of 6" of sand, pea gravel, or specified backfill material as a cushion for the piping. All field cutting of the pipe shall be performed in accordance with the manufacturer’s installation instructions.
5. A hydrostatic pressure test shall be performed before insulating the field joints or burying the system and shall be performed per the Engineer’s specifications. The factory recommended pressure test consists of an expansion phase and a test phase. Care shall be taken to insure all trapped air is removed from the system prior to the test. The expansion phase consists of an initial pressurization period of three hours at on and one-half times the normal system operating pressure. Makeup water shall be added to the system during this period to maintain the desired pressure. The test shall commence immediately after the expansion phase. The pressure shall be reduced by 10 psi and the test clock started. System pressure remaining within 5% of the target test pressure for one hour indicates no leakage has occurred. If the entire test procedure cannot be

completed within eight hours of the initial pressurization, the system shall be de-pressurized and allowed to relax for a minimum of eight hours before another test is attempted. *The piping system shall be restrained from uncontrolled movement in the event of a failure. Appropriate safety precautions shall be taken to guard against possible injury to personnel in the event of a failure.*

6. Field service, will be provided by a certified manufacturer's representative or company field service technician. The technician will be available at the job to check unloading, storing, and handling of pipe, joint installation, pressure testing, and backfilling techniques. This service will be added into the cost as part of the project technical services required by the pre-insulated pipe manufacturer.

3.04 FIELD QUALITY CONTROL

A. Field Tests - Pressure:
   1. Contractor shall provide all necessary labor and equipment required for the field tests specified below including, but not limited to, air compressor, gauges, conduit caps, temporary pipe and connections. Contractor shall provide water for all testing and may use only water from an approved source. Contractor shall also furnish and install all means and apparatus required for getting the water into the pipeline and testing; including pumps, gauges, and meters, plugs, caps, temporary blow-off piping and bypass piping, etc., complete with any necessary reaction blocking to prevent pipe movement during the testing. All pipelines shall be flushed clean (refer to Paragraph 3.6.B) and tested in such lengths or sections as agreed upon between the Engineer and Contractor. Contractor shall provide the Engineer reasonable notice of the time when he intends to test portions of the pipelines. The Engineer reserves the right to request additional testing of any section or portion of a pipeline.
   2. After flushing, all pipelines shall be hydrostatically tested to one and one half times the maximum system design pressure, but not less than 100 psi.
   3. The piping shall be filled with water for a period of not less than eight hours, then subject to the indicated test pressure. During the pressure test, there shall be no leakage. All air shall be purged from the line before pressure testing. The duration of the hydrostatic test shall be eight hours.
   4. Any leaks or defective pipe disclosed by the hydrostatic test shall be corrected by Contractor and the test repeated until passed.

B. Field Testing - Special:
   1. Carrier pipe and containment piping for both above and below ground piping shall be pressure tested. Carrier piping shall be tested at 150 psig and held for 8 hours. Conduit piping shall be pressure tested at 10 psig and held for 4 hours. Test reports shall be approved by the Contract Management entity and finial test reports submitted to the County.
   2. X-ray: All welded steel carrier piping joints shall be X-rayed by a third party X-ray certified party. The X-ray test reports shall be approved by the Contract Management entity, and final test reports submitted to the County.
   3. Dye penetration tests (Dye penetrant inspection): All conduit piping joints for the below ground hot and chilled water piping shall be dye penetration tested, and photo graphed. The dye penetration test reports shall be approved by the Contract Management entity, and final test reports submitted to the County.
   4. All exterior HDPE jacketing field joints shall be pressure tested to a minimum of 5 psig, for 5 minutes, soap tested, photographed prior to foaming of annular space.

C. Inspection:
   1. Examine areas to receive piping and accessories for:
      a. Defects that adversely affect execution and quality of the Work.
      b. Deviations beyond allowable tolerances.

c. Start the Work only when conditions are satisfactory.

2. The Engineer reserves the right to reject or authorize replacement of piping and accessories found to be defective or deviated from allowable tolerances.

3.05 ADJUSTING

A. All pre-engineered HVAC piping systems shall be adjusted and balanced per Section 15950, Balancing of Hydronic Systems.

3.06 CLEANING

A. Contractor shall provide all necessary labor and equipment required for flushing and cleaning. Contractor shall provide water for all flushing and may use only water from an approved source. Contractor shall also furnish and install all means and apparatus necessary for getting the water into the pipeline and flushing including pumps, gauges, meters, temporary blow off piping, bypass piping, etc., complete with all required reaction blocking to prevent pipe movement during the procedure.Before placing the pre-engineered HVAC piping system into service, Contractor shall thoroughly clean all piping systems by thoroughly flushing with water and chemical cleaner. All debris which may have entered the pipe during the construction period shall be removed. If after this cleaning any obstructions remain, Contractor shall correct to the satisfaction of the Engineer. Pipelines shall be flushed at a rate of at least 2.5 feet per second for duration suitable to the Engineer.

B. Cleaning methods and procedures shall be as recommended by the manufacturer of the cleaning agents and chemicals used. Chemical cleaning agents shall be as manufactured by Oakite, Nalco, Dearborn, or equal.

C. After the cleaning period, empty all dirt pockets and clean all strainers.

D. Remove all dirt, rust, dust, etc. from pre-engineered HVAC piping systems after installation.

E. Remove and dispose of all debris and waste from the Site resulting from installation.

END OF SECTION 15510

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes a UL Listed, CSA Certified and FM Approved heat tracing system for freeze protection of aboveground water lines consisting of self-regulating heating cable, connection kits and electronic controller.

1.02 RELATED SECTIONS

A. Section 15081 - Pipe Insulation

1.03 SYSTEM DESCRIPTION

A. System for freeze protection of aboveground water lines with Proportional Ambient Sensing Control (PASC), monitoring, integrated ground-fault circuit protection and Building Management System (BMS) communication capabilities.

1.04 SUBMITTALS

A. Product Data
   1. Heating cable data sheet
   2. UL, CSA, FM approval certificates for freeze protection for aboveground water lines
   3. Pipe freeze protection design guide
   4. System installation and operation manual
   5. System installation details
   6. Connection kits and accessories data sheet
   7. Controller data sheet
   8. Controller wiring diagram

1.05 QUALITY ASSURANCE

A. Manufacturer’s Qualifications
   1. Manufacturer to show minimum of thirty (30) years experience in manufacturing electric self- regulating heating cables.
   2. Manufacturer will be ISO-9001 registered.
   3. Manufacturer to provide products consistent with IEEE 515.1 and CSA 22.2 No 130-03 requirements.

B. Installer Qualifications
   1. System installer shall have complete understanding of product and product literature from manufacturer or authorized representative prior to installation. Electrical connections shall be performed by a licensed electrician.

C. Regulatory Requirements and Approvals
   1. The system (heating cable, connection kits, and controller) shall be UL Listed, CSA Certified and FM Approved for freeze protection of aboveground water lines.

D. Electrical Components, Devices, and Accessories: Listed and labelled as defined in NFPA 70, Article 100, by a Nationally Recognized Testing Laboratory (NRTL), and marked for intended use.

1.06 DELIVERY, STORAGE, AND HANDLING

A. General Requirements: Deliver, store and handle products to prevent their deterioration or damage due to moisture, temperature changes, contaminates or other causes.

B. Delivery and Acceptance Requirements: Deliver products to site in original, unopened containers or packages with intact and legible manufacturer's labels identifying the following:
   1. Product and Manufacturer
   2. Length/Quantity
   3. Lot Number
   4. Installation and Operation Manual
   5. MSDS (if applicable)

C. Storage and Handling Requirements
   1. Store the heating cable in a clean, dry location with a temperature range 0°F (-18°C) to 140°F (60°C).
   2. Protect the heating cable from mechanical damage.

1.07 WARRANTY

A. Extended Warranty
   1. Manufacturer shall provide ten (10) year warranty for all heating cables and components. Provide one (1) year warranty for all heat trace controllers.
   2. Contractor shall submit to owner results of installation tests required by the manufacturer.

PART 2 - PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

A. Contract Documents are based on manufacturer and products named below to establish a standard of quality.

B. Basis of Design
   1. Basis of Design Product Selections
      a. Manufacturer
         1) Manufacturers shall have more than thirty (30) years experience with manufacture & installation self-regulating heating cables.
         2) Manufacturer shall provide UL, CSA, FM approval certificates for freeze protection of aboveground water lines.
         3) Manufacturer shall be nVent Thermal, LLC, located at, 7433 Harwin Drive, Houston, TX 77036 Tel: (800) 545-6258
         4) Or Chromalox Inc.
      b. Pipe Freeze Protection System
         1) Raychem XL-Trace self-regulating heating cable
         2) Raychem RayClic connection kits and accessories
         3) DigiTrace ECW-GF digital electronic controller.
         4) DigiTrace ProtoNode multi-protocol device server

2.02 PRODUCTS, GENERAL

A. Single Source Responsibility: Furnish heat tracing system for the freeze protection of aboveground water lines from a single manufacturer.

B. The system (heating cable, connection kits, and controller) shall be UL Listed, CSA Certified and FM Approved for freeze protection of aboveground water lines. No parts of the system may be substituted or exchanged.

2.03 PRODUCTS

A. Self-Regulating Heating Cable
   1. Heating cable shall be Raychem XL-Trace self-regulating heating cable manufactured by Pentair Thermal Management.
      a. Model Numbers:
         1) 5XL2-CR/-CT
   2. The heating cable shall consist of a continuous core of conductive polymer that is radiation cross- linked, extruded between two (2) 16 AWG nickel-plated copper bus wires that varies its power output in response to pipe temperature changes.
   3. The heating cable shall have a modified polyolefin inner jacket and a tinned-copper braid to provide a ground path and enhance the cables ruggedness.
   4. The heating cable shall have a polyolefin (-CR) outer jacket.
   5. The heating cable shall have a self-regulating factor of at least 90 percent for 5/8XL or at least 70 percent for 12XL. The self-regulating factor is defined as the percent reduction of the heating cable power output going from a 40°F pipe temperature to 150°F pipe temperature.
   6. The heating cable shall operate on line voltages of 120 volts without the use of transformers.
   7. The heating cable shall be UL part of a UL Listed, CSA Certified and FM Approved system.
   8. The outer jacket of the heating cable shall have the following markings:
      a. Heating cable model number
      b. Agency listings
      c. Meter mark
      d. Lot/Batch ID

B. Heating Cable Connection Kits
   1. Heating cable connection kits shall be Raychem RayClic connection kits.
   2. Manufacturer shall provide power connection, splice/tee and end seal kits compatible with selected heating cable.
   3. Installation shall not require the installing contractor to cut into the heating-cable core to expose the bus wires. [for RayClic connection kits only].
   4. Connection kits shall be rated NEMA 4X to prevent water ingress and corrosion. All components shall be UV stabilized.
   5. Connection kits shall be UL Listed and CSA Certified.

C. Heating Cable Installation Accessories
   1. High temperature, glass filament tape for attachment of heating cable to fire sprinkler piping. Cable ties are not permitted. (PTM Catalog Number: GT-66)
   2. Plastic Piping - provide an aluminium self-adhesive tape over the heating cable on all plastic piping if required. (PTM Catalog Number: AT-180)
   3. Labels - Provide warning labels every 10 feet on exterior of insulation, opposite sides of pipe. (PTM Catalog Number: ETL)

D. Digital Temperature Controller with built-in Ground-Fault Protection Device (GFPD)
   1. Multiple Circuit Distributed Digital Control System
      a. Distributed digital control system shall be DigiTrace ACS-30 heat-trace control system.
      b. Heating cable manufacturer shall provide a distributed digital control system with pre-programmed parameters to provide concurrent control for heating cables used for pipe freeze protection, flow maintenance, hot water temperature maintenance,

surface snow melting, roof and gutter de-icing, freezer frost heave prevention and floor heating applications.

c. All programming shall be done through the central User Interface Terminal (ACS-UIT2).
d. The ACS-UIT2 shall be a color LCD touch-screen display with password protection to prevent unauthorized access to the system.
e. The ACS-UIT2 shall communicate with up to fifty-two (52) ACS Power Control Panels (ACS- PCM2-5) where each panel can control up to five (5) circuits and accept up to five (5) temperature inputs. The DigiTrace C910-485 digital controller may be added to the ACS-30 Network for single circuit extensions.
f. Digital control system shall be capable of assigning up to four (4) RTD temperature inputs per heat-tracing circuit.
g. The ACS-UIT2 shall communicate with up to sixteen (16) Remote Monitoring Modules (RMM2), where each module can accept up to 8 temperature inputs.
h. The ACS-UIT2 shall have a USB port to allow for quick and easy software update.
i. The ACS-UIT2 shall have three (3) programmable alarm contacts including an alarm light on the enclosure cover.
j. A separate offline software tool shall be made available to allow users to pre-program the digital control system and transfer program via a USB drive or Ethernet.
k. The ACS-UIT2 enclosure shall be NEMA 4 for indoor or outdoor locations.
l. The ACS-PCM2-5 panel shall be in a NEMA 12 enclosure approved for nonhazardous indoor locations.
m. The ACS-PCM2-5 panel shall provide ground-fault and line current sensing, alarming, switching and temperature inputs for five (5) heat tracing circuits.
n. Each ACS-PCM2-5 panel shall have five (5) 3-pole, 30 A contactors (EMR type).
o. The ACS-PCM2-5 panel shall be capable of operating at 120 V to 277 V.
p. The ACS-PCM2-5 shall have an alarm contact including an alarm light on the panel cover
q. Digital controller shall have an integrated adjustable GFPD (10 - 200 mA).
r. Digital control system can be configured for On/Off, ambient sensing, PASC and timed duty cycle control (HWAT only) modes based on the application. PASC control proportionally energizes the power to the heating cable to minimize energy based on ambient sensed conditions.
s. Digital control system will have a built-in self-test feature to verify proper functionality of heating cable system.
t. Digital control system will also be able to communicate with the plant SCADA system.
u. The following variables will be monitored by the digital controller and reported back to the SCADA system.
    1) Associated alarms
v. The ACS-UIT2 shall be c-CSA-us Certified. The ACS-PCM2-5 panel shall be c-UL-us Listed.

E. Thermal Pipe Insulation
    1. Pipes must be thermally insulated in accordance with the XL-Trace design guide requirements.
    2. Thermal insulation must be a type that is flame retardant (closed-cell or fiberglass) with waterproof covering.

2.04 SYSTEM LISTING

A. The system (heating cable, connection kits, and controller) shall be UL Listed, CSA Certified and FM Approved for freeze protection of aboveground water lines.

B. The freeze protection system shall have a design, installation, and operating manual specific to aboveground water lines.

PART 3 - EXECUTION

3.01 INSTALLERS

A. Acceptable Installers
   1. Subject to compliance with requirements of Contract Documents, installer shall be familiar with installing heat-trace cable and equipment.

3.02 INSTALLATION

A. Comply with manufacturer's recommendations in the XL-Trace System Installation and Operation Manual.

B. Apply the heating cable linearly on the pipe after piping has successfully completed any pressure tests. Secure the heating cable to piping with fiberglass tape.

C. Install electric heating cable according to the drawings and the manufacturer's instructions. The installer shall be responsible for providing a complete functional system, installed in accordance with applicable national and local requirements.

D. Position the heating-cable on the lower section of the piping to protect it from damage.

E. Provide the following minimum amount of additional footage of heating cable for the following heat sinks. Wrap heat sinks with heating cable as per the manufacturer's recommendations.

ITEM	FEET PER ITEM
Gate Valve	4.3
Butterfly Valve	2.0
Ball Valve	2.6
Glove Valve	3.9
Flanges	2.0 x pipe diameter (in feet)
Pipe Supports	3.0 x pipe diameter (in feet)

F. Apply "Electric Traced" labels to the outside of the thermal insulation.

G. Do not mount ambient thermostats where they will be exposed to direct sunlight. If it is unavoidable, provide sunshields.

H. Apply heat tracing where shown on drawings and all places where pipe freezing may occur.

I. Grounding of controller shall be equipment according to Division 26.

J. Connection of all electrical wiring shall be according to Division 26.

3.03 FIELD QUALITY CONTROL

A. Start-up of system shall be performed by factory technician or factory representative per the owner's requirements.

B. Field Testing and Inspections
   1. The system shall be commissioned in accordance to the XL-Trace Installation and Operation manual.

2. The heating cable circuit integrity shall be tested using a 2500 Vdc megohmmeter at the following intervals below. Minimum acceptable insulation resistance shall be 1000 megohms or greater.
   a. Before installing the heating cable
   b. After heating cable has been installed onto the pipe
   c. After installing connection kits
   d. After the thermal insulation is installed onto the pipe
   e. Prior to initial start-up (commissioning)
   f. As part of the regular system maintenance
3. The technician shall verify that the C910-485 control parameters are set to the application requirements.
4. The technician shall verify that the C910-485 alarm contacts are corrected connected to the BMS.
5. The technician shall verify that the C910-485 and ProtoNode-RER are configured correctly with the BMS.
6. All commissioning results will be recorded and presented to the owner.

3.04 MAINTENANCE

A. Maintenance Service
   1. Comply with manufacturer's recommendations in XL-Trace System Installation and Operation Manual.

PART 4 – SEQUENCE OF OPERATION

4.01 GENERAL

A. The work specified as par 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, inter-connection of systems, provision and installation of all necessary devise 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 their representatives.

4.02 SEQUENCE OF OPERATION – HEAT TRACE

A. The heat trace system shall be equipped with ambient air temperature sensors and the system shall become active any time the outside air temperature falls below 32˚F.

B. The heat trace system shall be monitored for any alarms by the plant wide SCADA system.

END OF SECTION 15705

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Provide exhaust fans, as specified herein, of sizes and capacities scheduled and in locations shown on drawings.

1.02 REFERENCE CODES AND STANDARDS

A. AMCA 99 - Standards Handbook

B. AMCA 210 - Laboratory Methods of Testing Fans for Rating

C. AMCA 300 - Reverberant Room Method for Sound Testing of Fans

D. ASHRAE Handbook, HVAC Applications Volume “Sound and Vibration Control”

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.

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 up on 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.

PART 2 – PRODUCTS

2.01 ACCEPTABLE PRODUCTS

A. The Owner and Engineer believe the following candidate manufacturers are capable of producing equipment and/or products that will satisfy the requirements of this Section. This statement, however, shall not be construed as an endorsement of a particular manufacturer's products, nor shall it be construed that a named manufacturer's standard equipment or products will comply with the requirements of this Section. Manufacturers shall include:
   1. Hartzell Air Movement
   2. Systech Design Inc.

2.02 MATERIALS

A. Materials of Construction:

Housing	FRP with Nexus veil and electric grounding
Propeller	FRP with electric grounding
Hub	Cast aluminum encapsulated in FRP
Hardware – Complete Fan	316SS
Shaft	316SS
Shaft Seal	Neoprene
Extended Lube Lines Fan & Motor Bearings	316 SS
Belt Guard / Shaft Guard / Weather Cover	Steel with inorganic zinc and epoxy top coat

2.03 CONSTRUCTION

A. Fans shall be suitable for continuous operation 24 hours per day. All equipment shall comply with NFPA 820 and Class 1, Div. 1 requirements depending on installation location.

B. Select fans to achieve the indicated operating capacity at below maximum recommended rpm for the selected fan size.

C. Refer to schedule at the beginning of this specification for specific fans requirements. Provide fan complete with controls, dampers, vibration isolation, motor, drive, guards, baseplate and sub-base.

D. Construction: Fans will be constructed in accordance with the ASTM D4167 standard specification for fiber-reinforced polymer (FRP) fans and to ensure structural integrity. The fan shall be constructed such that all surfaces in contact with the corrosive gas stream are to be made of solid, corrosion resistant FRP for fans housing and fans propeller. All nuts, bolts and fasteners in contact with the gas stream will be type 316 SS and encapsulated in FRP. All nuts, bolts, and fasteners outside the air stream will be 316 SS. Provide a "C" grade or better surface veil for corrosion barrier. Spark Resistant Construction with carbon or graphite rich topcoat in housing and propeller. Hartkoate or equal coating shall be applied by the fan manufacturer to protect against moisture and abrasive particles.

E. All FRP components shall be constructed of vinyl ester resin and glass or carbon fiber and shall be able to achieve E84 Class I flame spread below 25. Use of antimony trioxide to for fire-

retardant construction is not permitted. Resin to contain UV inhibitor for all external exposed surfaces.

F. Housing: Constructed from FRP using Derakane 510-B vinyl ester resin and electrically grounded. Fans housing will be designed so that air leakage through joints and seals is negated. All bolted pieces will be EPDM gasketed for air tightness.
   1. Fan housing shall have flanged discharge and inlet drilled connection and companion flanges. Fans will be separated from ductwork at inlet and outlet by flanged flexible connections. Contractor shall coordinate flange drilling with duct. Field drilling of the flanges is acceptable provided all edges are sealed with resin.
   2. Fans will be supplied with an FRP guide vane section.
   3. Stainless steel nameplates giving the name of the manufacturer, serial number, model number, rated capacity in cfm, head in inches of water (gauge), fans in rpm, and any other pertinent data will be permanently affixed to each fan with stainless steel hardware

G. Fan Propeller: FRP propeller with blades of airfoil design, one-piece, molded without hand lay-up or assembly of components. Propeller shall be constructed of Derakane 510-B vinyl ester resin with a totally encapsulated aluminum core insert for secure attachment to shaft. Select fans to achieve the indicated operating capacity at below maximum recommended rpm for the selected fan size. Fan propellers shall be secured to shafts with keys and set screws.

H. Fan Shaft: Shaft will be of Type 316 stainless steel designed to operate at 25% below first critical speed. Shaft and impeller will be statically and dynamically balanced at normal operating speed listed in schedule below. Provide Teflon shaft seal. Shaft may be encapsulated with FRP at the manufacturer's discretion. Seal will positively prevent liquid and gas leakage and shall be field replaceable.

I. Motor: Comply with NEMA MG 1 for designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.
   1. Enclosure Type: Totally Enclosed Fan Cooled (TEFC) [Explosion Proof (XP)]
   2. Provide motor rated for 40°C/104°F ambient air temperature. Motor shall be rated and labeled Class 1, Div. 1.
   3. Provide winding temperature switch and motor heater.

J. Fan Drives:
   1. Fan pulleys shall be secured to shafts with keys and set screws.
   2. Matched V-belts and fixed sheave pulleys will be cast iron, sized for minimum 1.2 service factor.
      a. The fan shall be V-belt driven by an electric motor mounted on a common base. The mounting plates shall be slotted to allow tension adjustment of the drive belts and a belt guard shall be supplied. The fan shall be provided with adjustable motor base.
   3. Bearings:
      a. Each fans shaft will be supported by approved, grease lubricated; self-aligning ball or roller bearings, vacuum degassed 52100 Steel. Ball or roller bearings will be made by manufacturer's who are members of the Anti-Friction Bearing Manufacturer's Association (AFBMA) and will be selected for a minimum rating life (L-10) of 100,000 hours at the fans maximum rated speed and based on Basic Dynamic Load Ratings calculated from AFBMA formulas (AFBMA Standards, Section No. 9, and Section No. 11, Latest Revisions). Material factors used in formula calculations will be based on values assuming a conventional good quality, hardened bearing steel without benefit of vacuum degassing. Specifically, for pound and inch units, factor "f" will be as given in the tables of AFBMA Standards cited above.
      b. Computations on bearing selection will be submitted for approval and will show complete details of loading. A dynamic factor of 2.0 will be applied to loading. Ball

and roller bearings will be enclosed in oil-tight housings equipped with approved shaft seal rings and will be suitably arranged for high-pressure grease lubrication.

c. The bearing supports for the shaft will be of rigid design and will be securely fastened to the base to ensure the proper alignment of the main shaft bearings. Bearings located in the corrosive gas stream are not acceptable.

d. Bearings will be factory lubricated with a premium quality NLGI 2 or 3- grade multi-purpose ball bearing grease having corrosion inhibitors, anti- oxidant additives and mechanical stability for high-speed operation. Bearing grease will be multi-purpose lithium soap grease. The grease will also have a minimum base oil viscosity of 500 SUS at 100°F and will be suitable to operate continuously at 225°F. Heavy, long fibered greased will not be acceptable for use in bearings.

e. Bearings shall be manufactured by one of the following:
   1) Link Belt
   2) Timken
   3) Rexnord

K. Belt and Shaft Guards / Weather Cover
   1. Steel with inorganic zinc and epoxy topcoat.

L. Accessories and Miscellaneous
   1. Extended lube lines to fan bearings 316 SS.

2.04 STANDBY COMPONENTS

A. The following standby components shall be provided for each fan size:
   1. One set of matched belts per fan size and horsepower requirement. (Belt Driven)
   2. One shaft seal
   3. One set of bearings (Belt Driven)

B. Disconnect Switches:
   1. NEMA rated: 7 & 9
   2. Positive electrical shut-off
   3. Wired from fan motor to junction box

PART 3 - EXECUTION

3.01 INSTALLATION

A. The fan shall be connected and installed as shown on the drawings and in accordance with the manufacturer's printed instructions.

3.02 GENERAL

A. Install fans, including all necessary structural supports and bracing 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.

3.03 START-UP, TESTING, DEMONSTRATION

A. Start-up fans after checkout to insure proper alignment and phased electrical connections.

B. Test fans individually and as part of system.

C. Insure fans are properly interlocked with supply fans and with control system.

D. Demonstrate operation to Owner and instruct maintenance personnel in operation of equipment.

E. Each fan shall be dynamically balanced in accordance with ASTM D4167 at the specified operating speed.

3.04 SUPPLIER'S SERVICES

A. Manufacturer will furnish the services of a qualified factory-trained manufacturer's service person for areas where the fans are installed to assist in the installation of the equipment, check the installation before it is placed into operation, assist in the performance of field vibration tests, supervise initial operations, and instruct the plant operators in the care, operation and maintenance of the equipment. Submit a certificate of proper installation after inspection.

B. Service person will not make less than two visits to the site. The first visit will be for a period of not less than one 8-hour day to assist in the installation of the equipment. The second visit will be for a period of not less than one 8-hour day to approve the installation, perform the field vibration tests, provide training for owner's personnel, and supervise initial operations.

C. Service person will verify that lubrication systems are complete, clean and filled with the proper grade of lubricants.

D. Reports: Manufacturer will submit a report by service person of each visit to the site. Reports will provide complete information on time, schedule, tasks performed, persons contacted, problems corrected, test results, training, instruction and all other pertinent information.

E. Training: In addition to above requirements, furnish services to instruct and train plant operators in the proper care, operation and maintenance of equipment.

END OF SECTION 15831

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PART 1 – GENERAL

1.01 SECTION INCLUDES

A. PVC ducts for wet well ventilation.

1.02 RELATED SECTIONS

A. Section 15075 – Mechanical System Identification

B. Section 15831 – Exhaust Fans

1.03 REFERENCES

A. ASTM D635 – Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.

B. ASTM D638 – Tensile Properties of Plastics.

C. ASTM D1784 – Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (PVC) Compounds.

D. ASTM E84 – Surface Burning Characteristics of Building Materials.

1.04 SUBMITTALS

A. Submit under provisions of Section 013300.

B. Provide manufacturers product data.

C. Provide manufacturers installation instructions.

1.05 QUALITY ASSURANCE

A. Duct manufacturer shall have a minimum of five years documented history of successful installations of similar size.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Duct: Spears Manufacturing, Sylmar CA Or Harvel Plastics Inc., Easton PA.

B. Flexible Fan Connectors: GENERAL RUBBER CORPORATION, South Hackensack, NJ.

2.02 MATERIALS

A. Duct shall be PVC Type 1, Grade 1, light gray material. Round duct in sizes from 6-inches to 24-inches diameter shall be seamless and extruded. Nominal wall thickness for sizes from 6-inches to 18-inches diameter shall be 0.187 inches.

B. Joints: Provide flanges at connections to structures and equipment. Join pipe runs using the solvent cement method. Socket depth at solvent cement joints shall be 3-inches.

C. Fittings: Elbows shall have a centerline radius of approximately 1-1/2 times the duct diameter. 90-degree elbows shall be constructed using 5-piece miter. 45-degree elbows shall be constructed using 3-piece miter. Miter joints shall be made by thermal welding.

D. Duct properties:
   1. Cell Classification: ASTM D1784, 12454-B.
   2. Tensile Strength: ASTM D638, 7,450 psi @ 73F.
   3. Modulus of Elasticity: ASTM D638, 420,000 psi @ 73F.
   4. Flame Spread: ASTM E84, 10 – 25.
   5. Smoke Generation: ASTM E84, 600 – 1,000.
   6. Burning Rate: Self extinguishing.
   7. Duct shall be non-electrolytic.

2.03 ACCESSORIES

A. Flanged style fan connectors, General Rubber Corp. Style 1092, neoprene elastomer, FRP backup bars and stainless steel bolts. Flange width shall be compatible with connector size and mating flange bolt hole location. The connector shall dampen axial, lateral, and vibrational duct movement. The connector shall be resistant to ultraviolet degradation and to the corrosive gases being processed.

B. PVC Cement: IPS Corporation Weld-On #719.

C. Hardware: Bolts, nuts and washers shall be 304SS.

D. Gaskets: 1/8-inch thick closed cell neoprene.

PART 3 – EXECUTION

3.01 PREPARATION

A. Receive, off-load and properly store the duct segments and accessories at the job site prior to installation.

3.02 INSTALLATION

A. Install pipe and fan connectors in accordance with manufacturer's installation instructions.

B. Support duct in accordance with SMACNA Thermoplastic Duct Construction Manual.

Duct Diameter (in.)	Minimum Clamp or Hanger Material (in.)	Rod Diameter (in.)	Maximum Center Spacing (ft.)
18 and below	1-1/4 x 1/8	1/4	8
19 thru 32	1-1/2 x 3/16	3/8	8
33 and above	2 x 3/16	3/8	5

3.03 FIELD QUALTIY CONTROL

A. Joints shall be leak-tight.

END OF SECTION 15840

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This section specifies requirements for testing, adjusting, and balancing of hydronic fluid distribution systems, including the equipment and devices associated with the 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 1.3 “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); 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) Hydronic 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 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.
   a) 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.
   b) 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 pump 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 National Environmental Balancing Bureau (NEBB).

C. Instrumentation type, quantity, and accuracy shall be as described in 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. National Environmental Balancing Bureau (NEBB)

B. Set the fluid flow delivery rates of each zone to within five percent of the values shown on the Drawings.

C. Set the pump delivery flow rates to be within 10 percent above the design value.

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 pressure taps, gauges, valves, 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 control valves 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 hydronic equipment, manual valves, automatic valves 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 pump 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 hydronic systems to see that they are free from abnormal obstructions, and that all piping, valves and equipment have been properly made fully operational. Determine that all equipment and control systems are performing correctly by functional testing.

F. Where existing systems are to be modified or added to ensure that all strainers and 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 at no additional cost to the Owner.

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 fluid distribution systems have been satisfactorily completed.

F. Actuate all safety devices in a manner that clearly demonstrates their workability and operation.

G. Cut insulation, ductwork, and piping for installation of test probes to the minimum extent necessary to allow adequate performance of test procedure if required.

H. Perform tests and compile test data for all the hydronic systems within the scope of work.

I. 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.

J. Hydronic Systems: Perform the testing, adjusting and balancing of hydronic systems in accordance with the detailed procedures outlined in the referenced standards; and including but not limited to the following:
   1. Preliminary procedure prior to balancing:
      a. Examine water in system and determine if water has been treated and cleaned.
      b. Check expansion tank to determine that it is not air bound and the system is completely full of water.
      c. Purge all air vents of water systems, check automatic air vents and determine if they are operating properly. Repair or replace any air vents that are not operating properly.
      d. Coordinate with control manufacturer for required cooling and heating temperature controls and corresponding, automatic valve operation settings.
      e. Open all normally open valves to full open position. Set automatic valves to full coil flow.
      f. Check water pumps for pump rotation and for proper flow rate delivery against manufacturer's pump curves.
      g. Set all balancing valves for required flow delivery at mains and branch mains to cooling and heating elements.
      h. Upon completion of flow readings and adjustments of balancing valves, mark all settings and record data, so that they can be restored to their correct "balanced" position, if disturbed later.
   2. Include the following as part of the final balancing:
      a. After required heating temperature controls and automatic valve operation settings are made, recheck pump flow requirements and readjust system as required.
      b. Record pressure drop through manifolds at set flow rate. Set balancing valves as required to achieve specified flow rates.
         1) Inlet water temperatures and static pressure at connections.

2) Leaving water temperatures and pressure drop of each manifold.

c. Record operating suction and discharge pressures of each pump and final total dynamic head and rated amperage versus actual amperage of pump motors.

d. Record entering and leaving water temperatures and flow through all equipment and devices.

e. Check and record all flow rates at all locations in the piping system with flow meters.

f. Retest, adjust, and balance systems subsequent to system modifications. Resubmit test results.

3.03 BALANCING SCOPE OF WORK

A. Contractor shall include a minimum of four total site distribution system balancing reports. Two each for heating and cooling system. Contractor shall bear the cost of any additional balancing iterations in their base bid price due to changes in construction sequencing/phasing driven by contractor.

1. The site distribution balancing reports shall test, adjust and document the heating hot water and chilled water supply and return mains flow, and document temperature and pressure for each building (pending the construction sequence) per the flow diagram on drawing H-PV-FD-1.

2. Test and document each building main hot and chiller water anti freeze bypass balancing valve per schedule on drawing H-SCH-1. Perform this work only after new piping system has been completed to the subject building. This testing requires the temporary shut down of the building heating and cooling systems, and must be coordinated with owner prior to scheduling & performing the test.

B. Provide a minimum of two balancing reports of the building interior systems per the systems identified in the building heating and cooling load spreadsheet in Section 01700 Maintenance of Plant Operations. Each balancing report shall be provided on the hot water and chilled water systems, one execution in the cooling season, one in the heating season. Do not proceed with any building side flow balancing until authorized in writing by owner.

C. Provide one balancing report for EF-1 system.

END OF SECTION 15950

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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. The Contractor shall 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 . 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.
   3. 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.

C. All existing plants will be maintained in continuous operation during the entire construction period of all contracts. Work under each contract shall be so scheduled and conducted by each Contractor that such work will not impede any process, or cause odor or other nuisance. In performing the work shown and specified, the Contractor shall plan and schedule his work to meet the plant operating requirements.

D. 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. No plant personnel 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.

E. It shall be the responsibility of the Contractor to move all equipment, desks, stored materials, etc. from one building to another. All moves shall be scheduled and coordinated with the Engineer.

1.02 RELATED SPECIFICATIONS

A. Specification 09900 – Painting.

B. Specification 16036 – Testing

1.03 PAYMENT

A. Payment for general electrical requirements shall be made as provided for in the Specifications.

1.04 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.

1.05 SUBMITTALS

A. Contractor shall submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the specifications.

B. Working Drawings:
   1. Point-to-point field wiring diagrams.
   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.

1.06 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 Engineer Approved 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, the Contractor shall perform the work with due regard to maintenance of operations and construction staging in accordance with the Specifications.
   5. The modification work shall be coordinated in advance with the plant superintendent and existing conditions. Contractor shall 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. The Contractor shall 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.
   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. For this Contract NEMA 4X areas include but are not limited to the Headworks Building, the Sludge Thickening Building, the below grade tunnels, and all exterior locations.
      b. Materials, equipment and incidentals installed in hazardous locations, shall meet NEC requirements for the Class and Division designated. Enclosures installed in hazardous locations shall be provided with stainless steel hardware and watertight gasketing. For this Contract, hazardous areas include but are not limited to the influent wet well area within the Headworks Building.
      c. Materials, equipment and incidentals installed in non-corrosive and non-hazardous areas shall meet NEC and NEMA 12 requirements. For this Contract NEMA 12 areas include but are not limited to the Control Building.

1.07 GENERAL CONSTRAINTS

A. General: Under Paragraph 1.09, 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 plant equipment the Contractor shall notify plant personnel immediately to allow for an orderly restart of affected equipment.

C. Personnel Access: Treatment plant personnel must have access to all areas which remain in operation throughout the construction period. The construction work must be phased, and access for plant workers must be maintained during construction.

D. Power, Light and Communication Systems: Electric power, lighting service and communications systems shall be maintained in uninterrupted operation in all areas which remain in operation. Individual units may be disconnected as required for replacement.

E. Sump Pumps and Sumps: All existing pumps shall be maintained in an operable condition with either existing pumps or temporary pumps. Interim piping, power and controls shall be provided as required by the staged construction sequence.

F. Service Interruptions:
   1. When a construction task requires a suspension of normal operations of a plant utility system for a period of less than twenty-four (24) continuous hours, the suspension shall be considered a service interruption.
   2. The contractor shall compile an inventory of the labor and materials required to perform the tasks, an estimate of the time required and a written description of the steps required to complete the task resulting in a service interruption. The inventory, time estimate and written procedure shall be submitted to the Engineer for review thirty (30) days prior to the start date of the task as defined in the CPM schedule. If the proposed procedure submitted by the Contractor is acceptable, the Engineer shall authorize in writing, the service interruption pending the verification of materials and labor and the final notification specified therein.
   3. No service interruption shall be initiated until the list of materials and labor is verified by the Engineer as on site at least one week prior to the proposed start date. After verification of the list of materials and labor, the Contractor shall notify the Engineer of the exact date that he wishes to perform the work in writing two (2) normal working days, excluding Saturdays, Sundays and holidays, prior to the proposed date.
   4. When the normal operations of a plant utility system unit are suspended longer than twenty-four (24) hours, then the procedures for a shutdown, specified hereinafter, shall be enforced.

1.08 PRIOR, CURRENT AND FUTURE CONSTRUCTION CONTRACTS

A. Refer to Specification 01010 – Summary Work

1.09 SEQUENCE OF CONSTRUCTION AND OPERATION

A. In order to maintain continuous plant operation during construction, a phased removal, construction and operational sequence will be required as described herein. The order in which the principal structures or work areas are presented herein is for convenience of presentation and is not intended as a sequence of work or a listing of priorities.

B. Refer to Specification 01310 – Maintenance of Plant Operations.

1.10 TEMPORARY FACILITIES

A. Temporary facilities shall be provided in accordance with the requirements of Paragraph 1.9, Sequence of Construction and Operation.

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.

1.11 INTERIM AND TEMPORARY MATERIAL AND EQUIPMENT

A. The Contractor shall 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 for maintaining a treatment process for a specific period, or the utility or service systems during the installation or connection of new equipment or material.

1.12 ADDITIONAL PROVISIONS

A. Shutdowns:
   1. Before commencing work on any of the existing equipment which requires a shutdown or suspension of normal operations, the Contractor shall request permission from the Engineer, in writing, at least thirty (30) days in advance of the date he proposes to commence such work. A date in a CPM schedule shall not constitute proper notification. In the request, the Contractor shall explain what construction procedures shall be used during the shutdown.
   2. The Contractor is prohibited from shutting down any treatment units or equipment before obtaining written authorization from the Engineer to proceed with such operations; such authorization shall, however, not be construed as a waiver of the requirements for the uninterrupted operation of the plant. A final notification in writing shall be submitted by the Contractor two (2) normal working days excluding Saturdays, Sundays and holidays, in advance of the actual shutdown.

B. Protection of Underground and Covered Facilities: The location and extent of these facilities are not guaranteed, and the Contractor is cautioned to proceed with care, in the construction of new work in order to prevent damage to any existing structures, piping, or facilities. Protection and support for all underground facilities shall be provided to insure that the service provided for all existing facilities will not be interrupted. Any rerouting of the existing facilities to facilitate construction operation shall be only with written permission of the Engineer and then in the manner and at the time approved by the Engineer. The rerouting shall be made at no additional cost. Contractor shall pay for all damage to existing underground facilities that he causes and compensate the County for any service interruption caused by such damages.

C. Special Protection of Machinery and Equipment:
   1. The Contractor shall take all protective measures to the satisfaction of the Engineer necessary to insure that inclement weather or dust and debris from demolition does not enter any of the mechanical or electrical equipment 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. The Contractor shall pay for all damage to machinery and equipment caused by his failure to adequately protect it.

2. Interior dustproof covers shall be a heavy reinforced polyethylene film curtain, minimum thickness 6 mils, supported by wood framing. All seams and penetrations 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. Exterior weather tight enclosures shall be provided whenever a section of a roof or exterior wall on an existing building is removed or equipment is installed in a new building.

D. Site Visits: The Contractor, before submitting his proposal, shall visit the sites and shall be responsible for having ascertained local conditions, such as location, accessibility and general character of the sites, the character and extent of any existing work within or adjacent to the sites, and any other work being performed on the sites at the time of submitting his proposal. The Contractor shall 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.

E. Existing Cables and Conduits
1. When working with existing equipment or wiring systems, care shall be taken to avoid damage, and shutdown of process equipment. Prior to working in an area, Contractor shall examine existing conditions and file an inspection report with the Engineer. Any additional defects which result from the Contractor's work, will result in the Contractor being held liable for damage to existing equipment.
2. Where new construction involves connecting to or using existing equipment, the Contractor shall include in his bid price, all cost, work and materials required to adapt, extend or rework the prevailing existing "As Is" condition, to the new work. Should an existing condition prove to be grossly deteriorated or inadequate for modification, such condition shall be reported to the Engineer for a remedy.
3. Where existing empty conduits are to be used for new wiring systems, they shall be assumed to be in poor condition requiring prior "make ready" work before using. A wire brush reamer shall be pulled through prior to wiring and, if necessary, water accumulations shall be pumped or blown out.
4. Contractor shall trace and tag all wires before these are relocated and reconnected from the equipment. Contractor shall coordinate removal of wires with the Field Engineer.
5. The Contractor's attention is directed to the requirement that he shall work on an existing Sewage Plant which shall remain in operation.
6. As indicated on the plans, certain equipment and/or wiring systems are being taken out of active service permanently and the Contractor shall perform all work required to remove or safely abandon existing systems.
7. The following describes the intended work scope for removals:
   a. The Contractor shall arrange for the safe de-energization of all electrical equipment.
   b. Feeder and branch wiring, conduits and boxes routed exposed shall be removed in their entirety by the Contractor.
   c. Feeder and branch wiring and conduits in earth, concrete slabs or masonry shall be abandoned in place, except that wiring ends shall be cut off (or removed) at the conduit mouth by the Contractor. When feeder and branch wiring and conduits interfere with the installation of any new project work they shall be removed in their entirety by the Contractor. Conduits which exit floor slabs, and walls, shall be cut or hammered down, flush with floor level or wall and filled with epoxy concrete by the Contractor.

8. Generally all equipment, boxes, fixtures, etc. shall be removed from the site and disposed of at Contractor's expense, or delivered to an on-site storage area when the Engineer directs.
9. 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.

F. Emergency Repair Crews: In case the Contractor's operations disrupt the process at any of the, at any time, he shall at his own cost immediately make all repairs or replacements and do all work necessary to restore the plant to operation to the satisfaction of the Engineer. Such work shall progress continuously to completion on a 24-hour day, seven work-day week basis. The Contractor shall provide the services of emergency repair crews, available on call 24 hours per day.

PART 2 - PRODUCTS

2.01 POINT-TO-POINT FIELD WIRING DIAGRAMS

A. The Contractor shall provide point-to-point field wiring diagrams for all equipment, including equipment provided by other Contractors.

B. The diagrams shall be developed for performance of the work and to document terminations. The diagrams shall be prepared 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.
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.

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 and motor controllers shall be shop painted.

D. Other equipment shall be painted with the manufacturer’s best grade finish paint system compatible with the finish coatings specified.

PART 3 - EXECUTION

3.01 MAINTENANCE OF OPERATIONS

A. Where execution of the work under this Contract requires certain equipment to be taken out of service, the Contractor shall perform the work with due regard to maintenance of operations and construction staging in accordance with Paragraph 1.09 of this specification.

B. The Contractor shall schedule the work in advance with the Engineer so as not to affect proper plant operations. When the work is scheduled, the Engineer shall be notified 48 hours prior to proceeding with the work to allow time for the plant superintendent to perform load switching and alternation of equipment.

C. To the maximum extent possible at the end of the workday, all equipment shall be back in place and ready for its normal service use should a plant emergency arise. In addition, should an emergency condition occur during execution of the work, at the request of the plant engineer, the equipment shall be placed back in service immediately and turned over to plant personnel.

D. In the event of accidental shutdown of plant equipment the Contractor shall notify plant personnel immediately to allow for an orderly restart of affected equipment.

3.02 DEMONSTRATION OF EQUIPMENT

A. The Contractor shall demonstrate, in the presence of the Engineer that all electrical systems and electrically operated equipment operates as specified, designed and as required.

B. The demonstration of equipment shall include the following:
   1. All power circuits shall be operated to verify proper connection to equipment.
   2. 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.
   3. 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.
   4. All instrumentation systems shall be operated to verify that wiring and data transmission is correct.

3.03 RESTORATION

A. The Contractor shall field paint after installation marred or scratched surfaces. All scratches, abrasions and other damage to equipment shall be touch-up painted.

END OF SECTION 16010

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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. The Contractor shall 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 County 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. Contractor shall 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. 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, the Contractor shall provide protection of adjacent plant areas, existing equipment and on-going construction. No electrical equipment shall be disposed off-site without the written approval of the County and Engineer.

C. The Contractor shall execute the work in a careful and safe manner with the least possible disturbance to the public and to the operation of the facility. All work shall be performed with due regard to maintenance of plant operations and construction staging in accordance with the Specifications.

D. Demolition and removal work shall be executed with care and performed by competent experienced workmen for the various types of demolition and removal work. All patching, replacing and refinishing of work shall be done by skilled workmen. The work shall be carried out through to completion with due regard to the safety of County employees, workmen on site and the public.

E. The Contractor shall make such investigations, explorations and probes as are 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 County. All equipment marked by the County 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 County.

G. The Contractor shall coordinate with other Prime Contractors to disconnect or remove sources of power to equipment being removed or relocated under other Contracts.

1.06 SITE CONDITIONS

A. The County 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. The Contractor shall 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.

C. The Contractor shall perform the work with due regard that in some areas only certain systems and equipment shall be demolished while other systems and equipment shall remain operational. Contractor shall field determine and make such investigations as required to determine the source and function of each circuit, to allow for the disconnection and removal each circuit not required as result of the demolition and to retain all active circuits for areas unaffected by the demolition work.

1.07 SCHEDULING

A. The Contractor shall proceed with the demolition and removal of equipment in a sequence designed to maintain the existing facility in operation. The Contractor shall notify the Engineer 48 hours before proceeding and meet with plant personnel to review removals and demolition work. Work shall begin only after approval of the County and Engineer.

B. Any 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 County.

C. The Contractor shall familiarize himself with the work of all contracts and coordinate and schedule demolition activities with the other Prime Contractors for proper sequencing of the work and the removal of equipment.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 PREPARATION

A. The Contractor shall provide protection and restoration of structures in accordance with the Specifications. Catch platforms, lights, barriers, weather protection, warning signs and other

items shall be provided as required for proper protection of the public, occupants of the building, workmen engaged in demolition operations, and adjacent construction.

B. The Contractor shall 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. The Contractor shall 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. The Contractor shall 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. Dust proof partitions shall be constructed of wood 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. Adequate ventilation shall be provided for a safe working environment.

E. The Contractor shall provide adequate fire protection during demolition in accordance with East Rockaway Fire Department requirements.

F. The Contractor shall not close or obstruct roadways, walkways, passageways, or stairways and shall not store or place materials in passageways, stairs or other means of egress. The Contractor shall conduct operations with minimum traffic interference.

G. The Contractor shall repair any damage to the existing structure or contents by reason of the insufficiency of protection provided.

3.02 REMOVALS

A. The Contractor shall demolish or relocate electrical equipment as shown on the Contract Drawings. All motors shall be disconnected by the Contractor, but removed with the driven equipment by the other Subcontractors.

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, the cable shall be cut back to the point of entrance.

C. All exposed conduits shall be removed and disposed. Conduits underground or concealed shall be abandoned. Abandoned conduits shall be cut flush with the slab or wall at the point of entrance and plugged.

D. Recessed equipment to be demolished shall be abandoned, unless otherwise noted on the Contract Drawings. Demolished recessed panelboards and boxes enclosure fronts and internals shall be completely removed. The enclosure fronts shall be covered with new blank cover plates.

E. Wherever cable and conduit are to be removed for disposition, the circuit shall be de-energized by the Contractor and adjacent circuits that are to remain in service shall be blanked off and then isolated.

F. All supports, pedestals and anchors for conduits, lighting fixtures and other equipment shall be removed with the equipment unless otherwise noted on the Contract Drawings. 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.

G. The Contractor shall dispose of all demolition equipment, debris and other items, not marked by the County to remain, off the site and in conformance with all applicable codes and regulations.

H. The Contractor shall perform patching, restoration, finishing and new work in accordance with the Specifications. All openings in structures as a result of the work, shall be patched and exterior openings made watertight. Where alterations occur, or new and old work join, the Contractor shall cut, remove, redrill or refinish the adjacent surfaces to the extent required by the conditions, so to leave the altered work in a condition as existed prior to the start of the work.

I. 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.

J. 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. The Contractor shall maintain the existing electrical power system to operate without interruption. Any interruption of electrical power to the existing facility and equipment shall be with the approval and permission of the County and the Engineer.

B. The Contractor shall maintain all protection facilities installed in preparation of the demolition work.

C. The Contractor shall provide on-site dump containers for collection of waste materials, debris and rubbish.

D. All existing surfaces shall be cleaned of dirt, grease, loose paint before refinishing.

E. The Contractor shall 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 16035

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. The Contractor shall perform all tests as specified in these specifications, and as required.

B. Individual testing requirements are detailed in the individual equipment specifications.

1.02 RELATED SPECIFICATIONS

A. Specification 16292 - Power Distribution System Coordination

1.03 REFERENCES

A. NETA - International Electrical Testing Association.

B. IEEE - Institute of Electrical and Electronics Engineers.

C. ANSI - American National Standards Institute.

1.04 DESIGN REQUIREMENTS

A. General
1. The Contractor shall furnish all instruments and qualified personnel for all tests.
2. Written notice of all tests shall be given to the Engineer at least two (2) weeks in advance.
3. Unless waived in writing by the Engineer, all tests shall be made in the presence of a duly authorized representative of the Engineer. When the presence of such representative is so waived, sworn statements, in duplicate, of the tests made and the results thereof, shall be furnished to the Engineer by the Contractor.
4. Necessary adjustments and testing shall be made in cooperation with the respective manufacturers and other Contractors when necessary.
5. The Contractor shall make available, the electrical system and personnel when required by other Contractors to test their respective equipment. The Contractor shall coordinate their resources with the other Contractors.

B. Factory and witness shop testing requirements shall be as detailed in the individual equipment specifications.

C. Field Testing: All electrical equipment furnished, installed or modified under this Contract shall be field tested by this Contractor as detailed in the individual equipment specifications.

D. Schedules and Plant Operations
1. When testing requires that certain pieces of equipment be taken out of service, all testing procedures and schedules must be submitted to the County's engineer for review and approval one month prior to any work beginning. When testing has been scheduled as above, the plant 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 plant equipment must be coordinated with plant personnel so as not to affect proper plant operations.
2. At the end of the workday, all equipment shall be back in place and ready for immediate use should a plant emergency arise. In addition, should an emergency condition occur during testing, at the request of the plant engineer, the equipment shall be placed back in service immediately and turned over to plant personnel.
3. In the event of accidental shutdown of plant equipment the contractor shall notify plant personnel immediately to allow for an orderly restart of affected equipment.

F. Final Field Testing
   1. The Contractor shall complete the installation and testing of the electrical installation at least two (2) months prior to the start-up and testing of all other contracts. During the period between the completion of electrical installation and the start-up and testing of all other contracts, the Contractor shall make all components of the Electrical Work available to the other contractors as it is completed for their use in performing Preliminary and Final Field Tests.
   2. Before each test commences, the Contractor shall submit a detailed test procedure, and also provide manpower and scheduling for the approval of the Engineer. In addition the Contractor shall furnish detailed test procedures for any of his equipment required as part of the field tests of systems by other contractors.

1.05 SUBMITTALS

A. Submit the following in accordance with Article GC-14 of the General Conditions and Division 1.

B. Certificate of Compliance
   1. Qualifications of independent testing firm and technicians.

C. Reports
   1. Proposed testing methods and schedules.
   2. All field test reports.

1.06 QUALITY ASSURANCE AND QUALIFICATIONS

A. As detailed above, the independent testing firm shall be a qualified firm employing NETA certified technicians.

END OF SECTION 16036

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Requirements for providing grounding. Grounding shall be provided in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.

B. The grounding 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 and grounding electrodes.

1.02 RELATED SPECIFICATIONS

A. Specification 16121 - Electric Wires and Cables

B. Specification 16131 - Electric Conduit System

1.3 PAYMENT

A. Payment for grounding shall be made as provided for in the Specifications.

1.4 REFERENCES

A. Grounding shall comply with the latest applicable provisions and recommendations of the following:
   1. NFPA 70, National Electrical Code.
   2. PSEG Long Island.
   3. UL Standard No. 467, Electrical Grounding and Bonding Equipment.

1.05 SUBMITTALS

A. Contractor shall 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. 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 materials proposed for use.
   3. Scaled working drawings showing proposed routing and layout of the grounding system.

C. Field test report shall be submitted.

1.06 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.

1.07 DELIVERY, STORAGE AND HANDLING

A. The grounding equipment shall be delivered, stored and handled in accordance with the Specifications and the manufacturer’s recommendations.

PART 2 - PRODUCTS

2.01 GROUND CABLE

A. The ground cable shall be soft drawn bare stranded copper conforming to ASTM B8 and B189. Size shall be as shown on the Contract Drawings.

B. The insulated cable for equipment grounding shall conform to the requirements of Specification 16121 - Electric Wires and Cables.

C. Ground cable shall be General Cable Corporation, Okonite Cable Company, Southwire, or equal to be approved by the Engineer.

2.02 GROUND RODS

A. Ground rods shall be copper-clad steel, 5/8-inch diameter and 10 feet long.

B. 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.

C. Ground rods shall be Heary Brothers Lightning Protection Company, Fushi Copperweld, or equal to be approved by the Engineer.

2.03 GOUNDING CONNECTORS

A. 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.

B. Welded connections shall be by exothermic process utilizing molds, cartridges and hardware designed specifically for the connection to be made.

C. Bolted or compression grounding connectors shall be 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. A complete ground grid system shall be installed as shown on the Contract Drawings.

B. Ground cable shall be installed 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. Test points shall be installed at locations and in accordance with the details shown on the Contract Drawings.

E. Equipment shall be connected in accordance with the details shown on the Contract Drawings. All steel column and underground connections shall be welded except for test points.

F. Metal casings or supporting frames of electrical equipment, such as transformers, panel boards, control panels, unit substations, and individual motor controllers shall be grounded. 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. An insulated cable for equipment grounding shall be installed 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, the completed ground system shall be field tested for operation and conformance. The field tests shall be witnessed by the Engineer and certified by the Contractor. The Contractor shall 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, the Contractor shall continue to drive ground rods in accordance with NEC 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. The Contractor shall provide a Field Test Report, the report shall identify the testing performed and the results obtained.

END OF SECTION 16061

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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.

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 A569, Specification for Steel, Carbon, Hot-Rolled Sheet and Strip Commercial Quality.
   2. ASTM A570, Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.
   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. Contractor shall 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 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. The Contractor shall provide the proper sized rods, channels, fittings, brackets and appurtenances necessary to adequately support the equipment.
3. The Contractor shall retain the services of a Licensed Engineer, registered in the State of New York, to prepare and stamp support details for equipment exceeding 50 pounds in weight.

B. Seismic Requirements:
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. The Contractor shall 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. The Contractor shall 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. The Contractor shall 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 conform to ASTM A569 or A570. 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. All channels, fittings, brackets and related hardware shall be steel and have an electro-plated zinc finish according to ASTM B633.

F. In corrosive areas, channels, fittings, brackets and related hardware shall be type 316 stainless steel or PVC coated.

2.03 CONDUIT HANGERS, SUPPORTS AND INSERTS

A. The Contractor shall provide channels, rods, straps, anchors and related hardware for support of the exposed electric conduit system.

B. The Contractor shall also 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.

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, the Contractor shall furnish leveling channels. The Contractor shall 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.

END OF SECTION 16071

+ + NO TEXT ON THIS PAGE + +

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 labeling 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 temporary 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.

1.02 RELATED SPECIFICATIONS

A. Specification 16121 - Electric Wire and Cable

B. Specification 16131 - Electric Conduit System

1.03 PAYMENT

A. Payment for labeling and identification shall be made as provided for in Division 1 of the Specifications.

1.04 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.

1.05 SUBMITTALS

A. Contractor shall 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. 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.

1.06 QUALITY ASSURANCE

A. All labeling and identification signs and nameplates shall be provided in accordance with the NFPA 70 and OSHA.

1.07 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.

C. High voltage signs shall read; "DANGER - HIGH VOLTAGE KEEP OUT".

D. 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 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.

C. Nameplates for distribution equipment shall have the following information:
   1. Equipment name and number.
   2. Voltage.
   3. Phases and number of wires.

D. Pullboxes, junction boxes and control stations shall have a nameplate identifying the equipment name and number.

E. 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.

F. All control and indicating devices shall have individual nameplates identifying device function.

G. 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 as recommended by the manufacturers.

B. Signs and nameplates shall be mounted with screws. Where mounting of signs or nameplates with screws is impractical, the Contractor shall alert the Engineer.

C. High voltage signs shall be installed on equipment operating at over 600 volts. High voltage signs shall also be installed 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 16076

+ + NO TEXT ON THIS PAGE + +

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 following index of this Specification is presented for convenience.

D. The cables and wires proposed for all instrumentation cables and wires shall be approved by the Contractor before Engineer approval can be given. The Contractor shall submit the approvals from the Contractor along with the cable and wire shop drawings for Engineer approval.

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. Contractor shall 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. Prior to equipment submission, a list of proposed manufacturers shall be submitted with the products they produce proposed for the contract.
2. Manufacturer's Literature, specifications and engineering data for the electric wires and cables and accessories.
3. 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.
4. 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.

C. Reports:
1. Shop and field test reports shall be submitted.
2. Acceptance testing report shall be submitted.

D. MATERIAL SAFETY DATA SHEETS
1. Material Safety and Data Sheets (MSDS) shall be submitted for all cables and wires supplied. MSDS 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 Des. 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.

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

2.01 300 VOLT INSULATED CABLE

A. 300 volt insulated cable shall be used for all instrumentation and communication circuits. The size and quantity of 300 volt insulated cable shall be as indicated in the conduit and cable schedule.

B. 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.

C. 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. Fire Alarm Cable shall be UL listed, made of Teflon and approved by the East Rockaway Building Department, Material and Equipment Acceptance Division.
   4. Communication and Fire Alarm Cable shall be by General Cable Corporation, Belden Company with Beldfoil shielding or equal to be approved by the Engineer.

2.02 600 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 3.03.

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, Southwire,` or equal to be approved by the Engineer.

C. When identified on the Contract drawings 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. 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.

2.03 600 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 `
   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.

2.04 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. The Contractor shall provide a shop test report. The report shall identify 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. The Contractor shall 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 the Contractor shall 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.

2.05 ARMORED METAL-CLAD CABLE

A. When identified in the cable and conduit schedule, armored metal-clad cable shall be used for all temporary power circuits. The armored metal-clad cable shall be in accordance with the following:
   1. Conductors shall be stranded, tinned, copper cable conforming to ASTM B8 and B33, No. 12 AWG minimum wire size.
   2. Insulation shall be flame-retardant EPR (FREP), moisture and heat resistant, thermoset, rated 90 degrees C in dry or wet locations and be listed by UL as Type MC-HL, Type XHHW-2 or Type RHW-2.
   3. Cable shall be assembled together with flame and moisture resistant fillers and tape.

4. Cable shall include an impervious, continuous, welded, corrugated aluminum sheath, which shall be resistant to gases, moisture, and liquids.
5. Cable shall include a bare stranded copper grounding conductor meeting the requirements of NFPA 70 and UL 1569.
6. XHHW-2 shall be used for all indoor circuits and RHW-2 for all underground circuits.
7. The cable shall be provided with all fittings and hardware necessary for proper installation.
8. The armored metal-clad cable shall be as manufactured by Okonite Company, BICC Cable Company or Rockbestos Cable Company.

2.06 FIBER OPTIC CABLES

A. Fiber optic cable shall be installed for inter-building and inter-panel communication as shown on drawings. These cables shall meet the following:
   1. Cable shall be suitable for installation as both trunk cable and riser cable.
   2. Cable shall be rated for indoor/outdoor use.
   3. Cable shall be 62.5/125 micrometer (core/clad) multimode fiber optic cable.
   4. Cable shall utilize a multi-fiber per tube (MFPT) design consisting of 24 fibers contained in tight buffer tubes.
   5. Cable shall utilize a 900 um diameter tight buffer coating on each optical fiber.
   6. Cable shall be riser rated distribution cable.
   7. Cable shall have a ripcord(s) to assist in jacket removal.
   8. Cable shall be suitable for direct termination with standard connectors.
   9. Manufacturer:
      a. Optical Cable Corporation, DX Series
      b. Belden, Lan Lite Series
      c. Approved equal

B. Fiber Optic Patch Cables
   1. Patch cables shall be 62.5/125 micrometer (core/clad) multimode fiber optic cable.
   2. Patch cables shall be terminated with connectors as scheduled.
   3. Manufacturer:
      a. Optical Cable Corporation
      b. Siecor
      c. Approved equal

PART 3 - EXECUTION

3.01 GENERAL

A. All cables and wires shall be installed within the raceways as shown on the Contract Drawings. They shall be carefully handled so as to avoid twists or kinks in the conductors or damage to the insulation.

B. The Contractor shall 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 latest applicable section of NFPA 70 National Electrical Code.

C. No splices shall be permitted between terminals except at approved (in writing) 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 water proofed.

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.

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. Cables shall be installed with maximum slack at all terminal points, boxes, handholes and manholes.

3.03 CONDUCTOR IDENTIFICATION

A. Each wire shall be labeled at each termination points 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. Each wire shall be identified 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, each power wire shall be identified 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:

System Voltage	Neutral	Phase A	Phase B	Phase C	Ground
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 witnessed by the Engineer and certified by the Contractor. The Contractor shall provide a report identifying the tests performed and the results obtained.

B. Each electrical circuit shall be tested 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 cables after they 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. 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 16121

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 following index of this Specification is presented for convenience.

D. The conduit system proposed for all circuits shall be approved by the General Contractor before Engineer approval can be given. The Contractor shall submit the approvals from the General Contractor along with the conduit layout submittals for Engineer approval.

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. Every conduit 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 SPECIFICATIONS

A. Specification 09900 - Painting.

B. 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.

1.05 SUBMITTALS

A. Contractor shall submit working drawings, shop drawings and material specifications for the approval of the Engineer.

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 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 PVC COATED RIGID STEEL CONDUIT

A. The Contractor shall provide PVC coated rigid steel conduit in the locations listed below, unless otherwise noted on drawings, with the exception of where flexible metallic conduit is required to permit movement of connected devices. All steel conduit shall comply with the requirements of ANSI C80.1, and the Underwriters' Laboratories, Incorporated, Standard for No. 6.
   1. All exterior above and below grade
   2. All Process Areas

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. Conduits, elbows and couplings shall include a PVC coating for all areas.

E. 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.

F. PVC coated rigid steel conduit shall be by Perma-Cote Industries, OCAL Incorporated, Robroy Industries or equal to be approved by the Engineer.

2.02 RIGID STEEL CONDUIT

A. The Contractor shall provide rigid steel conduit in the locations listed below, unless noted otherwise on drawings. All steel conduit shall comply with the requirements of ANSI C80.1, and the Underwriters' Laboratories, Incorporated, Standard for No. 6.
   1. All interior non-process areas
   2. Electrical rooms

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.

2.03 HANGERS, SUPPORTS AND INSERTS

A. The Contractor shall 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. The electric conduit system 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.

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 16071 – Supporting Devices. 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 except beam clamps, hanger rods and hardware shall be steel with electro-plated zinc finish. This shall also include bolts, nuts and washers. In corrosive locations, hangers and support hardware shall be type 316 stainless steel or factory applied 40 mil thick PVC coated.

F. Hangers, Supports and Inserts shall be by B-Line, Kindorf or equal to be approved by the Engineer.

2.04 FLEXIBLE METALLIC CONDUIT

A. The Contractor shall provide flexible metallic conduit only where required to permit movement of connected devices and where it is impracticable to complete runs with rigid conduit.

B. Liquid-tight flexible metallic conduit shall be used for all indoor non-hazardous areas.

C. Liquid-tight flexible metallic conduit shall be used for all outdoor non-hazardous areas.

D. 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.

E. 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. The Contractor shall 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 2.06. 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. For non-hazardous, indoor dry dusty areas pressed steel boxes of the proper size and depths for the application shall be provided. Boxes shall be rated NEMA 12, not less than No. 14 U.S. Standard Gauge (0.078 inch). The conduit openings shall be provided with oil-resistant gaskets. Conduits shall be fastened to these boxes with locknuts and bushings, and all unused outlets or holes shall be left sealed.

E. All outlet boxes intended for fixtures shall be provided with approved fixture studs.

F. 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. For concealed conduit work in non-hazardous areas in other than outside walls, connections between conduit and boxes may be made with drilled holes, using locknuts and bushings. 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.

G. 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.

H. Outlet boxes and fittings installed on PVC coated conduit shall also include interior and exterior coatings equivalent to the conduit.

I. For receptacle, switch, fixture, and other device outlet boxes recessed in walls, or exposed within hung ceiling spaces, in non-hazardous, indoor, dry areas above grade, standard galvanized pressed steel outlet boxes with partially pre-punched conduit connection cutouts, of the proper size and depth for the application, shall be provided. Conduits shall be fastened to these boxes with locknuts and bushings. Similar pressed steel boxes with blank covers may be used for junction and pull boxes in conduit runs where pressed steel device boxes are permitted.

2.05 CONDUIT ACCESSORIES

A. The Contractor shall provide conduit accessories for use with the conduit system. The conduit accessories shall be of approved types.

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 where PVC conduit is installed, seal fittings shall include interior and exterior coatings equivalent to the PVC conduit coating specified under Article 2.1.
4. Sealing fittings shall be by Crouse Hinds, Appleton Electric or equal to be approved by the Engineer.

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 0-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 0-Z Gedney, Thomas and Betts or equal to be approved by the Engineer.

G. Duct Seal:
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 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.
   b. 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.
   c. 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.
   d. 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 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.

2.06 TERMINAL, JUNCTION AND PULL BOXES

A. The Contractor shall provide terminal, junction and pull boxes as shown on the Contract Drawings and where otherwise required, or as directed by the Engineer.

B. Boxes in all areas shall be minimum NEMA Type 4X. Boxes shall be constructed of 316 stainless steel material with sealed seams.

C. 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.

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 outlet boxes, 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. All conduits shall be installed 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. They shall be installed 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.

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. Conduits shall be tagged using conduit tags. Conduit tags shall be installed 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. Conduit markers shall be installed 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. The Contractor shall 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. Conduits shall be securely fastened to each support with U-bolts, straps or clamps. All hanger types (trapeze and others) shall be furnished and installed in accordance with Specification 16071 – Supporting Devices. All items that are hung and supported shall be submitted as a separate shop drawing complete with licensed structural engineer P.E. seal.

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 waterstops. Conduit connections shall be made watertight. Contractor shall 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

Factory bent elbows or field bent elbows with approved tools may be used. Heating of conduit to facilitate bending is prohibited.

I. 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.

J. 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 conduit fittings. The ends of all empty conduits shall stub up six inches above the slab and shall be capped.

K. 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.

L. 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.

M. Thruwall type seals and conduit sealing bushings shall be installed for all conduits passing through concrete slabs, floors, walls or block walls.

N. 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.

O. Where conduit enter or leave equipment located within electrical and control rooms the conduit shall be sealed and packed with duct seal compound.

P. 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. Conduit shall be protected 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.

Q. 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.

R. 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, the Contractor shall 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.

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 manufacturer's recommendations to provide the additional movement necessary.

E. All conduit connections shall be made watertight and shall terminate at enclosures with approved conduit hubs.

F. 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.

G. All insulated grounding bushings shall be bonded together and to the structure of the enclosure by a continuous, copper bonding wire.

H. Removable, flame-retardant, insulating cable supports shall be provided in all boxes with any dimension exceeding 3 feet.

I. 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.

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, the electric conduit system shall be field tested. The field tests shall be witnessed by the Engineer and certified by the Contractor. The Contractor shall provide testing consisting of the following:
   1. Each conduit shall be tested 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. The Contractor shall provide a Field Test Report. The Report shall identify the testing performed and the results obtained.

END OF SECTION 16131

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PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Requirements for providing underground ducts. Underground ducts shall be provided in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.

B. Underground ducts shall be concrete encased. The Contractor shall provide reinforced concrete encasement for the duct system.

C. The Contractor shall perform all excavations and backfilling, as required, unless specifically shown otherwise on the Contract Drawings or stated in the Specifications.

1.02 RELATED SPECIFICATIONS

A. Specification 02200 – Earthwork

B. Specification 02500 – Surface Restoration

C. Specification 03300 - Cast-in-Place Concrete

D. Specification 05120 - Structural Steel Framing

E. Specification 16061 - Grounding

F. Specification 16131 - Electric Conduit System

1.03 PAYMENT

A. Payment for all work for underground ducts shown on the Contract Drawings and specified herein shall be included in the lump sum price bid for Contract Item 1. Payment for additional conduit, required by changes from that shown on the Contract Drawings or specified, will be made at the unit prices bid for additional conduit as described in the General Conditions and as specified under Division 1 of the Specifications.

1.04 REFERENCES

A. Underground ducts shall comply with the latest applicable provisions and recommendations of the following:
   1. NFPA 70, National Electrical Code.
   2. National Electrical Safety Code.
   3. UL No. 651, Schedule 40 and 80 PVC conduit.
   4. NEMA TC2, Electrical Plastic Tubing, Conduit and Fittings.
   5. UL No. 1684, Reinforced Thermosetting Resin conduit.

1.5 SUBMITTALS

A. Contractor shall 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. Prior to equipment submission, submit a list of proposed manufacturers with the products they produce proposed for the contract.

2. Manufacturer's Literature with manufacturer's name, designation and catalog number for all products proposed for the underground duct system.
3. Scaled Working Drawings showing the routing of the duct banks and the location of manholes, handholes and the principal outline of buildings and structures. Reference duct banks dimensionally from fixed objects or structures. Include profiles of duct banks showing crossings with piping and other underground systems.

1.06 DELIVERY, STORAGE AND HANDLING

A. Underground ducts shall be delivered, stored and handled in accordance with the Specifications and the manufacturer's instructions.

PART 2 - PRODUCTS

2.01 RIGID STEEL CONDUIT

A. Steel conduit for ducts shall be in accordance with the requirements of Specification 16131 - Electric Conduit System, except PVC coating of conduit is not required. Steel conduit shall be used for all medium voltage systems, instrumentation systems and communication systems throughout the underground system.

2.02 NON-METALLIC CONDUIT AND FITTINGS

A. Non-metallic conduit for ducts shall be PVC plastic or fiberglass-reinforced epoxy for all 600V systems.
   1. PVC plastic conduit shall be Schedule 40, NEMA type EPC-40-PVC, rated 90 degrees C, conforming to UL No. 651.
   2. Reinforced thermosetting resin conduit and fittings shall conform to UL No. 1684. Both conduit and fittings shall consist of 68 percent glass content encapsulated in an epoxy matrix.

B. All non-metallic fittings, elbows, bodies, terminations, expansions and fasteners shall be the same material and manufacturer as the conduit.

C. PVC conduit shall be by Carlon, Amoco or approved equal. Fiberglass-reinforced epoxy conduit shall be by FRE conduit, A.O. Smith or approved equal.

2.03 CONDUIT SPACERS

A. Conduit spacers shall be nonmetallic, interlocking type to maintain spacing between conduits. Spacers shall be suitable for all types of conduit in multiple sizes.

2.04 WARNING RIBBON

A. Warning ribbon shall be a three inch wide, four mil polyethylene or polyvinyl chloride tape. The tape shall be permanently imprinted in red color, "CAUTION BURIED ELECTRIC LINE BELOW."

B. Warning tape shall be by Seton, Ideal Industries or approved equal.

2.05 DUCT SEAL

A. Duct seal for conduits shall be in accordance with the requirements of Specification 16131 - Electric Conduit System.

2.06 REINFORCED CONCRETE

A. Concrete for envelope shall be Class 40 concrete in accordance with the requirements of Specification 03300 - Cast-in-Place Concrete. Steel reinforcement shall be in accordance with the requirements of Specification 05120 - Structural Steel Framing.

2.07 EXPANSION AND DEFLECTION FITTINGS

A. Where specifically shown on the Contract Drawings, expansion and deflection fittings shall be provided at the structural joints of the underground duct system.

B. Expansion and deflection fittings shall be in accordance with Specification 16131 - Electric Conduit System.

2.08 CONDUIT BUSHINGS

A. Conduit bushings shall be provided for the termination of rigid steel conduits at each manhole.

B. Conduit bushings shall be in accordance with Specification 16131 - Electric Conduit System.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The duct system shall be installed to avoid interferences with structures, piping and other underground systems. Terminate ducts with insulated grounding bushings at manholes and handholes. Conduit ducts shall be sized, arranged and installed in a reinforced concrete envelope as shown on the Contract Drawings.

B. Trenches for duct banks shall be in accordance with the requirements of Specification 02316 - Excavation. Duct bank trenches shall have the bottom tamped firm and even, and suitably braced side forms shall be employed in forming the envelope.

C. Duct banks shall follow straight lines as far as possible. Where deviation from a straight line becomes necessary, offsets shall be made using 5 degree angle coupling or make bend with sweeps. The sweep radius shall be 36-inch for 90 and 45 degree bends and 30-inch for 30 degree bends. Where directed by the Engineer, bends shall be made up with standard factory bends or other approved curved sections.

D. Duct bank installations and penetrations through foundation walls shall be made watertight.

E. Duct banks shall be assembled using non-magnetic saddles, spacers and separators. Separators shall be positioned to provide 3-inch minimum concrete separation between the outer surfaces of the ducts.

F. Concrete covering shall be provided on both sides, top and bottom of the concrete envelopes around conduits. Concrete covering shall be in accordance with the detail shown on the Contract Drawings. Top of concrete encasement shall not be less than thirty inches below finish grade. Add red dye to concrete used for envelopes or trowel a coloring on the concrete for easy identification during subsequent excavation.

G. Before pouring concrete, written approval shall be obtained from the inspecting engineer.

H. Ducts shall be firmly fixed in place during pouring of concrete. Concrete shall be carefully spaded and vibrated to insure filling of all spaces between ducts.

I. A transition shall be made from non-metallic to rigid steel conduit where duct banks enter structures or turn upward for continuation above grade. Rigid steel ducts shall be terminated using insulated grounding bushings. Ducts inside buildings shall be continued using rigid steel or PVC coated rigid steel conduits as required for the area.

J. Ducts entering manholes and hand holes shall be terminated using suitable end bells. Rigid steel ducts shall be terminated using insulated grounding bushings.

K. Backfilling for duct banks shall be in accordance with the requirements of Specification 02200 - Earthwork. Backfilling shall be permitted when directed by the Engineer to proceed. Backfilling shall not be with material containing large rock, paving materials, cinders, large or sharply angular substances, corrosive material or other materials which can damage or contribute to corrosion of ducts or cables or prevent adequate compaction of fill.

L. Duct runs shall be sloped for drainage toward manholes and away from buildings with a slope of approximately 3 inches per 100 feet.

M. A ground cable shall be installed in each duct bank envelope. Cable shall be in accordance with the requirements of Specification 16061 - Grounding. The ground shall be made electrically continuous throughout the entire duct bank system. Ground cable shall be connected to the building, station ground grid, equipment ground buses and to each conduit grounding bushing of the underground duct system. The ground cable shall be terminated at the last manhole or handhole for outlying structures.

N. After installation each conduit in each duct bank shall be cleaned and cleared of obstructions and foreign matter by rodding and by the passage of cleaning brushes or cutting mandrels. After cleaning, the clearance of each conduit shall be checked by passing a 12-inch long mandrel, of diameter 1/2 inch less than the nominal duct diameter, through the entire length of duct run. Ducts which do not permit passage of the mandrel shall be cleared, cut out and replaced or sealed and replaced by additional construction. The duct bank conduit cleaning shall be included in the electric conduit system field test report specified in Specification 16131 - Electric Conduit System.

O. A warning ribbon shall be installed approximately 12 inches below finished grade over all underground duct banks carrying cables of 480 volts and higher.

P. All ducts entering buildings and structures shall be sealed. All empty spare ducts shall be sealed and plugged.

Q. An expansion and deflection fitting shall be installed on each conduit at each of the structural expansion joints when shown on the Contract Drawings. Joints shall be located as defined by the criteria noted on the Contract Drawings.

END OF SECTION 16133

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 - Electric Conduit System, and Section 16121 - Electric Wire and Cable.

I. The conduit and cable schedule begins on the following page.

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.

END OF SECTION 16900

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