TECHNICAL SPECIFICATIONS FOR SENECA NATION OF INDIANS SULLIVAN HOLLOW WATER TREATMENT PLANT UPGRADES

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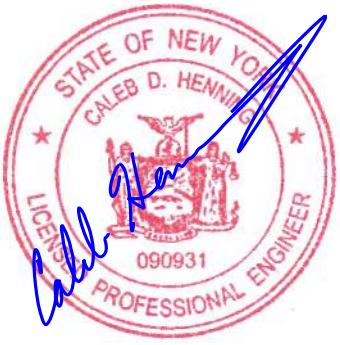

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SENECA NATION OF INDIANS
SULLIVAN HOLLOW WATER TREATMENT PLANT UPGRADES
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SECTION 02050

DEMOLITION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Removal of designated building equipment and fixtures.
B. Removal of designated construction.
C. Disposal of materials.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01043 - Coordination with the OWNER's Operation.
B. Section 01500 - Construction Facilities and Temporary Controls.
C. Section 01700 - Contract Closeout.

1.03 SUBMITTALS FOR REVIEW

A. Submit materials in accordance with Section 01340 - Submittal and Correspondence Procedure.
B. Demolition Methods

1. Submit for approval proposed means, methods, equipment, and operating sequences to be utilized for demolition. Include coordination for possible shut-off, capping, temporary services, continuation of utility services, and other applicable items to ensure no interruption of the operations of the OWNER.

C. Notification

1. At least ten (10) business days prior to commencement of demolition, notify ENGINEER in writing of the proposed schedule. Do not commence demolition without the written permission of the ENGINEER.

1.04 REGULATORY REQUIREMENTS

A. Conform to all applicable federal, state, and local laws and codes for demolition Work, dust control, and products requiring electrical disconnection.
B. Obtain any required permit(s) from regulatory authorities as necessary.
C. Do not close or obstruct egress width to any building or site exit.
D. Do not disable or disrupt building fire or life safety systems without giving five (5) days prior written notice to the OWNER.
E. Conform to procedures applicable when hazardous or contaminated materials are discovered.

1.05 SEQUENCING

A. Sequence activities as described in Section 01010 - Summary of Work.

1.06 SCHEDULING

A. Schedule demolition Work to coincide with new construction.
B. The CONTRACTOR shall coordinate the demolition Work with the OWNER.

C. Carry out operations so as to avoid interference with operations and work in and near adjacent facilities.
D. No shutdown of any kind shall occur without the written consent of the OWNER.

1.07 PROJECT CONDITIONS

A. Cease operations immediately if the structure appears to be in danger and notify the ENGINEER. Do not resume operations until directed by the ENGINEER.
B. If the CONTRACTOR believes that the location on which the current structure or apparatus being demolished is contaminated, based on casual visual observation or detection of atypical odors, operations shall be ceased immediately at that location. The condition shall be brought to the attention of the ENGINEER. If it is determined that there is contamination at this site, do not continue Work until directed by the ENGINEER.

1. If so directed by the ENGINEER, the CONTRACTOR shall employ a testing lab to take samples for analyses and determination of the hazard. The testing laboratory shall include recommendations pertaining to the potential hazard of the sampled substances. All costs for this Work shall be in addition to the Contract Value.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 SITE PREPARATION

A. Provide, erect, and maintain temporary barriers and security devices in accordance with this Specification.
B. Erect and maintain weatherproof closures for exterior openings.
C. Erect and maintain, as directed by the ENGINEER or as necessary, temporary partitions to prevent spread of dust, odors, and noise to permit continued OWNER occupancy.
D. Protect existing materials which are not to be demolished.
E. Prevent movement of the structure; provide bracing and shoring. The CONTRACTOR shall take care to prevent any unexpected collapse of existing structures.
F. Notify affected utility companies before starting Work and comply with their requirements.
G. Mark the location and termination of all utilities.
H. Provide appropriate temporary signage including signage for exit or building egress.

3.02 DEMOLITION

A. Disconnect, remove, cap, and identify designated utilities in demolition areas.
B. Demolish in an orderly and careful manner. Protect existing remaining structures, piping, valves, etc. from the demolition Work.
C. No materials shall be burned on site.
D. The use of explosives for demolition shall not be allowed.
E. Conduct operations with minimum interference to site access.
F. Obtain written permission from adjacent property owners when demolition equipment will traverse, infringe upon, or limit access to their property.
G. Incorporate provisions for sedimentation control during and after demolition, if applicable.

H. Perform all demolition and removal Work to prevent damage or injury to adjacent structures, occupants thereof, and features which might result from falling debris or other causes and so as not to interfere with the use and free and safe passage to and from adjacent structures.

I. Closing or obstructing of public roadways, sidewalks, and passageways adjacent to the Work by the placement or storage of materials shall not be permitted and all operations shall be conducted with a minimum interference to vehicular and/or pedestrian traffic on these ways.

J. Erect and maintain barriers, lights, sidewalk sheds, and other necessary protective devices when applicable.

K. Repair damage to facilities to remain or to any property belonging to the OWNER or occupants of adjacent facilities.

3.03 POLLUTION CONTROLS

A. 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, or 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 Work.

3.04 STRUCTURAL REMOVAL

A. Remove structures to the lines and grades indicated on the Contract Drawings. The removal of structures beyond those indicated limits shall be at the expense of the CONTRACTOR. Excess removal shall be reconstructed to the satisfaction of the ENGINEER, with no additional compensation to the CONTRACTOR.

B. All concrete, brick, tile, concrete block, roofing materials, 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.

C. The surfaces of walls, floors, ceilings, or other areas that are exposed by any of the removals specified, indicated, or required and which will remain as architecturally finished surfaces shall be repaired and re-finished by the CONTRACTOR. Utilize the same or matching materials as the existing adjacent surface or as otherwise approved by the ENGINEER.

D. Unless otherwise approved by the ENGINEER, building demolition shall proceed from the top of the structure to the ground. The CONTRACTOR shall complete demolition Work above each floor or tier prior to disturbing the supporting members of the lower levels.

1. Demolish concrete and masonry is small sections.
2. Break-up and remove foundations, slabs-on-grade, housekeeping pads, pipe supports, thrust blocks, etc. unless otherwise indicated to remain.
3. Carefully position demolition equipment so as not to impose excessive loads or undo stress on remaining walls, floors, or framing.
4. Remove demolition refuse immediately so as not to impose excessive loads on floors, walls, or framing.

E. If partial demolition of underground structures is indicated on the Contract Drawings, once removal of the designated foundation, wall, slabs, or structure is complete, the CONTRACTOR shall abandon-in-place the remaining portion and

neatly backfill and grade the area. No structural steel and/or concrete structures shall remain exposed above grade.

3.05 MECHANICAL AND PIPING REMOVAL

A. Mechanical removal shall consist of dismantling and removing of existing piping, valves, pumps, motors, equipment, and other appurtenances, such as gauges, instrument tubing, etc., as specified, indicated on the Contract Drawings, or required for the completion of the Work. It shall include cutting, capping, and plugging as required.

B. Existing process, water, chemical, gas, fuel oil, and other piping shall be removed where required, indicated, and specified. Chemical and fuel lines and tanks shall be purged and made safe prior to removal or capping. Where piping that is to be removed passes through existing walls that shall remain, the pipe shall be cut off and properly capped on each side of the wall.

C. Waste and vent piping shall be removed to points shown. Pipe shall be plugged with cleanouts and plugs. Where vent stacks pass through an existing roof that is to remain, they shall be removed and the hole in the roof properly patched and made watertight; new roof material shall be identical (or as close as practical) to the existing roofing materials unless otherwise directed by the ENGINEER.

3.06 ELECTRICAL AND INSTRUMENTATION REMOVAL

A. Electrical removal shall consist of the demolition of existing panelboards, motor control centers, control panels, motors, conduits and wires, poles and overhead wiring, exposed ground conductors, lighting fixtures, miscellaneous electrical devices, and all instrumentation as indicated, specified, or required to perform the Work.

B. The CONTRACTOR shall verify the function of all wiring prior to disconnecting and removing it. Ducts that are not to be reused shall be plugged where they enter buildings and made watertight.

C. All existing electrical equipment to be demolished shall be removed with such care as may be required to prevent unnecessary damage to remaining equipment and/or structures and to maintain OWNER operations. Any damage incurred shall be repaired.

D. Motors shall be disconnected and removed where required, indicated, or specified. Motors not designated by the OWNER to be salvaged shall be removed from the site and disposed of by the CONTRACTOR.

E. Conduits and wires shall be abandoned in-place or removed where required, indicated, or specified. Abandoned conduits concealed in floor or ceiling slabs or in walls shall be cut flush with the slab or wall at the point of entrance. The conduits shall be suitably plugged and the area repaired in a flush, smooth, approved manner. Exposed conduits and their supports shall be disassembled and removed from the site. Repair all areas of Work to prevent rust spots on exposed surfaces.

3.07 REFUSE REMOVAL, HANDLING, AND OWNERSHIP

A. Any item that is to remain the property of the OWNER shall be carefully removed, so as not to be damaged, from the existing Work by the CONTRACTOR and shall be placed in an OWNER designated protected and secure location within the site.

1. If an item is to be retained by the OWNER and stored off-site, it shall be so noted on the Contract Drawings. The CONTRACTOR shall include the costs associated with loading, securing, transporting, and unloading.

B. Remove materials as the Work progresses. Upon completion of the Work, leave areas in a clean condition. All demolished materials shall be removed from the site without delay.

C. All materials, equipment, and debris shall be transported and disposed of in an appropriate manner at the expense of the CONTRACTOR and in compliance with all existing and governing laws and regulations.

3.08 ALTERATIONS AND CLOSINGS

A. Alterations shall conform to all applicable Specifications, the Contract Drawings, and the directions and approvals of the ENGINEER.

B. Where alterations require cutting or drilling into existing floors, walls, and roofs, 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. Openings in existing concrete slabs, ceilings, masonry walls, floors, and partitions shall be closed and sealed as indicated or otherwise directed by the ENGINEER. New Work shall be keyed into the existing Work in an acceptable manner. New reinforcing steel shall be welded to the existing reinforcing steel. Welding shall conform to AWS D12.1, Reinforcing Steel Welding Code. In general, use the same or matching materials as the existing adjacent surface. The finished closure shall be a smooth, tight, sealed, permanent closure acceptable to the ENGINEER.

3.09 CLEAN-UP

A. Remove all temporary structures, barriers, and security devices upon completion of the Work.

B. The CONTRACTOR shall remove from the site all debris resulting from the demolition operations as it accumulates. Upon completion of the Work, all materials, equipment, waste, and debris of every sort shall be removed and premises shall be left, clean, neat, and orderly.

END OF SECTION

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SECTION 02070
SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Work of this Section includes demolition work of existing construction and building elements indicated on Drawings or by provisions of this Section.

B. Related work of other Sections includes the following:

1. Safety barriers and temporary closures are specified in Division 1 Section "Temporary Facilities."

1.2 SALVAGE

A. Salvage, General: Items shown or scheduled for removal or demolition are the property of the Contractor. Remove and dispose of items legally, off-site, in accordance with requirements of the Standard General Conditions.

1. Ancillary Materials: Where mechanical or electrical devices are indicated to be demolished, legally dispose of ancillary materials, including, but not limited to:
   a. Refrigerant in chillers. Refer to refrigrant disposal requirements article in this Section.
   b. Lubricant oils.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 DEMOLITION, GENERAL

A. Carry out all demolition work in a neat and orderly manner. Keep noise, dust, and similar nuisances to a minimum. Do not collapse walls. Do not throw or drop materials.

1. Where material indicated to be removed is suspected of containing asbestos, inform Owner's Representative immediately. Do not disturb materials suspected of containing asbestos until asbetstos content has been verified by Owner.
2. Use extreme caution when cutting into shafts and chases. Shafts and chases may end above occupied areas within building. Take all necessary precautions to prevent debris from falling through openings between floors during demolition operations. Comply with requirements of Division 1 Section "Temporary Facilities".

B. Take all necessary precautions to avoid damage to surrounding materials to remain. Erect barriers as indicated in Division 1 Section "Temporary Facilities."

1. Confine dust and debris to immediate area of demolition activity to the greatest extent practicable.
2. Protect existing finish work to remain in place and that will be exposed to view.

3. Cover or otherwise protect existing equipment, that is to remain operational, from moisture, dust, dirt, and debris in accordance with requirements of Division 1 Section "Temporary Facilities."
4. Protect existing utilities and services indicated to remain in service and protect them against damage during demolition operations.
5. Patch, repair or replace materials and items accidentally damaged during demolition operations.

C. Deliver materials to the work area and rubble and debris to ground level in a manner approved by the Owner's Representative in advance.

3.2 DEMOLITION OF ARCHITECTURAL FINISHES

A. Remove all loose material from partially demolished work leaving only sound and secure construction.

1. Flooring: Where shown, scheduled or otherwise required for application or installation of new floor finishes or coverings, remove existing flooring tile, resilient sheet flooring as follows:
   a. Remove all traces of existing flooring materials. Remove resilient sheet and tile flooring products in compliance with recommended methods of Resilient Floor Covering Institute "Recommended Work Practices for Removal of Resilient Floor Coverings."
   b. Remove adhesives, except those containing asbestos. Use chemical strippers approved by manufacturer of new flooring materials, or grind concrete floor surfaces to completely remove adhesive. Obtain Owner's Representative's approval of removal method prior to beginning removal work.
   c. Clean floor slabs of dust and adhesive residue.

END OF SECTION

SECTION 02100

CLEARING

PART 1 - GENERAL

1.01 DESCRIPTION

A. The CONTRACTOR shall furnish all supervision, coordination, labor, materials, equipment and incidentals required to perform all clearing and grubbing as shown, specified, and otherwise required to complete the Work.

B. The CONTRACTOR shall perform all clearing and grubbing as necessary along the line of the Work to be completed.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02221, Excavation, Backfill, and Trenching for Utility Systems
B. Section 02480, Landscaping and Restoration

1.03 QUALITY ASSURANCE

A. Codes and Standards: State and local laws and code requirements shall govern the hauling and disposal of trees, shrubs, stumps, roots, rubbish, debris and other matter.

1.04 JOB CONDITIONS

A. Protection:

1. Streets, roads, adjacent property and other works and structures shall be protected throughout the entire project. The CONTRACTOR shall return to original condition, satisfactory to the ENGINEER, damaged facilities caused by the operations of the CONTRACTOR.
2. Trees, shrubs and grassed areas which are to remain shall be protected by fences, barricades, wrapping or other methods as shown, specified or approved by the ENGINEER. Equipment, stockpiles, etc. shall not be permitted within tree branch spread. Trees shall not be removed without approval of the ENGINEER unless otherwise shown or specified.
3. The CONTRACTOR shall minimize the clearing done and make every effort to save trees during the execution of the Work.

1.05 GUARANTEE

A. The CONTRACTOR shall guarantee that Work performed under this Section will not permanently damage trees, shrubs, turf or plants designated to remain, or other adjacent work or facilities. If damage resulting from the operations of the CONTRACTOR appears during the period up to 12 months after completion of the project, the CONTRACTOR shall replace damaged items at no expense to OWNER.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 CLEARING AND GRUBBING

A. Prior to execution of the Work under this Section, the CONTRACTOR and the ENGINEER will examine the site and agree upon the extent of clearing and grubbing required.

1. In areas requiring extensive clearing and grubbing, agreement shall be on limits of the Work. These limits shall not exceed the limits of the temporary and/or permanent easements indicated on the Drawings and shall be the minimum required for construction. Damage outside these limits caused by the operations of the CONTRACTOR shall be corrected at the expense of the CONTRACTOR.

B. Except as noted below, the CONTRACTOR shall remove from the site and satisfactorily dispose of all trees, shrubs, stumps, roots, brush, vines, undergrowth, masonry, rubbish, scrap, debris, pavement, curbs, fences, and miscellaneous other structures not covered under other Sections as shown, specified, or otherwise required to permit construction of the new Work.

1. The CONTRACTOR shall grub the cleared areas, removing all stumps and roots over four (4) inches in diameter.

C. Trees, stumps, and other cleared and grubbed material shall be disposed of off site in an approved legal manner. No cleared or grubbed material may be used in backfills or structural embankments.

D. Burning or burying of material shall be strictly prohibited, unless otherwise directed by the OWNER and ENGINEER.

E. Trees and shrubs shall be trimmed to avoid removal or damage to them. Trimmed or damaged trees shall be treated and repaired by persons with experience in these specialties that are approved by ENGINEER. Trees and shrubs intended to remain which are damaged beyond repair or removed, shall be replaced by the CONTRACTOR at his expense.

F. Control air pollution caused by dust and dirt, and comply with all governing regulations.

END OF SECTION

SECTION 02221

EXCAVATION, BACKFILL, AND TRENCHING FOR UTILITY SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Specified

1. The CONTRACTOR shall furnish all supervision, labor, coordination, materials, equipment, and incidentals necessary for excavation, backfill, compaction, and trenching as shown and specified for utility systems. Disposal of excess and unsuitable excavated material is included.
2. Utility systems shall include underground piping and appurtenances for water distribution systems, stormwater drains, and sanitary sewage collection systems.
3. Earth excavations, as defined herein, shall be included in the appropriate Bid Items as described in Section 01025, Measurement and Payment.
4. Rock excavation, if required, will be paid for by the cubic yard with pay limits as indicated on the Contract Drawings and measured in the field.

B. Related Work Specified Elsewhere

1. Section 02100, Clearing
2. Section 02480, Landscaping Restoration
3. Section 01560, Environmental Management and Construction Plan
4. Section 15062, Ductile Iron Pipe, Fittings, and Accessories
5. Section 01563, PVC Pressure Pipe, Fittings, and Accessories
6. Section 15110, Valves Hydrants and Appurtenances

C. Classification of Excavation

1. Earth excavation shall include all clay, loam, sand, gravel, topsoil, paving materials, and all other materials not specifically classified as rock excavation. Earth excavation shall specifically include all shale rock that is ripable or dig-able with a conventional 1.5 cubic yard hydraulic excavator typically used on utility Work as described herein.
2. Shale rock that is not reasonably ripable or digable, in the sole judgment of the ENGINEER, shall be classified as rock excavation.

1.02 QUALITY ASSURANCE

A. Comply with the following reference standards:

1. ASTM A36, Structural Steel
2. ASTM A328, Steel Sheet Piling
3. ASTM D422, Particle-Size Analysis of Soils
4. ASTM D698, Moisture-Density Relations of Soils, using 5.5 lb. Rammer and 12-inch Drop
5. ASTM D1556, Density of Soil in Place by the Sand-Cone Method
6. ASTM D1557, Moisture-Density Relations of Soils, using 10 lb. Rammer and 18-inch Drop
7. ASTM D2321, Recommended Practices for Underground Installation of Pipe for Sewers and Other Gravity Flow Applications
8. ASTM D2922, Density of Soil and Soil-Aggregate in Place by Nuclear Method (Shallow Depth)

9. AISC Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings
10. Occupational Safety and Health Administration (OSHA) Regulations
11. Industrial Code Rule 23

1.03 SUBMITTALS

A. Before any excavation begins, the CONTRACTOR shall obtain all permits and licenses required by governing authorities having jurisdiction and submit certified copies to ENGINEER prior to Work being performed.

B. The CONTRACTOR shall submit proposed materials, methods, and operations of backfilling and compaction to the ENGINEER for review prior to the start of Work. A list of equipment to be used shall also be included.

PART 2 - PRODUCTS

2.01 MATERIALS

A. SELECT BACKFILL

1. Where called for on the Contract Drawings, and as approved by the ENGINEER, select backfill shall meet the following requirements:

a. Subbase Course Material (NYSDOT Item No. 304.14) meeting the requirements of NYSDOT Standard Specification 304-2.02, Type 4, with a size gradation as follows:

Sieve Size	Percent Passing By Weight
50mm (2″)	100
6.3mm (1/4″)	30 to 65
425µm (No. 40)	5 to 40
75µm (No. 200)	0 to 10

b. Select Granular Material (NYSDOT Item No. 203.07) meeting the requirements of NYSDOT Standard Specification 203-2.02, with a size gradation as follows:

Sieve Size	Percent Passing By Weight
100mm (4″)	100
425µm (No. 40)	0 to 70
75µm (No. 200)	0 to 15

2. The material shall consist of tough, durable particles and shall be free of soft shale, organic materials, or any otherwise deleterious materials.
3. Select fill shall be used for the full depth of the trench as indicated on the Contract Drawings, whenever the trench is in an existing or proposed roadway, driveway, sidewalk, or in other areas as called out on the Contract Drawings, or as ordered by the ENGINEER.
4. The select fill shall be placed for the full width of the pavements and shoulders as indicated on the Contract Drawings plus an additional five feet (5') on either side of the pavement or shoulder.
5. For driveways and sidewalk areas, the select fill shall be placed for the full width of the driveway plus an additional three feet (3′) on either side.

B. EXCAVATED MATERIALS

1. Excavated materials may be used for backfill provided:

a. Material is sandy, loamy, or similar to bank run gravel.
b. Material is free of debris, hazardous materials, frozen materials, organic, or other deleterious materials.
c. Material greater than six (6) inches in any direction is unacceptable.
d. Maximum dry density and optimum moisture content are determined in accordance with the above.
e. Material is reviewed and deemed acceptable by the ENGINEER.

C. BEDDING MATERIALS

1. Where called for on the Contract Drawings, and as approved by the ENGINEER, bedding material shall meet the following requirements:

a. Underdrain Filter Type II (NYSDOT Item No. 605.0901) meeting the requirements of NYSDOT Standard Specification 605-2.02 and 703-02, with a size gradation as follows:

Sieve Size	Percent Passing By Weight
12.5mm (1/2″)	100
6.3mm (1/4″)	20 to 100
2mm (No. 10)	0 to 15
850µm (No. 20)	0 to 5

b. No. 1 Crushed stone, Crushed Gravel, or Screened Gravel, conforming with NYSDOT standard specification 605-2.02 and 703-02. The bedding material shall be well graded with no particles larger than 1 inch and having a size gradation as follows:

Sieve Size	Percent Passing By Weight
1 inch	100
½ inch	90 to 100
¼ inch	0 to 15
No. 200	0 to 1.0

c. No. 1A Crushed stone, Crushed Gravel, or Screened Grave, conforming with NYSDOT standard specification 605-2.02 and 703-02. The bedding material shall be well graded with no particles larger than ½ inch and having a size gradation as follows:

Sieve Size	Percent Passing By Weight
½ inch	100
¼ inch	90-100
1/8 inch	0-15
No. 200	0-1.0

D. CONTROLLED LOW STRENGTH MATERIAL (CLSM)

1. Where called for on the Contract Drawings, and as approved by the ENGINEER, CLSM shall meet the requirements of the NYSDOT Standard Specification 204-2.01.
2. CLSM shall generally be composed of cement and water, and upon approval by the ENGINEER, may also contain fly ash, aggregate, and chemical admixtures.
3. The materials shall meet the requirements of the following subsections of the NYSDOT Standard Specifications:

Portland Cement, Type 1 or Type 2	701-01
Water	712-01
Fly Ash*	711-10
Chemical Admixtures	711-08

Aggregates: 100% passing 2mm (No.10) sieve and a miximum of 20% passing the 75µm (No.200) sieve.

*The loss on ignition shall be waived.

4. The CLSM shall have a 28-day compressive strength of between 40 psi and 150 psi.
5. Prior to mixing any slurry backfill material the CONTRACTOR shall submit to the ENGINEER results of laboratory tests, or results of tests made previously on CLSM used for other Work. Test results shall show source and type or class of materials, batch proportions, and conformance to the strength requirements.
6. The materials shall be mixed at a stationary mixing plant. The mixer shall be either a continuous or a batch type plant, designed to accurately proportion either by volume of by weight, so that when the fly ash material and cement are incorporated in the mix, a thorough and uniform mix will result. The mixer shall be capable of providing accurate control at all times of the amount of fly ash, cement and water entering the mixer per time interval. The mixer shall be equipped to mechanically interlock the fly ash feed with the cement feed, such that the uniformity of the mixture is assured at all times.
7. Cylinders shall be cast during the placement of the material, and tested to verify that the compressive strength is within the specified limits. The frequency of test specimens will be determined by the ENGINEER. The CLSM material shall be accepted on the basis of inspection and approval by the ENGINEER.

E. TOPSOIL

1. Topsoil shall be furnished and installed in accordance with Section 02480, Landscaping and Restoration, of these specifications.

F. EXPLOSIVES

1. Explosives are not allowed to be used nor allowed on site without the written consent of the both the OWNER and ENGINEER.

G. SHEETING, SHORING, AND BRACING

1. The CONTRACTOR shall be responsible for the proper design, placement, and maintenance of shoring and bracing in all trenching and excavation Work. The CONTRACTOR shall conduct all Work in conformance with the requirements of OSHA and the New York State Department of Labor.
2. Shoring may be steel or wood as required. For pipeline trench work a trench box or cage may be used.

3. Provide sheeting, bracing, or shoring where required to properly support the surface of excavations to protect the construction work, to protect adjacent work, to protect adjacent existing structures or utilities, and/or to protect workmen.
4. If the ENGINEER is of the opinion at any point that sufficient or proper supports have not been provided, he may order additional supports at the expense of the CONTRACTOR. Neither the placing of such additional supports by the order of the ENGINEER, or the failure of the ENGINEER to order such additional supports, shall release the CONTRACTOR from his ultimate responsibility for the sufficiency of such supports and the integrity of the Work.
5. The CONTRACTOR shall not leave shoring and bracing in place after completion of the Work, except as ordered by the ENGINEER. Take special care to prevent caving of the sides of the excavation and injury to the completed Work or adjacent property when removing sheeting and bracing. If the ENGINEER orders the sheeting and bracing left in place, it shall be cut off not less than two feet (2') below the established finished grade.
6. Used material shall be in good condition, not damaged or excessively pitted. Unless otherwise specified, all sheeting to remain in place shall be new. New or used sheeting may be used for temporary work.
7. All timber used for breast boards (lagging) shall be new or used, meeting the requirements for Douglas Fir Dense Construction grade or Southern Pine No. 2 Dense S3. Where close or tight sheeting is required, wood sheeting shall be tongued and grooved.
8. All steel work for sheeting, shoring, bracing, cofferdams, etc. shall be designed in accordance with the provisions of the "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings", of the AISC except that field welding will be permitted.
9. Steel sheet piling shall be manufactured from steel conforming to ASTM A328. Steel soldier piles, wales and braces shall be new or used and shall conform to ASTM A36.
10. Steel sheeting shall have a minimum thickness of ⅜-inch in web, unless otherwise specified.
11. No additional payment shall be made for sheeting and/or shoring. All costs for this Work shall be included in the price bid for pipe work.

H. GEOTEXTILES

1. Geotextiles used for soil stabilization and reinforcement applications shall be TenCate Mirafi HP-Series Woven Polypropylene Geotextiles, specifically HP570, or approved equal.
2. Geotextiles used in drainage system applications shall be TenCate Mirafi N-Series Nonwoven Polypropylene Geotextiles, specifically 140NC, or approved equal.
3. Geotextiles used in bank and channel stabilization/protection applications shall be TenCate Mirafi PW-Series Woven Monofilament Polypropylene Geotextiles, specifically FW700, or approved equal.

PART 3 - EXECUTION

3.01 GENERAL

A. All Work shall be coordinated and performed in accordance with Industrial Code Rule 53. The CONTRACTOR shall notify utility companies with underground facilities of location of pipe laying activity, and shall obtain clearance from utility companies concerning location of underground utilities, prior to the pipelines being staked in the field.
B. 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. The CONTRACTOR shall notify the ENGINEER of conditions detrimental to

the proper and timely completion of Work. The CONTRACTOR shall not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to the ENGINEER.

C. The CONTRACTOR shall be required to adhere to, and maintain throughout the course of the Work, all erosion and sediment control measures. The project site is estimated to be less than 1 acre and will not require the preparation of a Storm Water Pollution Prevention Plan (SWPP). The Contractor shall be solely responsible for implementing and maintaining any and all Best Management Practices (BMP) used to prevent erosion and sedimentation from leaving the site or entering the stream

3.02 EXISTING UTILITIES

A. The CONTRACTOR shall satisfy himself as to the locations of all existing structures and underground utilities as well as the value and location of the Work, the general conditions, particularly those bearing upon transportation, disposal, handling and storage of materials, availability of labor, water, electric power, and roads, physical conditions at the site, the confirmation and condition of the ground, the character, quality and quantity of surface and subsurface materials to be encountered, and all other matters which can in any way affect the Work or the cost thereof, under this Contract.

B. Any failure of the CONTRACTOR to acquaint himself with all available information concerning these conditions will not relieve him from responsibility of estimating properly the difficulty or cost of doing Work.

C. The CONTRACTOR shall be solely responsible for the location of all underground facilities located within the path of the piping. The plans indicate approximate locations of known facilities, but in no way shall the locations depicted on the plans be considered accurate. They have been shown solely for the purpose of making the CONTRACTOR (and Bidder) aware of their existence. The CONTRACTOR shall also recognize that additional underground facilities may exist which have not been indicated on the drawings. It shall be the CONTRACTOR'S sole responsibility to take all actions necessary to determine the location of all underground facilities, to include visual confirmation if required. The CONTRACTOR shall be solely responsible to repair any facilities damaged as a result of their operations, or that of any of its representatives (i.e. subcontractors). Neither the OWNER or ENGINEER, or any of their representatives, will be responsible for this work, for compensation for any work performed to obtain accurate locations, or for any costs associated with the repair of any damaged facilities.

3.03 REMOVAL OF TOPSOIL

A. Remove all existing topsoil from areas to be disturbed or where excavation or fill is required. Depth of topsoil varies; the CONTRACTOR shall strip to depth encountered exercising reasonable care not to mix with subsoil. Stripped topsoil shall be stockpiled at an approved location. Stockpiles shall be placed, graded, and shaped for proper drainage. Stockpiles shall be seeded immediately after placement with an approved grass seed mixture to minimize erosion.

3.04 TEST PITS

A. Where indicated on the Contract Drawings or ordered by the ENGINEER, the CONTRACTOR shall excavate and backfill test pits in advance of construction to determine conditions or location of existing facilities. The CONTRACTOR shall perform all Work required in connection with excavating, stockpiling, maintaining, sheeting, shoring, backfilling, and restoring the surface for the test pits.

B. Test pits which the CONTRACTOR excavates, whether indicated on the Drawings, or specified, or ordered by the ENGINEER shall be at the expense of the CONTRACTOR. No extra payment shall be made for test pits.

C. No test pits will be dug prior to utility company stakeout.

D. The CONTRACTOR shall be responsible to repair all areas where test pits we dug, to at a minimum, the pre-construction state, or as directed by the ENGINEER. The cost of this work shall be included in the various items bid for this project.

3.05 EXISTING SUBSURFACE CONDITIONS

A. It is anticipated that construction of the improvements depicted on the Contract Drawings and specified herein will involve primarily earth excavation. Some areas of the proposed construction areas have had utility construction in the past, and no unusual conditions are known. However, the CONTRACTOR shall be responsible to make all investigations required to become aware, and verify, all subsurface conditions, prior to submission of a Bid. No additional compensation will be provided to the CONTRACTOR in the event that existing subsurface conditions are identified in the field at the time of construction, which were not specifically mentioned in these Contract Documents.

B. The CONTRACTOR shall notify the OWNER and ENGINEER immediately should varying subsurface conditions exist.

C. Should the CONTRACTOR wish to make its own subsurface investigations, the work shall be coordinated with the OWNER and ENGINEER prior to the start of any such investigation, and a copy of all results should be provided to the OWNER and the ENGINEER. The CONTRACTOR shall be solely responsible for all costs associated with this work.

3.06 UNAUTHORIZED EXCAVATION

A. All excavation outside the lines and grades shown and not specified, together with the removal and disposal of the associated material shall be at the expense of the CONTRACTOR. The unauthorized excavation shall be filled as directed by the ENGINEER, at the expense of the CONTRACTOR. Claims and damages resulting from the CONTRACTOR'S unauthorized excavation will be the sole responsibility of the CONTRACTOR.

3.07 TRENCH EXCAVATION

A. The CONTRACTOR shall perform all excavation required to complete the Work shown and specified. Excavations shall include earth, sand, clay, gravel, hardpan, boulders and ledge rock, slate/shale, decomposed rock, pavements, rubbish and all other materials within the excavation limits, except rock.

B. Excavation shall include clearing the Work site, care and protection of existing structures and their removal and replacement, if necessary, complete handling of materials, wet or dry, including disposal, loading and transportation, protection of excavation and structures above and below ground requiring shoring, sheeting and bracing, all drainage, pumping and handling of water, blasting where permitted, and all incidental work.

C. Excavations for pipelines, utilities, and structures shall be open excavations, shored and braced where necessary, according to OSHA standards, to prevent possible injury to workmen and to new and existing structures or pipelines.

D. The trench shall be drained so as to provide a safe and efficient place to Work. Such provision shall be the obligation of the CONTRACTOR. Trench water or other water accumulated in excavations shall be drained by pumps or otherwise to natural drainage channels, storm sewers, or drains. The CONTRACTOR shall not be paid the cost of pumping as an extra item. Such construction methods shall be in accordance with the provisions of the State Industrial Code as a minimum and shall adhere to all NYSDEC Standards for Stormwater Discharges.

E. Banks of the trenches shall be vertical to a point one foot (1') above the top of the pipe being installed. Thereafter, trench walls may be sloped at the option of the CONTRACTOR; however, no additional payments shall be made beyond the pay lines as shown on the plans, or specified herein.

F. The trench width will depend upon the depth, nature of material excavated, and method by which excavation is accomplished. In any case, sufficient clearance around the pipe shall be provided to properly lay the pipe, make the joint, and install and compact the backfill. The width of trench shall be as shown on the Contract Drawings, but at least 6", but no more than 14" clearance, shall be provided on each side of all pipe unless specified otherwise. Clearance between the trench shield, if used, and pipe barrel shall be a minimum of 6". No payment for extra work shall be allowed for trenches that are wider than the minimum.

G. Excavation for manholes and other accessories shall have 12" minimum and 24" maximum clearance on all sides.

H. All rock, boulders, and large stones shall be removed from the trench so as to provide the required clearance beyond the pipe bells.

I. Unless otherwise provided, trench shall have a flat bottom of sound earth, which shall give the pipe good bearing for its full length. Excavation shall not be carried below the required level. Where a mistake in grade may have been made, if low, the trench shall be built back to grade with stone bedding properly compacted as directed by the ENGINEER.

J. When the material encountered at grade in the trench is unsatisfactory to support the pipe or may be otherwise harmful in the opinion of the ENGINEER, the CONTRACTOR shall adopt such means as may be necessary to provide satisfactory foundations. In general, unstable soil shall be removed and replaced with gravel, or crushed stone (select backfill) that shall be thoroughly tamped. The ENGINEER shall determine the depth of removal of unsatisfactory soil. In the case of water or quicksand, no extra allowance shall be made for pumping subdrains, sumps or other drainage structures.

K. The trench shall be excavated to the necessary line and grade to accommodate the pipe in its designed position. Excavations for pipelines shall be made sufficiently wide to permit proper laying and jointing of the pipe. The trench pay limits should not be greater than the inside diameter of the pipe barrel plus 28-inches, but shall be of sufficient size to allow thorough compacting of earth refill adjacent to the bottom half of the pipe. The depth of trench shall be sufficient to allow a minimum of four and one-half (4-½) feet cover over the top of the pipe unless otherwise directed by the ENGINEER. The use of excavating equipment which requires the trench to be excavated to an excessive width will not be allowed.

L. Acceptable excavated materials shall be stockpiled in specified areas until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.

1. Locate and retain soil materials away from edge of excavations.
2. Unsuitable backfill material shall be kept separate from all other material and shall be disposed of as specified hereinafter. Disposal of unsuitable and excess excavated material shall be accomplished immediately upon removal from the excavation.
3. Stockpiles shall not be located such that they interfere with traffic or access to public or private property. All excavated material shall be piled or stored in such a manner as to not obstruct sidewalks and driveways. Gutters shall be kept open to permit proper street drainage. If necessary, the CONTRACTOR shall maintain additional stockpile areas located elsewhere on the site, and shall transport the suitable backfill material to and from such stockpile areas as required for the Work.
4. In built-up districts and in streets where traffic conditions render it necessary, the material excavated from the initial opening shall be removed by the CONTRACTOR as soon as excavated, and the material subsequently excavated, if suitable for the purpose, shall be used to backfill the trenches in which pipe has been laid or structures have been built, and neither the excavated material nor materials of construction shall be stored on the streets or sidewalks.

M. Unless otherwise directed or permitted, not more than 50 feet of trench in advance of the end of the completed pipe or structure therein shall be opened at any time. Every trench in rock shall be fully opened at least 30 feet in advance of any place where masonry or pipe

is being laid. Any time when the CONTRACTOR'S crews are not on the job working, a trench length equal to or less than one-half of the last length of pipe installed may be left open, but properly covered or barricaded to protect the public.

3.08 ROCK EXCAVATION

A. Should rock be encountered that cannot be removed by ripping or digging, the CONTRACTOR shall be responsible to propose an alternate means for removal for the approval of the ENGINEER. The actual method of removal will vary depending on the proximity of adjacent structures and utilities. As specified elsewhere, it is the responsibility of the CONTRACTOR to protect all adjacent structures and utilities, and to protect all workers and other persons during the prosecution of the Work. The CONTRACTOR shall comply with all applicable rules, laws, ordinances, and regulations pertaining to the rock excavation Work.

B. The CONTRACTOR shall perform all Work in a workmanlike manner with all due regard to the safety and health of employees and of the public, and shall comply with all applicable OSHA requirements regarding the safety and protection of persons employed in the Work.

C. Should the CONTRACTOR propose drilling and blasting the following shall be required:

1. A project meeting relative to the method, manner, and procedure of blasting shall be held at the site with the OWNER, the ENGINEER, the CONTRACTOR, the project blaster, and representatives of all interested agencies prior to commencing Work.
2. Explosives shall be of such character and strength and in such amounts as is permitted by State and local laws and ordinances and all respective agencies having jurisdiction over them.
3. Blasting shall be done only at such time as is approved by the OWNER, the ENGINEER, and those agencies having jurisdiction.
4. The CONTRACTOR shall employ qualified and experienced supervisors and workmen in the handling, loading, and firing of explosives.

3.09 DRAINAGE AND DEWATERING

A. General

1. Prevent surface and subsurface water from flowing into excavations and from flooding adjacent areas.
2. Remove water from excavation as fast as it collects.
3. Maintain the ground water level at least two (2) feet below the bottom of the excavation to provide a stable surface for construction operations and to prevent damage to the Work during all stages of construction.
4. Provide and maintain pumps, sumps, suction and discharge lines and other dewatering system components necessary to convey water away from excavations.
5. Provide sediment traps and all other necessary and required erosion and sediment control measures, as specified by the SWPPP, and as directed by the ENGINEER, when water is conveyed into water courses.
6. Notify the ENGINEER before shutting down dewatering systems for any reason.
7. Standing water shall not be permitted in the excavation at any time. If the material at the design grade becomes unsuitable or contaminated due to the actions of the CONTRACTOR, the CONTRACTOR shall excavate additional material to the depth necessary and shall backfill to the proposed grade with select backfill or crushed stone at no expense to the OWNER.
8. One hundred percent (100%) stand-by pumps (gasoline powered) shall be maintained at the site at all times.

9. Any hardships created by the temporary dewatering for this Contract which adversely affects the water supply to local property owners, shall be satisfactorily resolved by the CONTRACTOR, including the provision of temporary water service, if required, at no additional cost to the OWNER.

B. Disposal of Water Removed by Dewatering Systems

1. 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.
2. Dispose of water in such a manner as to cause no inconvenience to the OWNER or others on or adjacent to the site.
3. Convey water from the excavation in a closed conduit. Do not use trench excavations as temporary drainage ditches.
4. Disposal of water shall be by specified methods and shall not cause erosion or sedimentation to occur in existing drainage systems. All sedimentation or blocking of existing systems shall be thoroughly cleaned and returned to original condition by the CONTRACTOR at his expense.
5. Damage caused by the operations of the CONTRACTOR to public or private property shall be repaired by him to the satisfaction of the ENGINEER and the damaged property owner at the expense of the CONTRACTOR.
6. The CONTRACTOR shall perform all work, furnish all materials and install all measures required to reasonably control soil erosion resulting from construction operations and prevent excessive flow of sediment from the construction site. Such work may include the installation of water diversion structures, diversion ditches and sediment basins and seeding, mulching or sodding critical areas to provide temporary protection.
7. All erosion and sediment control practices shall be in place prior to any grading operations and installation of proposed structures or utilities.
8. All erosion and sediment control practices shall be left in place until construction is completed and/or area is stabilized.
9. Where necessary, disturbed areas shall be temporarily seeded and/or mulched until proper weather conditions exist for establishment of a permanent vegetative cover.

3.10 SHEETING, SHORING, AND BRACING

A. General

1. Unless otherwise shown or specified, excavations shall be open, shored and braced or sheeted where necessary to prevent injury to workmen, structures, pipelines, and utilities.
2. All municipal, county, state and federal ordinances, codes, regulations, laws and OSHA regulations shall be observed.
3. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down the shoring and bracing as excavation progresses.
4. Safe and satisfactory sheeting, shoring, and bracing shall be the entire responsibility of the CONTRACTOR.
5. The CONTRACTOR shall be held accountable and responsible for the sufficiency of all shoring and bracing used and for all damage to persons or property resulting from the improper quality, strength, placing, maintaining, or removing of the same.
6. The permission of the ENGINEER to precede with Work in either a sheeted, shored, braced, or open trench condition shall in no way relieve the CONTRACTOR from the above responsibilities.

7. The clearances and types of temporary structures, insofar as they affect the character of the finished work, and the design of steel sheeting to be left in place, will be subject to the review of the ENGINEER, but the CONTRACTOR shall be solely responsible for the adequacy of all sheeting, shoring, bracing, cofferdamming, etc.
8. Unless otherwise shown, specified, or ordered, all materials used for temporary construction shall be removed when work is completed. Such removal shall be made in a manner not injurious to the pipelines or structures.

B. Sheeting Left in Place

1. Steel sheet piling shall be left in place or where conditions are such that the removal of sheeting will endanger the work or adjacent pipes or structures or when ordered in writing to be left in place by the ENGINEER. It shall consist of rolled sections of the continuous interlocking type unless otherwise specified. The type and design of the sheeting and bracing shall conform to the above specifications for all steel work for sheeting and bracing.
2. Steel sheet piling to be left in place shall be driven straight to the lines and grades as shown or directed. The 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 by new piling.
3. The type of guide structure used and method of driving for steel sheet piling to be left in place shall be submitted to the ENGINEER for review. Jetting will not be permitted.
4. The CONTRACTOR shall cut off piling left in place at least two feet (2') below road surface or to the grades shown or ordered by the ENGINEER and shall dispose of the cutoffs.
5. Portions of sheeting or soldier piles and breast boards which are in contact with concrete shall be left in place.

C. Removal of Sheeting and Bracing

1. Sheeting and bracing shall be removed from excavation unless otherwise indicated by the ENGINEER. Removal shall be done so as to not cause injury to the Work.
   a. Wood or steel sheeting shall not be removed when adjacent to structures, pavement, pipes, or any other public or private property where removal may cause damage to such property.
   b. Fill all voids left by removal of sheeting with select fill.

D. In areas where the Drawings call for sheeting to remain in place, alternate sheeting methods will not be allowed. Only pre-driven, steel sheet piling systems designed for the CONTRACTOR by a Professional ENGINEER will be allowed in these areas.

3.11 BACKFILL AND COMPACTION

A. In general, all backfilling and compaction shall be performed in accordance with the NYSDOT Standard Specification 203.15 "Fill and Backfill at Structures, Culverts, Pipes, Conduits and Direct Burial", NYSDOT Standard Specification 203.12 "Compaction", the Contract Documents, and as directed by the ENGINEER.

B. Backfilling shall not be done in freezing weather except with written permission of the ENGINEER. No backfill shall be made with frozen materials, nor shall backfilling be done when the material in the trench is already frozen.

C. Where the type of backfill material is not indicated on the Drawings or Specified, the CONTRACTOR may backfill with the excavated material, provided that such material consists of clay, sand, gravel, or other materials, which, in the opinion of the ENGINEER are suitable for backfilling.

D. No stones or cobbles larger than six inches (6") in any dimension shall be placed in the pipe zone to a point twelve inches (12") above the pipe in utility construction.

E. Any deficiency in the quantity of material for backfilling the trenches or for filling depressions caused by settlement shall be supplied by the CONTRACTOR.

F. Backfill shall be mounded to allow for settlement.

G. Backfill around any buried or partially buried structures shall be placed symmetrically on all sides to avoid damaging or dislodging the structure.

H. Select backfill shall be used for the full depth of the trench whenever the trench is in an existing or proposed roadway, driveway, sidewalk, or where indicated on the Contract Drawings, or as ordered by the ENGINEER. The select backfill shall be placed for the full width of the pavement (roadway) as shown on the plans plus an additional five (5) feet on either side of the pavement, or shoulder. For driveways and sidewalks, the select backfill shall be placed for the full width of the driveway or sidewalk, plus an additional three (3) feet on each side. Excess excavated material shall be properly disposed of at the expense of the CONTRACTOR and in an approved manner.

I. Rock and/or earth material may be encountered during the Work that is unsuitable for backfilling. When this material is encountered, it shall be disposed of in the specified manner, possibly resulting in a shortage of suitable backfill material. In this event, the CONTRACTOR shall be responsible for furnishing, delivering and installing clean earth or select backfill materials to properly and completely backfill the excavation. Backfill material for these situations may be obtained from other areas of the project where suitable material is available or from offsite locations as approved by the ENGINEER. All backfill material is subject to the ENGINEER'S review and must meet the minimum requirements of the specifications above.

J. In excavations and areas requiring select backfill, a minimum of 95 percent of Standard Proctor Maximum Density shall be attained. Select backfill material shall be placed in horizontal layers not exceeding 6" prior to compaction, with each layer being compacted by mechanical means approved by the ENGINEER.

K. In excavations and areas requiring general backfill (approved excavated material), a minimum of 90 percent of Standard Proctor Maximum Density shall be attained. General backfill material shall be placed in horizontal layers not exceeding 8"-12" layers, with each layer being compacted by mechanical means approved by the ENGINEER.

L. Equipment, suitable and adequate for uniform compaction to the specified densities, must be on hand and approved by the ENGINEER before any backfill operations are started by the CONTRACTOR. All compaction equipment must be in good working order and any worn or defective equipment not specifically manufactured for compacting purposes will not be considered as compaction equipment.

M. During placement, no segregation of large or fine particles shall be allowed, but the select backfill material as spread shall be well graded with no pockets of fine material. Each layer shall be tamped sufficiently with approved mechanical vibratory tampers to secure the required compaction. Any consolidation or settlement of the trench after placement of the select backfill shall be repaired promptly by the CONTRACTOR.

N. Compaction testing using an approved method such as Nuclear Density Testing per ASTM D2922 will be required at the discretion of the ENGINEER and at the expense of the CONTRACTOR.

1. Generally, compaction testing will be required early in the job to determine the level of compaction effort necessary to achieve desired densities.
2. Thereafter, should results remain satisfactory and effort dedicated to compaction remain consistent, further testing will not be required.
3. Should the ENGINEER determine that results are deteriorating, or that the nature of the select backfill material is different, or that the method of compaction is different, further testing at the expense of the CONTRACTOR will be required.
4. The firm or agency chosen to perform the density testing shall be duly qualified, and shall be approved by the ENGINEER. All costs for gradation analysis and testing shall be borne by the CONTRACTOR.

5. Gradation and density preliminary laboratory analysis shall be provided as a shop drawing submission.

O. Backfill excavations as promptly as work permits, but not until completion of the following:

1. Inspection by the ENGINEER of all Work within the excavation.
2. Tie-Down (locating) of all fittings, valves, service taps, and miscellaneous appurtenances for establishment of record drawings.
3. Installation of tracer (locating) wire when required.
4. Inspection, testing approval, and recording of locations of underground utilities, connections, branches, structures, and other facilities.
5. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in a manner to prevent settlement of the structure or utilities, or leave in place if required.
6. Removal and proper disposal of trash and debris.

P. The CONTRACTOR shall not access any part of an existing water supply system (fire hydrants, etc.) as a source of water for any reason during construction activities, including the use of water for backfilling to obtain the proper moisture content.

Q. If the specified densities are not obtained because of the CONTRACTOR'S improper control of placement or compaction procedures, or because of inadequate or improperly functioning equipment, the CONTRACTOR shall perform whatever Work is necessary and required to provide the specified densities. This Work shall include complete removal of unacceptable fill areas, replacement, and recompaction until the specified backfill and compaction requirements, as set forth by the Contract Documents, or as ordered by the ENGINEER, are achieved.

R. Where pipe is laid in rock excavation, bedding material, as approved by the ENGINEER, generally being crushed stone or select backfill material, shall be carefully placed and tamped over the rock before the pipe is laid. After laying pipe, the balance of the backfill shall be placed as described herein.

S. The attention of the CONTRACTOR is directed to the provision which requires a one-year performance and maintenance bond. Satisfactory performance of the trench backfill shall be evidenced by no backfill settlement and no settlement cracks in the pavement placed thereon. The CONTRACTOR shall repair any settlement that occurs at no additional cost to the OWNER.

3.12 CONTROLLED LOW STRENGTH MATERIAL (CLSM)

A. The method of placing CLSM shall be subject to the approval of the ENGINEER, and shall be performed in accordance with the Contract Documents, and Section 204 of the NYSDOT Standard Specifications.

3.13 REPAIRS TO CULVERTS, DRAINS, DITCHES, AND SERVICE LINES

A. Repairs to culverts, sump drains, ditches, drain lines, existing septic systems or laterals, etc. which have been removed or damaged by construction operations shall be made immediately where failure to make such immediate repair or restoration shall result in interruption of a service, flooding, or other undesirable conditions.

1. In all cases, such repairs or restorations shall be made no later than the day following the occurrence of the damage (maximum time - 32 hours from occurrence). Service lines shall be repaired immediately.
2. Where such repairs require replacement of existing materials, replacement shall be in kind.

B. The cost of this work, when required, shall be the sole responsibility of the CONTRACTOR. No additional compensation will be provided to the CONTRACTOR by the OWNER.

3.14 GRADING

A. General

1. Uniformly grade areas within limits of grading under this Section, 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

1. Finish areas to receive topsoil to within not more than one inch (1") above or below the required subgrade elevation.

C. Walks and Pavements

1. Shape surface of areas under walks to line, grade and cross-section, with finish surface not more than ½-inch above or below the required subgrade elevation.

D. Slabs

1. Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of ¼-inch when tested with a ten (10) foot straightedge.

E. Compaction

1. After grading, compact subgrade surfaces to the depth and percentage of maximum density required.

3.15 PAVEMENT SUBBASE COURSE

A. General

1. Place subbase material, in accordance with the Contract Documents, and applicable sections of the NYSDOT Standard Specification Section 304, over ground surface to support the pavement base course.

B. Grade Control

1. During construction, maintain lines and grades including crown and cross-slope of subbase course.

C. Shoulders

1. Place shoulders along edges of subbase course to prevent lateral movement. Construct shoulders of acceptable soil materials as specified, placed in such quantity to compact to thickness of each subbase course layer. Compact and roll at least twelve inch (12") width of shoulder simultaneously with compacting and rolling of each layer of subbase course.

D. Placing

1. Place subbase course material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting subbase material during placement operations. When a compacted subbase course is shown to be six inches (6") thick or less, place material in a single layer. When shown to be more than six inches (6") thick, place material in equal layers, except no single layer more than 6" or less than 3" in thickness when compacted.

3.16 DISPOSAL OF EXCAVATED MATERIALS

A. Material removed from the excavations which does not conform to the requirements for fill or is in excess of that required for backfill shall be hauled away by the CONTRACTOR and disposed of in compliance with Municipal, County, State, Federal or other applicable regulations at no additional cost to the OWNER.

B. The CONTRACTOR shall not dispose waste excavated material in any of the following locations:

1. Wetland areas.
2. Flood plains.
3. Any area where excess siltation will damage or pollute receiving water.

C. As part of this Work, the CONTRACTOR shall be required to properly grade and restore (lawn or field restoration) all disposal areas, as directed by the ENGINEER, or the owner of the property where said waste materials are being disposed of. The cost of this work shall be included in the various bid items which require work covered under Section 02221.

D. The CONTRACTOR shall be required to consolidate piles of waste material on a daily basis, so as to help prevent erosion of the waste materials. Piles in a consolidated and compacted state will resist erosion and sediment run-off better than piles just dumped, and left. Silt fence shall be placed around all waste material piles, and the piles shall be seeded to develop vegetation growth. The cost of this work shall be included in the lump sum price bid for the SWPPP Bid Item.

3.17 RESTORATION AND CLEAN-UP

A. Following installation, the CONTRACTOR shall restore all areas to their original condition to the requirements of Section 02480, Landscaping and Restoration, and to the satisfaction of the ENGINEER.

B. Surplus pipe line material, tools, and temporary structures shall be removed by the CONTRACTOR and all dirt, rubbish, and excess earth and excavation shall be hauled to an approved disposal location provided by the CONTRACTOR.

C. Pavements shall be kept clean of dirt, dust, or mud from excavations.

D. The CONTRACTOR shall remove all temporary Erosion and Sediment Control measures.

E. The construction site shall be left clean to the satisfaction of the ENGINEER.

END OF SECTION

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SECTION 02300
EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Preparing subgrades for slabs-on-grade and walks.
2. Excavating.
3. Drainage and moisture-control fill course for slabs-on-grade.
4. Subbase course for walks.
5. Subsurface drainage backfill for walls and trenches.
6. Excavating and backfilling trenches within building lines.
7. Excavating and backfilling for underground mechanical and electrical utilities and appurtenances.

1.2 DEFINITIONS

A. Unauthorized excavation consists of removing materials beyond indicated subgrade elevations or dimensions without direction by the Architect. Unauthorized excavation, as well as remedial work directed by the Architect, shall be at the Contractor's expense.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide approved borrow soil materials from off-site when sufficient approved soil materials are not available from excavations.

B. Satisfactory Soil Materials: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter.

C. Unsatisfactory Soil Materials: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT.

D. Backfill Materials: Satisfactory soil materials.

E. Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, ASTM D 448, coarse aggregate grading size 57, with 100 percent passing a 1-1/2-inch sieve and not more than 5 percent passing a No. 8 sieve.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and adjacent plant materials from damage caused by earthwork operations.

3.2 EXCAVATION

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 0.10 foot.

1. Excavations for Footings: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Excavation for Walks: Excavate surfaces under walks to indicated cross sections, elevations, and grades.
3. Excavation for Utility Trenches: Excavate trenches to indicated slopes, lines, depths, and invert elevations.
    a. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit.
    b. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit.

B. Fill unauthorized excavation under foundations by extending indicated bottom elevation of concrete foundation or footing to excavation bottom.

3.3 UTILITY TRENCH BACKFILL

A. Place and compact initial backfill of satisfactory soil material or subbase material, free of particles larger than 1 inch, to a height of 12 inches over the utility pipe or conduit.

B. Coordinate backfilling with utilities testing.

C. Place and compact final backfill of satisfactory soil material to final subgrade.

3.4 COMPACTION

A. Place backfill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill materials evenly on all sides of structures to required elevations. Place backfill and fill uniformly along the full length of each structure.

C. Compact soil to not less than 95 percent maximum dry density according to ASTM D 1557.

3.5 DRAINAGE FILL

A. Under slabs-on-grade, place drainage fill course on prepared subgrade.

1. Compact drainage fill to required cross sections and thickness.
2. When compacted thickness of drainage fill exceeds 6 inches thick place materials in equal layers, with no layer more than 6 inches thick nor less than 3 inches thick when compacted.

3.6 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the Owner's property.

END OF SECTION

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SECTION 02444

CHAIN LINK FENCE

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope:

1. CONTRACTOR shall furnish all labor, materials, equipment and incidentals required to provide fencing as shown and specified.
2. The extent of fencing is shown on the Drawings.
3. The types of fencing and appurtenances include the following:
   a. Galvanized steel systems.
   b. Accessories and fittings.

B. Related Work Specified Elsewhere:

1. Section 03300, Cast-In-Place Concrete.

1.2 QUALITY ASSURANCE

A. Erector Qualifications: Erector must be a firm experienced in the erection of fencing of the type specified and approved by the manufacturer.
B. Design Criteria: Comply with the standards of the Chain Link Fence Manufacturer's Institute for "Galvanized Steel Chain Link Fence Fabric" and Federal Specification RR-F-191/1C, unless otherwise shown or specified.
C. Source Quality Control: Provide chain link fence as a complete unit produced by a single manufacturer, including necessary erection accessories, fittings and fastenings.
D. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:

1. ASTM A36 Standard Specification for Carbon Structural Steel.
2. ASTM A121 Standard Specification for Metallic-Coated Carbon Steel Barbed Wire.
3. ASTM A392 Standard Specification for Zinc-Coated Steel Chain-Link Fabric.
4. ASTM A780 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-dip Galvanized Coatings.
5. ASTM A817 Standard Specification for Metallic-Coated Steel Wire for Chain Link Fence Fabric and Marcelled Tension Wire.
6. ASTM A824 Standard Specification for Metallic-Coated Steel Marcelled Tension Wire for Use With Chain Link.
7. ASTM B221 Standard Specification for Aluminum and Aluminum Alloy Bars, Rods, Wire Profiles and Tubes.
8. ASTM F552 Standard Terminology Relating to Chain Link Fencing.
9. ASTM F567 Standard Practice for Installation of Chain Link Fence.
10. ASTM F626 Standard Specification for Fence Fittings.
11. ASTM F900 Standard Specification for Industrial and Commercial Swing Gates.
12. ASTM F1043 Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework.
13. ASTM F1083 Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
14. ASTM F1184 Standard Specification for Industrial and Commercial Horizontal Slide Gates.
15. ASTM F1910 Standard Specification for Long Barbed Tape Obstacles.
16. ASTM F1911 Standard Practice for Installation of Barbed Tape.

17. ASTM F2200 Standard Specification for Automated Vehicular Gate Construction.
18. UL 325 Door, Drapery, Gate, Louver and Window Operators.
19. WLG2445 Chain Link Fence Manufacturers Institute, Chain Link Fence Wind Load Guide for the Selection of Line Posts and Line Post Spacing

1.3 SUBMITTALS

A. Shop Drawings:

1. The CONTRACTOR shall submit for approval Shop Drawings for fences and gates, including plan layout and details illustrating fence height, location and sizes of posts, rails, braces, gates, and footings, hardware list and erection procedures.
2. The CONTRACTOR shall submit for approval copies of manufacturer's technical data test reports on physical properties, and installation instructions for steel fences and gates.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials: Deliver material in manufacturer's original packaging with all tags and labels intact and legible.
B. Handling of Materials: Handle and store material in such manner as to avoid damage.

PART 2 - PRODUCTS

2.1 GENERAL

A. Pipe sizes specified are commercial pipe sizes.
B. Tube sizes specified are nominal outside dimension.
C. Roll-formed section sizes are the nominal outside dimensions.
D. Finish for framework, fabric, appurtenances, etc. The CONTRACTOR shall furnish the following finishes for fencing materials:

1. Material as specified for each component hereafter described.

2.2 FABRIC

A. The CONTRACTOR shall furnish chain link fabric as follows:

1. Fabric Height to be 8 feet.
   a. One-piece fabric widths.
   b. No. 9 gage wires.
   c. 2-inch mesh size.
2. Top selvages twisted and barbed and bottom selvage knuckled for fabric over 60 inches high.
3. Galvanized finish with not less than 1.2 ounces zinc per square foot, complying with ASTM A 392, Class I.

2.3 FRAMEWORK

A. Steel Pipe Type 1: ASTM F1083 standard weight Schedule 40 hot-dip galvanized pipe.
B. External and internal coatings shall be per ASTM F-1234 with a minimum coating of 1.8 oz. per square foot.
C. End, Corner and Pull Posts: The CONTRACTOR shall furnish ends, corners and pull posts of the minimum sizes and weights as follows:

1. 6-8 feet fabric height.

a. 2-7/8 inches OD pipe.
b. .203 inches wall thickness.
c. 5.79 lb/ft weight

D. Line Posts: The CONTRACTOR shall furnish line posts as follows:

1. 6-8 feet fabric height
   a. 2-3/8 inches OD pipe.
   b. .154 inches wall thickness.
   c. 3.65 lb/ft weight

E. Rails & Braces: The CONTRACTOR shall furnish top rails, unless otherwise shown, of the following:

1. 1-5/8 inch OD pipe, 0.140 inch wall thickness, 2.27lb/ft weight.
2. The CONTRACTOR shall furnish in manufacturer's longest lengths, with expansion type couplings, approximately 6-inches long, for each joint. The CONTRACTOR shall provide means for attaching the top rail securely to each gate, corner, pull, and end post.

2.4 FITTINGS

A. Tension Wire: ASTM A 824 Type II, zinc coated steel wire, 7 gauge wire.
B. Barbed Wire Supporting Arms: The CONTRACTOR shall furnish pressed steel, wrought iron, or malleable iron barbed wire supporting arms, complete with provisions for anchorage to posts attaching 3 rows of barbed wire to each arm. Supporting arms shall be integral with post top weather cap. The CONTRACTOR shall provide following type:

1. Single 45 degree arm, one for each post.

C. Barbed Wire: Galvanized steel 2 strand, 11 gage wire with 4-point barbs spaced 6-inches on center or as follows:

1. Galvanized, complying with ASTM A 121, Class 3.

D. Post Caps: Galvanized steel pressed steel, wrought iron, or malleable iron, designed as a weather-tight closure cap, for tubular posts. The CONTRACTOR shall furnish one cap for each post unless equal protection is afforded by combination post top cap and barbed wire supporting arm, where barbed wire is required.

1. The CONTRACTOR shall furnish caps with openings to permit through passage of the top rail.

E. Tension (Stretcher) Bars: Galvanized Steel, wrought iron, or malleable iron, spaced not over 15-inches on center to secure stretcher bars to end, corner, pull, and gate posts.
F. Bands may also be used with special fittings for securing rails to end, corner, pull and gate posts.
G. Wire Ties: For tying fabric to line posts, the CONTRACTOR shall use galvanized steel 9 gage wire ties spaced 12-inches on center. For typing fabric to rails and braces, the CONTRACTOR shall use galvanized steel 9 gage wire ties spaced 24-inches on center. For tying fabric to tension wire, the CONTRACTOR shall use galvanized steel 11 gage hog rings spaced 24-inches on center. The CONTRACTOR shall finish off ties to match fabric finish.

2.5 CHAIN LINK SWING GATE

A. Swing gates shall be either double leaf or single leaf as shown on the plans. Unless otherwise shown on the plans or approved by the ENGINEER, single leaf gates shall provide for a 5′ opening, and match the proposed fence height (plus 1′ when 3 strands barbed wire are required). Double leaf gates shall provide for a 20′ opening, and match the proposed fence height (plus 1′ when 3 strands barbed wire are required). Chain link swing gates shall be fabricated in accordance with ASTM F900. Gate frames shall be of welded construction. Weld areas shall be protected with zinc-rich paint per ASTM A780. The gate frame members are to be spaced no greater than 8′ apart horizontally or vertically. Exterior members are to be 1.900″ OD pipe, interior members when required shall be 1.660″ OD pipe. Pipe is to be Type 1-ASTM F108, and chain link fabric shall match specification of fence system. Fabric is to be stretched tightly and secured to vertical outer frame members using tension bar and tension bands spaced 12″ on center and tied to the horizontal and interior members 12″ on center using 9 gauge galvanized steel ties.

B. Hinges: hot dip galvanized pressed steel or malleable iron, structurally capable of supporting gate leaf and allow opening and closing without binding. Non-lift-off type hinge design shall permit gate to swing 180°.

C. Latch: Galvanized forked type capable of retaining gate in closed position and have provision for padlock. Latch shall permit operation from either side of gate.

D. Double gates: Galvanized drop rod with center gate stop pipe or receiver to secure inactive leaf in the closed position. Provide galvanized pressed steel locking latch, requiring one padlock for locking both gate leaves, accessible from either side.

E. Gate holdback: Galvanized gate hold back keeper for each gate leaf over 5′ wide. Gate keeper shall consist of mechanical device for securing free end of gate when in full open position.

F. Gate posts: Grade 1 pipe ASTM F1083.

Gate fabric height up to and including 6′:

Gate leaf width	Outside Diameter
Up to 4′	2.375″
Over 4′ to 10′	2.875″
Over 10′ to 18′	4.000″

Gate fabric height over 6′ to 12′:

Gate leaf width	Outside Diameter
Up to 6′	2.875″
Over 6′ to 12′	4.000″
Over 12′ to 18′	6.625″
Over 18′ to 24′	8.625″

2.6 CHAIN LINK INTERNAL TRACK ALUMINUM CANTILEVER SLIDE GATE

A. Aluminum cantilever slide gate shall be of the internal roller design per ASTM F1184 Type II Class 2. Cantilever slide gate shall be constructed of ASTM B221 aluminum members welded and designed for maximum structural integrity. Vertical external and internal members shall be a minimum of 2″ square, spaced a maximum of 8′ on center. Gates having fabric greater than 8′ in height require a horizontal member. The top horizontal member shall be a one-piece precision extruded structural framing member having an integral enclosed track. Bottom horizontal member shall be a minimum of 2″ x 4″. Adjustable diagonal X trusses shall be installed in each gate panel to transfer the alternating forces as the gate slides. The gate opening portion shall be filled with chain link fabric stretched taut and secured to the frame members. Chain link fabric shall match the fence system specification. The overall gate structure shall be a minimum of 40% larger than the gate opening to support the cantilevered portion of the gate in the closed position with a minimum deflection per ASTM F1184. The minimum 40% back frame does not require the installation of chain link fabric for those gates not to be electrically operated. Electrically operated gates per ASTM F2200 and

UL 325 require the back frame to be filled with fabric. Single leaf cantilever design for openings larger than 30′ up to 40′ shall be fabricated by welding together two horizontal top structural/track members creating a dual track system. Single track gates up to 30′ opening require two support posts and two internal truck assemblies. Dual track gates over 30′ up to 40′ require two sets of dual posts and four internal truck assemblies.

B. Internal truck assemblies shall be capable of swiveling to accommodate gate movement and ensure full contact of the four support wheels and two guide wheels to the internal track surface. The galvanized steel truck assembly post bracket, truck assembly vertical support axle as well as the support wheels shall be designed to handle static and dynamic forces required to support and operate the gate. The truck assembly, support axle and internal wheels shall be comprised of stainless steel or galvanized steel components.

C. Galvanized steel bottom guide roller brackets containing two 3″ rubber wheels shall be supplied to keep the bottom of the gate plumb and in proper alignment.

D. Single gates shall be supplied with a galvanized steel latch mechanism capable of securing the gate with a padlock accessible from either side. Double gates shall have a galvanized drop rod to hold the inactive leaf and a latch mechanism capable of securing the gate with a padlock accessible from either side. The CONTRACTOR shall provide a drop rod receiver to engage the center drop rod. Electrically operated gates per ASTM F2200 and UL325 shall not contain any latch or locking mechanism.

E. Cantilever gate posts shall be 4.00″ OD Grade 1 pipe per ASTM F1083. Single leaf cantilevers up to 30′ require three 4″ OD posts, dual track single leaf cantilevers over 30′ up to 40′ require two sets of pre-fabricated dual 4.00″ OD support posts and one 4″ latch post. The gate is supported in the center of the dual posts.

2.7 POST SETTING MATERIAL

A. Concrete: Class A, minimum 28-day compressive strength of 3,000 psi per Section 033000 "Cast-In-Place Concrete."

2.8 ACCESSORIES

A. Padlocks: Commercial Grad 2″ Solid Stainless Steel Rectangular Padlock with "Weatherbuilt" protection, as offered by American Lock; or approved equal.

B. Privacy Slats: Slats to be manufactured from a combination of color pigments, quality high density virgin polyethylene and ultraviolet inhibitors, having a 25 year limited warranty against either color fading or breakage of slats and locking-channel. Color shall be as directed by OWNER.

PART 3 - EXECUTION

3.1 INSPECTION

A. The CONTRACTOR and his installer must examine the conditions under which the fence is to be installed and notify the ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. The CONTRACTOR shall not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to the ENGINEER.

3.2 PREPARATION

A. The CONTRACTOR shall not begin fence installation and erection before the final grading is completed, with finish elevations established.

B. The work under this section requires all new material.

3.3 INSTALLATION

A. Excavation: Drill holes of diameters and spacings shown, for post footings in firm, undisturbed or compacted soil.

1. If not shown on the Drawings, the CONTRACTOR shall excavate holes to the minimum diameters as recommended by fence manufacturer.
2. Unless otherwise indicated, the CONTRACTOR shall excavate hole depths approximately 4-inches lower than the post bottom, with bottom of posts set not less than 44-inches below the surface when in firm, undisturbed soil.
   a. The CONTRACTOR shall spread soil from excavations uniformly adjacent to the fence line, or on adjacent areas of the site, as directed.
3. When solid rock is encountered near the surface, the CONTRACTOR shall drill into rock at least 12- inches for line posts and at least 18-inches for end, pull, corner, and gate posts. The CONTRACTOR shall drill a hole at least 1-inch greater diameter than the largest dimension of the post to be placed.
   a. If solid rock is below soil overburden, the CONTRACTOR shall drill to full depth required, except penetration into rock need not exceed the minimum depths specified above.

B. Setting Posts: Remove loose and foreign materials from sides and bottoms of holes, and moisten soil prior to placing concrete.

1. The CONTRACTOR shall center and align posts in holes 4-inches above bottom of excavation.
2. The CONTRACTOR shall place concrete around posts in a continuous pour, and vibrate or tamp for consolidation. The CONTRACTOR shall check each post for vertical and top alignment, and hold in position during placement and finishing operations.

3. The CONTRACTOR shall trowel finish tops of footings, and slope or dome to direct water away from posts. The CONTRACTOR shall extend footings for gateposts to the underside of the bottom hinges. The CONTRACTOR shall set keeps, stops, sleeves and other accessories into concrete as required.
4. The CONTRACTOR shall keep exposed concrete surfaces moist for at least 7 days after placement, or cure with membrane curing materials, or other acceptable curing method.

C. Concrete Strength: Allow concrete to attain at least 75 percent of its minimum 28- day compressive strength (3000psi), but in no case sooner than 7 days after placement, before rails, tension wires, barbed wire, or fabric is installed. Fabric and wires shall not be stretched, and gates shall not be hung until the concrete has attained its full design strength.

1. The CONTRACTOR shall take samples and test concrete to determine strength as specified in concrete sections of Division 3.

D. Top Rails: Run rail continuously through post caps or extension arms, bending to radius for curved runs. Expansion couplings as recommended by fencing manufacturer shall be provided.

E. Center Rails: Provide center rails only where shown. Install in one piece between posts and flush with post on fabric side, using special offset fittings where necessary.

F. Brace Assemblies: Install braces so posts are plumb when diagonal rod is under proper tension.

G. Tension Wire: Install tension wires by weaving through the fabric and tying each post with not less than 6 gage galvanized wire, or by securing the wire to the fabric.

H. Fabric: Leave approximately 2-inches between finish grade and bottom selvage, except where bottom of fabric extends into concrete. Pull fabric taut and tie to posts, rails, and tension wires. Install fabric on security side of fence, and anchor to framework so that fabric remains in tension after pulling force is released.

I. The CONTRACTOR shall repair coatings damaged in the shop or during field erection by recoating with manufacturer's recommended repair compound, applied per manufacturer's direction.

J. Stretcher Bars: Thread through or clamp to fabric 4-inches on center, and secure to posts with metal bands spaced 15-inches on center.

K. Barbed Wire: Install three parallel wires on each extension arm; on security side of fence, unless otherwise indicated. Pull wire taut and fasten securely to each extension arm.

L. Tie Wires: Use U-shaped wires conforming to diameter of pipe. Clasp pipe and fabric firmly with ends twisted at least two full turns. Bend ends of wire to minimize hazard to persons or clothing.

M. Fasteners: Install nuts for tension band and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

N. Swing gates: Installation of swing gates and gate posts shall be per ASTM F567. Direction of swing shall be as shown on drawings, or as directed by the Engineer. Gates shall be hung plumb in the closed position with minimal space from grade to bottom of gate leaf. Double gate drop bar receiver shall be set in a minimum concrete footing 6" diameter by 24" deep. Gate leaf holdbacks shall be installed on all double gates and all gate leafs greater than 5' in width. Electrically operated gates shall comply with ASTM F2200 and UL 325.

O. Cantilever slide gates: Install cantilever horizontal slide gates and gate posts in accordance with ASTM F567. Cantilever sliding gates shall be plumb in the closed position with minimal ground clearance and slide with an initial force of 40 lbs. Double gate drop bar receiver shall be set in a minimum concrete footing 6" diameter by 24" deep. Install top and bottom safety roller covers and adjacent safety guide posts on ASTM F1184 Type I Class 2 external roller cantilever slide gate applications.

3.4 ADJUSTMENT AND CLEANING

A. The CONTRACTOR shall adjust all fencing and leave in good working condition.

B. The CONTRACTOR shall repair or replace any broken or bent components as directed by the ENGINEER.

C. The CONTRACTOR shall protect gates and fencing from construction traffic until acceptance of the Work.

END OF SECTION

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SECTION 02480

LANDSCAPING AND RESTORATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope

1. The CONTRACTOR shall furnish all supervision, coordination, labor, materials, equipment and incidentals required to provide landscaping, cleanup, and restoration as of all natural and manmade surfaces and utilities, which are disrupted as a direct or indirect result of the Work.
2. All surfaces and materials, whether manmade or natural, which are disturbed as a result of the Work, shall be replaced in kind.

B. The types of landscaping required include the following

1. Rough and final grading.
2. Topsoil from off-site sources.
3. Topsoil stockpiled for reuse.
4. Lawn areas.
5. Ground cover areas.
6. Trees, shrubs and other nursery stock.
7. Maintenance work as specified until completion of the Contract.
8. Miscellaneous landscape materials.

C. Restoration of paving and sidewalks, curbs, and gutters are specified under Sections 02500 and 02510 of these Specifications.

1.02 COORDINATION

A. Review installation procedures under other Sections of these Specifications, and coordinate the installation of items that must be installed with the landscaping.
B. Notify other contractors in advance of the installation of the landscaping to provide the other contractors with sufficient time for the installation of items included in their contracts that must be installed prior to landscaping.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02221 - Excavation, Backfill, and Trenching for Utility Systems
B. Section 02500 - Paving and Surfacing
C. Section 02510 – Concrete Sidewalks, Curbs, and Driveways

1.04 QUALITY ASSURANCE

A. The CONTRACTOR shall obtain each type of material from no more than one (1) manufacturer. The OWNER reserves the right to reject the material of a manufacturer if that material fails to meet the requirements or performance criteria of these Specifications.
B. Landscape materials shall be shipped with certificates of inspection as required by governmental authorities. Comply with governing regulations applicable to landscape materials.
C. 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, to include, but not be limited to, hydrogen-ion value, organic matter, and available phosphoric acid and potassium. Supply twenty-pound (20 lb.) samples and perform tests at no additional expense to the OWNER, when required. If deficiencies in the topsoil are

found as a result of this analysis they shall be corrected at no additional expense to the OWNER.

D. Topsoil from off-site sources: Topsoil from off-site sources may be provided for use on this project, upon approval by the ENGINEER.

1.05 REFERENCE STANDARDS

A. 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. American Joint Committee on Horticultural Nomenclature, Standardized Plant Names.
   5. Official Seed Analysts of North American, Standards of Quality.
   6. FSO-F-241D, Fertilizer, Mixed, Commercial.

1.06 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

   1. Manufacturer's specifications and installation instructions for all materials required.

B. Certificates: Submit for approval the following:

   1. The CONTRACTOR shall provide the certification of the manufacturer that the proposed materials, to be incorporated into the Work, conform to the Specifications herein.
   2. Certificates of inspection as may be required by governmental authorities to accompany shipments and manufacturers' or vendors' certified analysis for soil amendments and fertilizer materials. For standard products submit other data substantiating that materials comply with specified requirements.
   3. 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.
   4. Certificates from manufacturers shall state that the product meets or exceeds all technical and packaging requirements.
   5. Certificate guaranteeing Work through the specified maintenance period.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials: Do not deliver materials until site conditions are ready for planting.

   1. Deliver packaged materials in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery.
   2. Notify ENGINEER of delivery schedule in advance so plant material may be inspected upon arrival at job site.
   3. Remove unacceptable material immediately from job site.

B. Storage of Material

   1. Store and cover materials to prevent deterioration. Remove packaged materials that have become wet or show deterioration or water marks from the site. Replace at no additional cost to OWNER.
   2. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from damage, weather, excessive temperatures and construction operations.

1.08 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 five (5) miles per hour.
3. Do not plant when drought, or excessive moisture, or other unsatisfactory conditions prevail.

B. Scheduling

1. Plant or install materials only during normal planting seasons for each type of landscape work required. Correlate planting with specified maintenance periods to provide maintenance until occupancy by the OWNER.

1.09 GUARANTEE

A. Guarantee lawns and landscape through the specified one-year maintenance period.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Topsoil

1. Shall be stockpiled from stripping operation and re-used, or supplied from an approved off-site source.
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, rocks, clay, or other extraneous material harmful to plant growth.
3. Supply topsoil with the following analysis:

a. 3/4 inch mesh: 100 percent passing
#4 sieve: 90-100 percent passing
#200 sieve: 0-10 percent passing
b. Clay content of material passing a #200 sieve not greater than 60 percent, as determined by hydrometer tests.
c. A pH of 5.0 to pH 6.5. If approved by ENGINEER, natural topsoil not having the hydrogen-ion value specified may be amended by the CONTRACTOR at his own expense.
d. Organic content not less than 5 percent, as determined by ignition loss.
e. Free of pests and pest larvae.

4. When work is being performed within an Agricultural District, the topsoil stripped, shall be the topsoil placed. The use of off-site topsoil shall not be permitted, unless otherwise approved by the ENGINEER. Refer to Appendix D of these Specifications for further details.

B. Soil Amendments

1. Lime: Shall conform to NYSDOT 713-02 Specifications. The Total Neutralizing Value shall equal a minimum 88% calcium carbonate equivalence.

2. Peat Humus: Provide peat humus which is a natural product of sphagnum moss, reed, or sedge peat, taken from a fresh water site. Supply shredded material, free from lumps, roots, stones and other extraneous foreign matter, capable of passing through ½-inch screen, which can easily be incorporated with the topsoil. Supply peat humus with the following analysis:

   a. Not less than 90 percent organic matter by weight on an oven dry basis.
   b. pH range 5 to 7.5.
   c. Moisture content 35 percent at time of incorporation into soil.

3. Commercial Fertilizer: Available phosphoric acid derived from superphosphate, bone, or tankage. Potash derived from muriate of potash. Uniform in composition, free flowing and suitable for application with approved equipment. Minimum 50% of available nitrogen must be water soluble. Provide fertilizer with the following percentages of available plant nutrients.

Nitrogen	5%
Phosphoric Acid	10%
Potash	10%

   a. For lawns, provide fertilizer with not less than 4 percent phosphoric acid and not less than 2 percent potassium, and the percentage of nitrogen required to provide not less than 1.5 pounds of actual nitrogen per 1000 square feet of lawn area.
   b. Package fertilizer in the standard containers of the manufacturer, weighing not more than 100 pounds each.
   c. The container shall contain the net weight, guaranteed analysis, and name and address of the manufacturer.

C. Seed

1. Provide fresh, clean, new-crop seed complying with the tolerance for purity and germination established by the Official Seed Analysts of North America. Provide seed of the grass species, proportions and minimum percentages of purity, germination, and maximum percentage of weed seed, as specified.
2. Seed shall be packaged and tagged in accordance with New York State Seed Law.
3. The "Schedule of Grass Seed Requirements for Lawn Restoration" is as follows:

Name of Grass	By Weight	Application Per 1000 sq. ft.
Blend of Kokomo 2, Paragon GLR & Pizzaz 2 Perenial Ryegrass	34%	5 pounds
Boreal Creeping Red Fescue	33%	
Kenblue Kentucky Bluegrass	33%	

   a. Weed seed content not over 0.25 percent and free of noxious weeds.
   b. All seed will be rejected if the label lists any of the following contaminants: Timothy, Orchard Grass, Sheep Fescue, Meadow Fescue, Canada Blue Grass, Alta Fescue, Kentucky 31 Fescue, and Bent Grass.

4. Field areas shall be seeded with a mixture according to the following table:

Name of Grass	By Weight	Application Per 1000 sq. ft.
Tall Fescue	30%	3 pounds
Creeping Red Fescue	25%	
Annual Ryegrass	20%	
Timothy	12%	
85/80 Kentucky Bluegrass	10%	
White Cover	3%	

5. High erosion areas shall be seeded with a mixture according to the following table:

Name of Grass	By Weight	Application Per 1000 sq. ft.
Blend of Evening Shade, Patriot 4 & Paragon Perennial Ryegrass	50%	6 pounds
Annual Ryegrass	20%	
Boreal Creeping Red Fescue	15%	
Kenblue Kentucky Bluegrass	15%	

D. Mulch

1. Mulch shall consist of hay or straw free from noxious weeds, or approved substitute.

E. Erosion Control Blanket

1. In high erosion areas, and along steep embankments, an erosion control blanket shall be placed after placement of topsoil, seed, and fertilizer for temporary soil stabilization until vegetation is established.
2. The extended-term double net erosion control blanket shall be a machine-produced mat consisting of 70% agricultural straw and 30% coconut fiber with a functional longevity of up to 24 months.
3. The blanket shall be covered on the top side with heavyweight photodegradable netting having ultraviolet additives to delay breakdown and an approximate 0.63 in. x 0.63 in. mesh and on the bottom side with a lightweight photodegradable polypropylene netting with an approximate 0.50 in. x 0.50 in. mesh. The blanket shall be sewn together on 1.50 in centers with degradable thread.

F. Jute Matting

1. In high erosion areas, jute matting shall be placed after placement of topsoil, mulch, seed, and fertilizer for temporary soil stabilization until vegetation is established.
2. Jute mat shall be cloth of a uniform plain weave of un-dyed and unbleached single jute yarn, 48 inches in width plus or minus one inch and weighing an average 1.2 pounds per linear yard of cloth with a tolerance of plus or minus five percent (5%), with approximately 78 warp ends per width of cloth and 41 weft ends per linear yard of cloth.
3.. 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 of its normal diameter.

G. Spruce Trees

1. Provide nursery grown single-stem spruce trees, where indicated on the Contract Drawings, or specified herein, with straight trunks, well-shaped and balanced

crowns, and healthy balled and burlap wrapped root systems developed by transplanting or root pruning.

3. All trees shall be grown in native soil, free of disease, insects, larvae, and defects such as knots, sunscalds, abrasions, or disfigurement. Comply with ANSI Standard Z60.1 for type, size, and grade.
4. Each tree shall include a securely attached waterproof tag bearing the easily legible designation of both the botanical and common name.
5. All trees shall have a minimum trunk diameter of 3" at a height of 6' above the ground.

H. Maple Trees

1. Provide nursery grown single-stem maple trees, where indicated on the Contract Drawings, or specified herein, with straight trunks, well shaped and balanced crowns, and healthy balled and burlap wrapped root systems developed by transplanting or root pruning.
3. All trees shall be grown in native soil, free of disease, insects, larvae, and defects such as knots, sunscalds, abrasions, or disfigurement. Comply with ANSI Standard Z60.1 for type, size, and grade.
4. Each tree shall include a securely attached waterproof tag bearing the easily legible designation of both the botanical and common name.
5. All trees shall have a minimum trunk diameter of 2" at a height of 3' above the ground.
6. Plant trees on private property (out of the right of way), per the direction of the individual homeowner and as approved by the ENGINEER.

I. Bank and Channel Protection – Stone Filling (Rip-Rap)

1. Stone Fill: Materials used for Stone Filling shall generally be in conformance with Section 620-2 of the NYSDOT Standard Specifications (2008 edition), specifically Section 620-2.02, for Fine, Light, Medium, and Heavy Stone Fill.
2. Bedding: When/Where required, bedding material shall be supplied in conformance with Section 02221, 2.01, A of these specifications.
3. Geotextile Fabric: Woven Monofilament Polypropylene Geotextiles; TenCate Mirafi FW-Series, or approved equal.

J. Hydromulch

1. This section specifies a hydraulically-applied, 100% biodegradable, High Performance-Flexible Growth Medium (HP-FGM or hydromulch) that is manufactured in the United States and is composed of 100% recycled thermally refined (within a pressure vessel) wood fibers, crimped interlocking man-made biodegradable fibers, mineral activators, naturally derived crosslinked biopolymers and water absorbents. The hydromulch is phytosanitized, free from plastic netting, requires no curing period and upon application forms an intimate bond with the soil surface to create a continuous, porous, absorbent and flexible erosion resistant blanket that allows for rapid germination and accelerated plant growth
2. The hydromulch shall conform to the following property values when uniformly applied at a rate of 3500 pounds per acre (3900 kilograms/hectare) under laboratory conditions.

Property	Test Method	Req. Value (English)	Req. Value (SI)
Physical			
Mass Per Unit Area	ASTM D6566[a]	12 oz/yd^2 minimum	407 g/m^2 minimum
Thickness	ASTM D6525[a]	0.22 inch minimum	5.6 mm. minimum
Wet Bond Strength	ASTM D6818[a]	9 lb/ft	131 N/m
Ground Cover	ASTM D6567[a]	99% minimum	99% minimum
Water Holding Capacity	ASTM D7367	1700% minimum	1700% minimum
Material Color	Observed	Green	Green
Performance			
Cover Factor[b]	Large Scale Testing[d]	0.01 maximum	0.01 maximum
% Effectiveness[c]	Large Scale Testing[d]	99 % minimum	99 % minimum
Cure time	Observed	0 - 2 hours	0 - 2 hours
Vegetation Establishment	ASTM D7322[a]	800 % minimum	800 % minimum
Yield[e]	Calculated	2.6 minimum	2245 minimum
Kinetic Energy Absorption Potential[f]	Calculated	2.0 minimum	734 minimum
Environmental			
Functional Longevity[g]	ASTM D5338	Up to 18 months	Up to 18 months
Ecotoxicity	EPA 2021.0	96-hr LC50 > 100%	96-hr LC50 > 100%
Effluent Turbidity	Large Scale Testing[d]	100 NTU maximum	100 NTU maximum
Biodegradability	ASTM D5338	100% minimum	100% minimum

a. ASTM test methods developed for Rolled Erosion Control Products and have been modified to accommodate Hydraulically-Applied Erosion Control Products.
b. Cover Factor is calculated as soil loss ratio of treated surface versus an untreated control surface.
c. % Effectiveness = One minus Cover Factor multiplied by 100%.
d. Large scale testing conducted at Utah Water Research Laboratory. For specific testing information please contact a Profile technical service representative at 866-325-6262.
e. Yield = (Mass per Unit Area)*(Thickness)*(Ground Cover Percentage).
f. Kinetic Energy Absorption Potential = (Wet Bond Strength)*(Thickness)
g. Functional Longevity is the estimated time period, based upon ASTM D5338 testing and field observations, that a material can be anticipated to provide erosion control and agronomic benefits as influenced by composition, as well as site-specific conditions, including; but not limited to – temperature, moisture, light conditions, soils, biological activity, vegetative establishment and other environmental factors.

2. Composition

a. All components of the hydromulch shall be pre-packaged by the Manufacturer to assure both material performance and compliance with the following values. No chemical additives with the exception of fertilizer, soil pH modifiers, extended-term dyes and biostimulant materials should be added to this product.
b. Thermally Processed (within a pressure vessel) Wood Fiber – 80% $\pm$ 3%
c. Heated to a temperature greater than 380 degrees Fahrenheit (193 degrees Celsius) for 5 minutes at a pressure greater than 50 psi (345 kPa)
d. Crosslinked Biopolymers and Water Absorbents – 10% $\pm$ 1%
e. Crimped, Man-made Biodegradable Interlocking Fibers – 5% $\pm$ 1%
f. Micro-Pore Granules – 5% $\pm$ 1%

4. The hydromulch shall be Flexterra® HP-FGM or approved equal.

PART 3 - EXECUTION

3.01 GENERAL

A. The CONTRACTOR shall restore all surfaces in kind or as specified herein in a neat and workmanlike manner, in accordance with these Specifications, the recommendations of the manufacturer, and as generally accepted by the industry.

B. At the clearing phase, where feasible, and definitely at the completion of construction, the entire disturbed area shall be graded to fill in depressions created during clearing and construction.

1. The Work areas shall be restored to design grade and contour unless changes made to grade and contour have improved the area. Where original fill in trenches and major depressions have settled below ground level, additional fill shall be added and graded to bring all such areas up to grade.

3.02 TREE REMOVAL

A. The CONTRACTOR shall completely remove the tree, including trimming, topping, removal of log and stump, cutting up the trunk and branches, chipping all branches, removing all branch and trunk wood, chipped branches and stump from site, clean up the lawns and restore all surface damage caused during the tree removal.

B. Properly dispose of all removed tree parts as required by applicable laws and environmental standards.

C. Exercise extreme care and diligence to protect all adjacent properties, structures, vehicles, pedestrians, passersby, or others from the tree removal operations. All damaged property shall be restored or replaced at the expense of the CONTRACTOR. Provide adequate flagmen and safety barricades as required to secure the area before beginning tree removal work.

3.03 INSPECTION

A. The CONTRACTOR and his installer must examine the subgrade, verify the elevations, observe the conditions under which Work is to be performed, and notify the ENGINEER of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.04 PREPARATION

A. Turfbed Preparation

1. Loosen subgrade of turf bed areas to a minimum depth of 4 inches. **Remove stones over 1 inch 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 depth matching existing topsoil conditions after natural settlement and light rolling. **A minimum of four (4) inches of topsoil shall be maintained**.

a. Do not spread topsoil while in a frozen or muddy condition.

3. Apply ground limestone, by machine, over all areas to receive turf, as required, to bring the soil to a neutral pH (minimum of 6.5). Work lightly into topsoil at least five (5) days before applying the commercial fertilizers.

4. Apply commercial fertilizers in the following quantities:

   a. For grass apply only at a rate sufficient to supply 1.5 pounds of nitrogen per 1000 square feet. For 5-10-5 use 30 pounds per 1000 square feet.

5. Apply commercial fertilizers within 10 days of seeding. After the fertilizer is spread, it shall be thoroughly disked, harrowed, or raked into the soil to a depth of approximately 1 inch.
6. Apply superphosphate for grass areas at the rate of 20 pounds per 1000 square feet.
7. Grade turf bed 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 turf bed 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 turf bed areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.

3.05 INSTALLATION

A. Seeding Lawns

1. Seed shall be applied at 150 pounds per acre, or as recommended by seed packager. Sow not less than the quantity of seed specified. Seed shall be sown mechanically to insure uniform distribution.
2. Distribute seed evenly over entire area by sowing equal quantity in 2 directions at right angles to each other.
3. Protect seeded areas against erosion by spreading specified lawn mulch after completion of seeding operations.

   a. Mulch shall be placed mechanically or by hand over the seeded areas.
   b. Mulch shall be loose enough to allow sunlight to penetrate and air to slowly circulate, but thick enough to shade the ground, reduce moisture evaporation and prevent or reduce water and or wind erosion.
   c. Mulch shall be applied at two (2) tons of straw per acre.

4. If the CONTRACTOR desires to use any other method, such as mixing fertilizer and seed with water and pressure spraying the mixture, approval must first be obtained from the ENGINEER.
5. Place fertilizer, lime, seed, and mulch during the period from May 15 to October 10 of a calendar year and as soon as practical after the earthwork is completed and the excavations have been compacted.

B. Reconditioning Existing Turf

1. Recondition existing turf areas damaged by the operations of the CONTRACTOR 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 satisfactorily reconditioned turf. Provide 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 operations of the CONTRACTOR including oil drippings, stone, gravel and other loose building materials.
5. In areas approved by 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 seed bed mulch, if required, to maintain moist condition.
6. Water newly planted areas and keep moist until new turf is established.

C. Seeding Field Areas

1. Disturbed field areas shall be graded and raked smooth to **remove stones greater than 2" in diameter and debris**.
2. Original stockpiled soil with as much original topsoil as possible on the top shall be used for seedbed **(minimum 2").**
3. No additional topsoil shall be used except as required to provide a minimum of 2" to establish and maintain growth.
4. Fertilize area and lightly rake. Fertilizer shall be a 20-10-5 mixture and be applied at a rate of four hundred (400) pounds per acre.
5. Seed shall be applied at 70 pounds per acre, or as recommended by packager. Seed shall be sown mechanically to insure uniform distribution.
6. Lightly rake after seeding.
7. Mulch shall be placed mechanically or by hand over the seeded areas.

    a. Mulch shall be loose enough to allow sunlight to penetrate and air to slowly circulate, but thick enough to shade the ground, reduce moisture evaporation and prevent or reduce water and or wind erosion.
    b. Mulch shall be applied at two tons of straw per acre.

8. If the CONTRACTOR desires to use any other method, such as mixing fertilizer and seed with water and pressure spraying the mixture, he may do so upon obtaining approval of the ENGINEER.
9. Place seed and mulch during the period from May 15 to October 10 of a calendar year and as soon as practical after the earthwork is completed and the excavations have been compacted.
10. The CONTRACTOR shall furnish water and water application equipment. Apply water in a manner which will not damage topsoil, seed and mulch.

D. High Erosion Areas

1. Areas noted on the Contract Drawings as highly susceptible to erosion shall be raked, seeded, and mulched according to the requirements as set forth in 3.04.C. Other areas determined to be high erosion areas in the field shall also be prepared per this item as directed by the ENGINEER at no additional cost to the OWNER.
2. Erosion Control Blankets or Jute matting shall be applied after the topsoil, seed, and fertilizer for temporary soil stabilization in the following manner:

    a. Individual rolls should be applied up and down the slope, never along the contour.
    b. Sides of rolls shall overlap at least four inches (4"), and rolls shall have at least a three-foot overlap when an uphill roll joins to a downhill roll. The uphill roll shall overlie the downhill roll.

c. Staples shall be made of wire, 0.091-inch in diameter or greater, "u" shaped with legs at least six inches in length and a one-inch crown. Longer staples are required in loose or sandy soils.

d. Staples shall be driven perpendicularly into the slope face, and shall be spaced approximately five feet (5') apart down the sides and center of the roll. Spacing between staples at the upper end of a roll or at the end overlap of two rolls shall not exceed one foot (1").

e. Matting shall be continued beyond the edge of the mulched or seeded area at least one foot at the sides and three feet at the top and bottom of the area. If existing vegetation or structures mark the boundaries of the area, the matting shall be continued into the stable vegetated area or to the edge of the structure.

f. The upper end of the matting at the top of the area shall be buried in a trench at least eight inches (8") deep.

g. The matting shall make uniform contact with the slope face underneath. No "bridging" of rills or gullies is allowed.

E. Bank and Channel Protection – Stone Filling (Rip-Rap)

1. The ground surface on which bank or channel protection is to be placed shall be free of brush, trees, stumps, and other objectionable material and shall be dressed to a smooth surface. Material shall be removed to the lines, grades, and depth shown on the plans, or as directed by the ENGINEER, to permit placement with the required material. Filled areas and bedding material shall be installed and compacted in accordance with applicable provisions of Section 02221 of these specifications.

2. Stone Filling shall be placed in a manner that will produce a reasonable well-graded mass of stone with smaller stone fragments filling the space between the larger ones, so as to result in the minimum practicable amount of voids. The final section of stone filling shall be in conformance with the lines, grades, and thickness shown on the plans, of as directed by the ENGINEER. Stone Fill used for bank or channel protection shall be placed to its full course thickness in one operation, and in such a manner that the underlying material will not be displaced or worked into the layer of stone filling. Placement of stone fill upon bedding material, when required, shall be carefully controlled to avoid disruption and damage to the layer of bedding material. The stone fill shall be placed such that there will be no pockets of uniform size material.

3. A Geotextile mat shall be installed under all stone fill in accordance with the manufactures recommendations, and as further directed by the ENGINEER. The geotextile can be joined by overlapping or sewing. When overlapping is being utilized, up-stream/up-slope sections shall always overlap down-stream/down-slope sections. Anchor the geotextile firmly at the top of the slope using an anchor trench or pins, or other means approved by the ENGINEER. When placing the geotextile along a stream or other places where water movements are expected, anchor the toe of the geotextile with anchor trench, to prevent scour beneath it.

F. Hydromulching

1. Substrate and Seedbed Preparations.

a. Examine substrates and conditions where materials will be applied. Apply product to geotechnically stable slopes that have been designed and constructed to divert runoff away from the face of the slope. Do not proceed with installation until satisfactory conditions are established.

b. Depending upon project sequencing and intended application, prepare seedbed in compliance with other specifications.

2. Installation

a. Strictly comply with equipment manufacturer's installation instructions and recommendations. Use approved hydro-spraying machines with fan-type nozzle (50-degree tip). To achieve optimum soil surface coverage, apply the hydromulch from opposing directions to soil surface. Rough surfaces (rocky terrain, cat tracks and ripped soils) may require higher application rates to achieve 100% cover. Slope interruption devices or water diversion techniques are recommended when slope lengths exceed 100 feet (30 m). Maximum slope length is for product applications on a 3H:1V slope. For application on steeper slopes, slope interruption lengths may need to be decreased based on actual site conditions. Not recommended for channels or areas with concentrated water flow. The hydomulch may be applied on saturated soils and does not require a curing period to be effective. No chemical additives with the exception of fertilizer, liming and biostimulant materials should be added to this product.

b. For Erosion Control and Revegetation: To ensure proper application rates, measure and stake area. For maximum performance, apply the hydromulch in a two-step process*:

I. Step One: Apply fertilizer with specified prescriptive agronomic formulations and 50% of seed with a small amount of hydromulch for visual metering.

II. Step Two: Mix balance of seed and apply the hydromulch at a rate of 50 lb per 125 gallons (23 kg/475 liters) of water over freshly seeded surfaces. Confirm loading rates with equipment manufacturer. Do not leave seeded surfaces unprotected, especially if precipitation is imminent.

*Depending upon site conditions the hydromulch may be applied in a one-step process where all components may be mixed together in single tank loads. Consult with Manufacturer for further details. Best results and more rapid curing are achieved at temperatures exceeding 60°F (15°C). Curing times may be accelerated in high temperature, low humidity conditions with product applied on dry soils. Over-application of product may inhibit germination and plant growth.

c. Mixing: A mechanically agitated hydraulic-application machine is strongly recommended:

I. Fill 1/3 of mechanically agitated hydroseeder with water. Turn pump on for 15 seconds and purge and pre-wet lines. Turn pump off.

II. Turn agitator on and load low density materials first (i.e. seed).

III. Continue slowly filling tank with water while loading fiber matrix into tank.

IV. Consult application and loading charts to determine number of bags to be added for desired area and application rate. Mix at a rate of 50 lb of hydromulch per 125 gallons (23 kg/475 liters). Contact Equipment manufacturer to confirm optimum mixing rates.

V. All hydromulch should be completely loaded before water level reaches 75% of the top of tank.

VI. Top off with water and mix until all fiber is fully broken apart and hydrated (minimum of 10 minutes — increase mixing time when

applying in cold conditions). This is very important to fully activate the bonding additives and to obtain proper viscosity.

VII. Add fertilizer.

VIII. Shut off recirculation valve to minimize potential for air entrainment within the slurry.

IX. Slow down agitator and start applying with a 50-degree fan tip nozzle.

X. Spray in opposing directions for maximum soil coverage.

d. Application Rates: These application rates are for standard conditions. Designers may wish to reduce rates to encourage faster vegetation establishment or may need to increase application rates on rough surfaces.

Slope Gradient / Condition	**English**	**SI**
≤ 4H to 1V	2500 lb/ac	2800 kg/ha
> 4H to 1V and ≤ 3H to 1V	3000 lb/ac	3400 kg/ha
≥ 3H to 1V and ≤ 2H to 1V	3500 lb/ac	3900 kg/ha
> 2H to 1V and ≤ 1H to 1V	4000 lb/ac	4500 kg/ha
> 1H to 1V	4500 lb/ac	5100 kg/ha
Below ECB or TRM	1500 lb/ac	1700 kg/ha
As infill for TRM*	3500 lb/ac	3900 kg/ha

*Use only approved and tested TRMs to create the GreenArmor™ System

3. Cleaning and Protection

a. After application, thoroughly flush the tank, pumps and hoses to remove all material. Wash all material from the exterior of the machine and remove any slurry spills. Once dry, material will be more difficult to remove.

b. Clean spills promptly. Advise OWNER of methods for protection of treated areas. Do not allow treated areas to be trafficked or subjected to grazing

3.06 MAINTENANCE

A. Begin maintenance immediately after planting.

B. Maintain turf for a period as required to establish an acceptable stand, as determined by the ENGINEER.

C. 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.

3.07 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. Treat, repair or replace damaged landscape Work as directed.

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.

E. Remove all temporary Erosion and Sediment Control Measures.

3.08 INSPECTION AND ACCEPTANCE

A. When the landscape Work is completed, including maintenance, the ENGINEER will make an inspection to determine acceptability.

B. Restoration resulting in growth/coverage of less than 80% shall be considered unacceptable by the ENGINEER and shall require repair or reseeding. Excessive weed growth within the restored areas shall be considered unacceptable.

B. Evaluation of the restoration Work shall take place two to four (2-4) weeks after initial seeding.

C. Where inspected landscape Work does not comply with the requirements, replace rejected work and continue specified maintenance until re-inspected by the ENGINEER and found to be acceptable.

1. Remove rejected plants and materials promptly from the Project site.
2. Reseeding shall be performed as needed until all sites are successfully stabilized.

END OF SECTION

SECTION 02485

TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.01 DESCRIPTION

A. The CONTRACTOR shall furnish all supervision, coordination, labor, materials, equipment and incidentals required to perform all tree and plant protection as shown, specified, and otherwise required to complete the Work.
B. The CONTRACTOR shall perform all tree and plant protection as necessary along the line of the Work to be completed.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02100, Clearing
B. Section 02480, Landscaping and Restoration

1.03 QUALITY ASSURANCE

A. Codes and Standards: State and local laws and code requirements shall govern the hauling and disposal of trees, shrubs, stumps, roots, rubbish, debris and other matter.

1.04 DEFINITIONS AND QUALIFICATIONS

A. Certified Arborist - An Arborist currently certified by the International Society of Arboriculture (ISA), who has the knowledge, training, and experience in management of trees and shrubs during site planning, site development and construction.
B. Care of Trees - Steps taken prior to, during and post construction to ensure the health and structural integrity of the trees to be conserved. This may include but not limited to: pruning, cabling, pest control, fertilization, root zone treatment, root pruning, etc.
C. Caliper - Caliper measurement of the trunk shall be taken six inches above the ground up to and including four inch caliper size. If the caliper at six inches above the ground exceeds four inches, the caliper should be measured at 12 inches above the ground.
D. Consulting Arborist - An Arborist currently certified by the International Society of Arboriculture (ISA), who has the knowledge, training, and experience in management of trees and shrubs during site planning, site development and construction. This position is hired by and given authority by the Engineer or Owner to oversee all aspects of tree and vegetation protection and planting during construction.
E. DBH - Diameter of a tree at 4.5 feet above grade.
F. Drip Line - The area delineated by the spread of the crown of a single or group of plants.
G. Plants - All vegetation with the exception of turf.
H. Protection Zone Barriers - Fencing and signage installed to limit access to the Plant Protection Zone and or Root Protection Zone as needed to prevent damage to the plant.
I. Plant Protection Zone (PPZ) - The area surrounding a tree defined by a specific distance in which construction related activities should be avoided. To be used to protect the above ground portions of the tree.
J. Root Protection Zone (RPZ) - The soil area surrounding a tree defined by a specific measurement in which excavation, compaction and other construction related activities should be avoided or mitigated. Diameter of the Root Protection zone to be determined in most cases by the formula (DBH" x 1.5 = X').
K. Suitability of Conservation - A relative rating system that combines tree health, structure with species tolerance for development.

1.05 PLANNING PHASE

A. The Consulting Arborist shall be involved at an early stage in the planning process.
B. The Consulting Arborist's input shall include an evaluation of all trees impacted by the proposed construction. The evaluation shall include the suitability of conservation based upon the impact of the proposed construction.
C. A Plant Protection Report and Plan shall be developed for the trees to be conserved on the site. This report shall take into consideration:

1. Plant health
2. Structural integrity
3. Species characteristics
4. Age and longevity
5. Cost-benefit analysis

D. A Plant Protection Plan shall include specific steps to be taken to reduce the impact of construction on the trees to be conserved. This should include but not limited to:

1. Specific delineation of plant protective barriers
2. Storage locations for construction material
3. Access points and paths for equipment
4. Care of trees prior to, during and post construction

E. Consequences need to be established for damage to plants or violations to the Plant Management Plan.
F. Consulting Arborist has the authority to "Stop Work" in order to stop or prevent damage to plant material.

1.06 PRECONSTRUCTION

A. All removals to be verified by the Consulting Arborist.

1. Plants scheduled for removal shall be identified and marked prior to removal.

B. Plant protection barriers to be installed as per specifications.
C. Plant protection barriers to be inspected and approved by the Consulting Arborist.
D. Review the "Care of Trees" with the CONTRACTOR and/or sub-contractor(s).
E. Plant Protection Plan objectives, specifications and consequences shall be reviewed with the project manager, CONTRACTOR, and sub-contractor(s).

1.07 CONSTRUCTION

A. Adherence to the Plant Protection Plan shall be monitored by the Consulting Arborist during all aspects of the construction. Consulting Arborist will provide reports as requested.
B. Lack of compliance with the Plant Protection Plan shall be reported. The report shall include:

1. Details of the violation
2. Remedies that need to be implemented
3. Consequences for the violation, including remedial measures

C. CONTRACTOR will be responsible for all remedies recommended by the Consulting Arborist
D. Consulting Arborist shall directly monitor any and all work to be performed on plants, this includes pruning, cabling, pest control, fertilization, root zone treatment, root pruning, etc. or any work within the Root Protection Zone (RPZ). This does not include removals.

E. A Certified Arborist meeting the requirements in Qualifications and Definitions shall perform all tree related work with the exception of removal, stump grinding and clean up following pruning or stump grinding.

1.08 POST CONSTRUCTION

A. Upon completion of the construction the Consulting Arborist will present a report to include any and all violations of the Plant Protection Plan, and detail any measures to be taken to address health concerns of the plants.

B. A long term care plan should be implemented which shall include maintenance of new and existing plants. Plan should include:

1. Time frame
2. Irrigation requirement
3. Fertilization requirement
4. Pest control requirements
5. Removal of tree support systems
6. Remedial steps as per consequences for violations to the Plant Protection Plan

1.09 GUARANTEE

A. The CONTRACTOR shall guarantee that Work performed under this Section will not permanently damage trees, shrubs, turf or plants designated to remain, or other adjacent work or facilities. If damage resulting from the operations of the CONTRACTOR appears during the period up to 12 months after completion of the project (or for a period specified on the Contract Drawings, whichever is longer), the CONTRACTOR shall replace damaged items at no expense to OWNER.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 PLANT PROTECTIVE BARRIERS

A. Fencing to be installed at a distance and location specified in plans.

1. Minimum distance from the tree should be to the drip line.
2. Plastic orange construction fencing constructed of high density extruded and stretched polyethylene fabric with 2″ maximum opening in pattern and weighing a minimum of 0.4 lbs per foot, remaining flexible from -60 to 200 °F secured with plastic bands, galvanized wire, or stainless steel wire ties and supported by t-posts spaced no more than 8 feet apart or at a distance to prevent drooping. Shall maintain a minimum height of 4 feet.
3. Signage: A sign stating that the area is a plant protection zone will be installed on all sides in prominent and visible locations.
4. Fencing shall not be installed to create a hazard by being a visibility barrier to vehicular or pedestrian traffic.
5. Fencing will be maintained by the CONTRACTOR in good condition for the duration of the construction and final mobilization of equipment from the site.
6. Weeding, mowing, and trash pickup will be maintained by the CONTRACTOR for the duration of the construction.
7. Under no circumstances shall any construction activity happen within the Plant Protective Zone without authorization of the CONSULTING ARBORIST.

3.02 EXCAVATION

A. Excavation outside the Plant Protective Zone

1. Redirect roots within the excavation where possible. For larger roots, expose them beyond the excavation as needed to allow redirection without breakage.
2. Root pruning within the excavation shall be completed according to root pruning specifications, in Part 3.03 of this Section.
3. Shoring shall be used to prevent sloping or benching.
4. The excavated area around the existing tree roots shall be backfilled as soon as construction activities permit with the specified or approved materials.
5. If the excavated area around the existing tree roots is not backfilled within 4 hours, all roots shall be kept moist, to prevent desiccation. Roots shall be covered with a biodegradable material, burlap, peat moss, topsoil, etc.
6. Backfill where applicable shall consist of original soil and subsoil placed in original layering.

B. Excavation within the Plant Protective Zone

1. Every effort should be made to avoid excavation within the Plant Protective Zone.
2. Tunneling, or pneumatic ram should be used to avoid open trenching.
3. If tunneling cannot be done, pneumatic excavation shall be used.
4. Use only hand tools around roots once pneumatic excavation has been completed.

3.03 ROOT PRUNING

A. Existing tree roots greater than 1 inch (25 mm) in diameter, measured at the edge of excavation, shall be pruned within 4 hours of the time they have been damaged by construction activity.
B. The severed root shall be pruned at the edge of excavation, or 3 inches (75 mm) beyond the entire damaged portion of the tree root if damaged root extends beyond the edge of excavation into undisturbed soil.
C. Pruning shall be in accordance with ANSI A300 Part 1 Standard Practices Pruning and ANSI Z133-2012 Arboricultural Operations Safety Requirements.

1. All cuts shall be cleanly made with sharp tools.
2. The cutting surfaces of all tools shall be washed with a disinfectant at the start of any work on a tree to prevent the spread of plant diseases.

D. Do not apply tree paint to pruning cuts.

3.04 CROWN PRUNING

A. All removal work shall be performed following ANSI Z133-2012 Arboricultural Operations Safety Requirements.
B. Pruning shall be in accordance to ANSI A300 Part 1 Standard Practices.

1. Trees as shown in the contract documents shall be pruned so the resulting crown retains the growth habit of the tress species.
2. Any and all branches interfering with or hindering the healthy growth of the tree shall be removed.
3. All diseased branches and all dead branches 1 inch (25 mm) or more in diameter shall be removed.
4. Any branch which may be partly dead yet has a healthy lateral branch at least one third the diameter of the parent branch shall be removed beyond the healthy branch.
5. All stubs or improper cuts resulting from former pruning shall be removed.

6. All cuts shall be cleanly made with sharp tools as close to the parent trunk or limb as possible without disturbing the bench bark ridge or callus collar.

C. Do not apply tree paint to pruning cuts.
D. Any structural defects found within the tree shall be reported in writing to the Consulting Arborist.

3.05 CROWN DAMAGE PREVENTION

A. The choice of equipment can greatly reduce the potential damage to the tree's crown. All efforts should be made to use equipment that poses the least amount of risk to the tree.
B. To provide clearances for equipment, limbs shall be tied back as long as the limbs are flexible enough to be tied back without breaking. Using a material at least 3/4" wide or more to prevent damage to the bark.
C. In some cases, pruning can accomplish necessary clearance. This will be allowed with authorization from the Consulting Arborist. Pruning cannot damage the shape, structure, or health of the tree.
D. Ties will be installed as close to the commencement of construction near the tree and shall be removed as soon as construction in that area is completed. They shall be removed during the growing season after no more than 48 hours and not replaced for 24 hours.

3.06 REMOVAL

A. All removal work shall be performed following ANSI Z133-2012 Arboricultural Operations Safety Requirements.
B. The CONTRACTOR shall be responsible to coordinate all work involving utilities with the respective utility company. All trees shall be topped and limbed before felling unless otherwise approved. Stumps of trees removed under this item for removal shall be grubbed, cut, ground to the depth of 6 inches (150 mm) below grade or as specified in the contract documents.
C. All stump holes shall be backfilled with topsoil, unless otherwise specified in the contract documents and backfill shall be compacted. Unless otherwise specified in the contract documents, grass shall be established on stump holes.

3.07 CABLING AND BRACING

A. Cabling and bracing shall be in accordance ANSI A300 Part 3 Support System Standard Practices.
B. Cable location and layout shall be approved by the Consulting Arborist.
C. Cabling and Bracing shall not be used in a tree that has been deemed a hazard by the Consulting Arborist.

3.08 VERTICAL MULCHING

A. Locations of work shall include areas within the dripline or wider root zone of existing trees to be preserved as shown on the contract documents.
B. Appropriate drilling tools shall be used for drilling of holes for root zone restoration. Drilling equipment shall be hand held or light weight devices (no heavy machinery) so as to avoid further impact to tree roots through compaction.
C. Holes shall be drilled and existing soil removed within a zone beginning 3 inches (75 mm)from the trunk of the specified tree and extending to its dripline on an approximately 2 foot (0.6 M) x 2 foot (0.6 M) grid. Dimensions of holes or drill size shall be approximately 2 inch (50 mm) in diameter and a minimum of 12 inches (300 mm) deep. Efforts should be made to minimize drilling through large tree roots (especially near the trunk).
D. When woody roots are encountered, the drill hole shall be moved to avoid root damage.

E. The hole shall be completely filled to original grade as follows, to be determined by the Consulting Arborist:

1. Method 1: with mortar sand.
2. Method 2: with mortar sand amended with Mycorrhizal Fungi.
3. Method 3: with compost.
4. Method 4: with compost amended with Mycorrhizal Fungi.

F. When mycorrhizal fungi are specified, they shall be a dry granular powder specifically designed for vertical mulching applications. Apply in accordance with the manufacturer's recommendations.

3.09 TRANSPLANTING

A. Plant Material

1. All plant material shall be approved by the Consulting Arborist before it is planted.
2. All plant material shall meet the ANSI Z60.1 2004 standards.
3. Plant material will be free of insects and diseases.
4. Plant material will be free from physical damage.

B. Planting

1. Planting shall follow the ANSI A300 Transplanting standard.
2. Plants shall be placed so that the top of the root ball is at or slightly above grade.
3. No soil shall be added on top of the root ball.
4. All burlap and wire cages shall be cut and removed from the top and sides of the root ball.
5. Back fill will be with approved topsoil meeting ASTM D 5268.
6. Sample(s) of the topsoil shall be taken by the Consulting Arborist and tested prior to its use.
7. A 3" layer of double shredded mulch shall be added on top of the root ball but not within 3" of the trunk.
8. "Hot" or "sour" mulch shall not be used.
9. All trees shall be staked using 2 stakes for trees up to 3 inches, 3 stakes for trees 3 to 6" caliper and over 6" caliper 3 duck bill anchors should be used.
10. Cables for duckbill anchors shall be flagged with orange survey tape. Tape maintained for 2 years.
11. All support systems shall be checked and repaired for damage to the tree or the support system itself by the CONTRACTOR every 3 months for a period of 2 years at which time they may be removed with authorization of the Consulting Arborist.

3.10 REPAIR AND REPLACEMENT CONSEQUENCES

A. Plant material not scheduled for removal, that is damaged or destroyed by construction operations shall be repaired or replaced by the CONTRACTOR as required by the Consulting Arborist.

1. Repairs to the plant material shall be performed by a Certified Arborist under the supervision of the Consulting Arborist.
2. Replacement of plant material shall follow the transplanting specifications, in Part 3.09 of this Section
3. Number and size of the replacements shall be determined by the Consulting Arborist to provide equal landscape value of the plant material lost.

B. Trees not scheduled for removal that are destroyed or damaged beyond restoration as determined by the Consulting Arborist shall be replaced as follows: Appropriate species to be chosen by the Consulting Arborist

1. Damaged trees 4″ in caliper or less shall be replaced with tree of the same size.
2. Damaged trees over 4″ and less than 8″ be replaced with a tree 4″.
3. Damaged trees over 8″ and less than 12″ to be replaced with 2 trees 4″ in caliper.
4. Damaged trees over 12″ and less than 18″ to be replaced with 3 trees 4″ in caliper.
5. Damaged trees over 18″ shall be replaced at 1 4″ caliper tree for every 6″ of caliper.

END OF SECTION

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SECTION 02500

PAVING AND SURFACING

PART I - GENERAL

1.01 SCOPE OF WORK

A. The CONTRACTOR shall furnish and install all paving and surfacing as indicated on the Contract Drawings and specified herein, and dispose of all excess material.

1. All existing blacktop paved roads which are removed or damaged during the construction shall be repaired and resurfaced.
2. Work under this Section shall not begin until the backfill has been installed and compacted in accordance with the Contract Documents, and approved by the ENGINEER.
3. Final surfacing of bituminous pavements and walks shall not be performed until all excavation and backfilling which could affect the Work has been completed, and approved by the ENGINEER, and the heavy construction equipment is no longer required to traverse the areas of proposed pavements and walks.
4. All permits necessary from the Village, Town, County or State Highway Departments shall be obtained and paid for by the CONTRACTOR. The terms of the permit shall be adhered to as if they were a part of these Specifications.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Hot Mix Asphalt (HMA) Pavement and Driveways

1. Unless otherwise directed by the ENGINEER, all HMA materials and installation procedures shall conform to the requirements of the Contract Documents, and the NYSDOT Standard Specification Section 402 – Hot Mix Asphalt (HMA) Pavements.
2. The composition of all HMA mixtures to be used shall be in accordance with Table 401-1 "Composition of Hot Mix Asphalt Mixtures" of the NYSDOT Standard Specifications. Mixtures to be utilized on this project shall be 37.5-mm F9 Base, 80 series compaction (NYSDOT Item No. 402.378903), 25.0-mm F9 Binder, 80 series compaction (NYSDOT Item No. 402.258903), and 12.5-mm F3 Top, 80 series compaction (NYSDOT Item No. 402.128303), unless otherwise directed and approved by the ENGINEER.
3. HMA mixtures installed in NYSDOT roadways shall use 70 series compaction: Base shall be NYSDOT Item No. 402.377903, Binder shall be NYSDOT Item No. 402.257903, and Top shall be NYSDOT Item No. 402.127303.

B. Tack Coat

1. Unless otherwise directed and approved by the ENGINEER, Tack coat material shall meet the requirements of the Contract Documents, and shall further conform to the requirements of the NYSDOT Standard Specifications Section 407 – Tack Coat, and subsection 702-90 – Asphalt Emulsion for Tack Coat.

B. Stone/Gravel Driveways and Parking Areas

1. Subbase materials shall be approved, well-graded crushed gravel, or well-graded crusher run stone, conforming to the requirements of the NYSDOT Standard Specifications Section 304-2.02, for Type 4 subbase material (NYSDOT Item No. 304.14).
2. Finish topping material for Stone/Gravel Driveways and Parking areas shall be 2" Crusher Run Limestone, meeting the requirements of NYSDOT 304-2.02, for Type 2 subbase material.

C. Concrete For Roadways

1. When required, and unless otherwise directed and approved by the ENGINEER, Roadways shall be constructed of NYSDOT Class A concrete, having a minimum 28 day compressive strength equal to 4000 psi, and a 5-7% entrained air with a slump not to exceed 3".
2. Reinforcing bars (when required) shall conform to the requirement of ASTM A615 Grade 40. Reinforcing mesh (when required) shall conform to the requirements of ASTM A185, and shall be 6 x 6 x 10 gauge.
3. Expansion joint filler material shall conform to ASTM D1752.
4. When concrete material is to be used for the repair of a roadway under the jurisdiction of the NYSDOT, the concrete mixture proposed must be approved by the NYSDOT prior to its use.

D. Gravel Shoulder Material

1. Unless otherwise directed by the OWNER or ENGINEER, materials used for construction/repair of roadway shoulders shall be 2" Crusher Run Gravel or 2" Screened Asphalt Millings as shown on the Contract Drawings, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General

1. The CONTRACTOR shall take note of the payment limits detailed on the Contract Drawings, and as are further specified in these Technical Specifications, as work performed outside of the pay limits, necessary and required due to the CONTRACTOR'S actions, will be performed at the CONTRACTOR'S expense.
2. The CONTRACTOR shall maintain ingress and egress along all roadways, driveways, and parking areas throughout the course of the Work. The CONTRACTOR shall be required to provide for continued Maintenance and Protection of Traffic (MP&T), in accordance with the Manual of Uniform Traffic Control Devices (MUTCD), latest edition.
3. The CONTRACTOR shall provide for all necessary and required temporary measures, as directed by the ENGINEER, to provide for safe and easy crossing of all roadways, driveways, and parking areas, until the final restoration measures have been completed. This work shall include, but not be limited to, repair of pot-holes, placement of cold-patch, placement and

compaction of subbase material, placement of steel plating, placement of transition berms, and all other similar measures necessary and required, as determined by the ENGINEER. The cost of this work shall be included in the unit prices bid for the various applicable restoration items.

4. All roadways, driveways, and parking areas shall be kept cleaned, clear of debris, spoils, and construction materials, while this work is being performed.
5. The CONTRACTOR shall be required to saw-cut all existing asphalt and concrete roadways, driveways, parking areas, and sidewalks when the Work must be performed within their boundaries. Saw-cutting must be performed by mechanical means, with an approved saw specifically designed for the saw-cutting of asphalt and concrete. The use of a "pizza-cutter" attachment or similar means will not be permitted, unless otherwise directed by the ENGINEER.
6. The CONTRACTOR will not be permitted to perform final restoration Work, until all other work performed within the proposed restoration area (i.e. waterline, services, structures, backfilling, testing) has been tested and accepted by the ENGINEER.
7. When ingress and egress can not be maintained or provided through a proposed roadway, driveway, or parking area in which restoration work is required, the CONTRACTOR shall provide for alternate driving routes, or parking areas, and shall maintain these facilities until ingress and egress can be provided again. The cost of this work shall be included in the unit prices bid for applicable restoration Bid Items.
8. All Work affecting paved roads, streets or highways shall be done in a manner satisfactory to the authority having jurisdiction over the particular pavement.

B. Sub-grade Preparation

1. After backfilling and grading is completed, the sub-grade shall be shaped and compacted in accordance with the Contract Documents, and as further directed by the ENGINEER.
2. All deleterious and unsuitable sub-grade materials, to include but not be limited to, soft materials, boulders, vegetation, and loose stones shall be removed and replaced with well compacted select backfill material.
3. As the Contract Documents require the full depth installation of select backfill material in all roadway, driveway, parking, and sidewalk areas, the sub-grade material, installation, and preparation shall meet the requirements of the Contract Documents, specifically as stated in Section 02221.
4. If at the time in which the CONTRACTOR performs the final restoration work included under this Section, and the ENGINEER determines that the sub-grade material previously placed is "contaminated", or to wet to be considered acceptable, the CONTRACTOR shall be required to remove and replace as much of the material as is directed by the ENGINEER. It shall be the CONTRACTOR'S responsibility to take all measures necessary and required to prevent this situation, and as such, any removal and replacement work required, shall be performed at the CONTRACTOR'S expense.
5. The CONTRACTOR shall grade the sub-grade, such that surface water drains off of it, to help prevent the saturation of sub-grade material.

C. Hot Mix Asphalt (HMA) Pavement and Driveways

1. All HMA shall be produced and installed in conformance with the Contract Documents, the NYSDOT Standard Specifications Section 402, and as directed by the ENGINEER.
2. All work performed outside of the payment limits, as are specified by the Contract Documents, will be performed at the CONTRACTOR'S expense. The maximum pay limits for this work shall be determined by taking the inside diameter (I.D.) of the pipe installed within a particular roadway, driveway, parking, or sidewalk area, adding 28-inches, and then adding 1-foot of cut-back area either side of the trench. In all cases, the pavement will be required to be cut back one foot (1') onto undisturbed earth on each side of the excavation. Therefore, in areas in which an 8" waterline has been installed, the maximum allowable trench pay limit would be 3', plus 2' for the two 1' cut backs, which equates to a maximum pay limit of 5'. If the area restored is less than the maximum allowable pay limit, than the CONTRACTOR shall receive payment for the limits actually restored. The CONTRACTOR shall receive payment for all areas restored outside the maximum pay limits when work outside the pay limits is approved, or directed, by the ENGINEER.
3. The CONTRACTOR shall take note that if the CONTRACTOR "lays" the top of pipe trench back beyond the trench pay limit, the CONTRACTOR will be responsible to pay for all backfilling and restoration work required outside the pay limits, unless otherwise directed by the ENGINEER. The CONTRACTOR shall also note that the restoration section must extend a minimum 1' beyond the pipe trench limit created by the CONTRACTOR.
4. The CONTRACTOR shall saw-cut all existing bituminous pavements, driveways, parking areas, and sidewalks their full depth, to provide for a neat, strait, clean edge prior to the placement of any HMA material. If at any time during the restoration process, the edge is damaged or broken off (smashed down), regardless of who damaged or broke the edge off, the CONTRACTOR shall be required to saw-cut the edge again, a minimum of 12", to remove the broken section, and provide for a neat, strait, clean edge. If the integrity of the top course of existing HMA is such that it can be cut and removed from the binder or base course, as determined by the ENGINEER, than the CONTRACTOR shall have the option of only cutting and removing the top course material to provide for a cut back, due to a damaged or broken off edge, and would not have to provide a full-depth saw cut, removal, and repair. In any event, it shall be the CONTRACTOR'S responsibility to provide and perform all necessary and required measures to protect the integrity of all edges. No additional compensation will be provide for this work when outside the payment limits, unless otherwise directed by the ENGINEER.
5. Whenever HMA restoration is required where existing bituminous pavement does not exist on both sides of the restoration area, a minimum section of 24-inches in width shall be placed, to help prevent the replacement section from breaking off. In addition, if the restoration area is such that existing HMA will remain (exist) on either side, but the existing HMA section is less than 24" in width, the proposed restoration area shall be extended all the way to the edge, to include the existing section which is less than 24" in width.

6. The CONTRACTOR shall place tack coat on all existing bituminous and concrete edges prior to installation of the HMA. The tack coat shall be applied just prior to the HMA placement. Tack coat applied days before the HMA placement, or tack coat which has become dirty or wet, will not be accepted, and the CONTRACTOR will be required to apply the tack coat again, at the CONTRACTOR'S expense, just prior to the HMA placement.
7. All roadways, driveways, parking areas, and sidewalks requiring HMA restoration shall be restored to match the existing (or preconstruction) lines and grades, unless otherwise directed by the ENGINEER. The minimum compacted depth of the HMA section shall be as stated below, or shall otherwise match the depth of the existing section if greater than the minimum depths detailed below:

Item	DOT HMA Roadways
Base (NYSDOT Item No. 402.377903)	4 inch
Binder (NYSDOT Item No. 402.257903)	3 inch
Top (NYSDOT Item No. 402.127303)	1.5 inch

Item	Municipal HMA Roadways	Municipal Oil and Chip Roadways	Driveway, Parking, and Sidewalk Areas
Base (NYSDOT Item No. 402.378903)	N/A	N/A	N/A
Binder (NYSDOT Item No. 402.258903)	3 inch	3 inch	3 inch
Top (NYSDOT Item No. 402.128303)	1.5 inch	1.5 inch	1.5 inch

   a. Gutters, Curbs, & Miscellaneous Area: Shall be constructed to the dimensions as directed by the ENGINEER. The CONTRACTOR and the ENGINEER shall agree to these dimensions prior to this work being performed.

8. The layers of HMA described above shall be placed in single lifts, unless otherwise directed by the ENGINEER.
9. When multiple layers of HMA are required to complete the restoration work, the CONTRACTOR shall be required to keep the top of each previous layer clean, until the next layer is applied. The CONTRACTOR will be required to perform all work necessary and required to clean any layer placed, that is to dirty to allow the placement of the next layer, as determined and directed by the ENGINEER. The cost of this work, when required, shall be paid for by the CONTRACTOR. It shall be the CONTRACTOR'S sole responsibility to take all actions and measures necessary and required to keep the layers clean.
10. HMA shall be produced, delivered to the work site, and incorporated into the Work within 50°F of the temperature specified by Table 401-1

"Composition of Hot Mix Asphalt Mixtures" of the NYSDOT Standard Specifications. For the HMA products noted above to be incorporated into this Work, the placing temperature range for the HMA material shall be 248°F – 329°F. All HMA material which is not within this temperature range at the time of placement will be rejected, and the CONTRACTOR will not be allowed to place the material, and will be required to remove the material from the project site. The CONTRACTOR will be responsible to pay for all costs associated with removing and disposing of HMA material which has been rejected.

11. All HMA material shall be transported to the site in equipment approved by the ENGINEER. Transporting vehicles shall have clean, smooth and tight metal boxes. The HMA mixture shall be covered with waterproof covers during transportation. If a flexible cover is used, it must overlap the vehicle's sideboards and back by a minimum of 6", and be securely fastened. The inside of the surface of the vehicle body may be lightly coated with a release agent, meeting all State and Federal environmental requirements. The use of Petroleum products or solvents will not be permitted for use as release agents, on any equipment being utilized for the transportation or placement of HMA.
12. HMA material shall be dumped directly from the transportation vehicle, into the proposed placement area. The dumping of HMA material out of the transportation vehicle, onto the ground, and then picking it back up again, or several times, prior to placement, will not be allowed, unless otherwise directed by the ENGINEER. In the event that the ENGINEER has allowed for the HMA material to be dumped out of the transportation vehicle, prior to direct placement into the proposed placement area, the CONTRACTOR will still be required to meet all other conditions of the HMA placement, such as meeting the temperature requirement, and that the product remains clean, free from any dirt and etc. The ENGINEER will not be responsible for HMA that is rejected because it was too cold at the time of placement, or to dirty, just because the ENGINEER granted the CONTRACTOR permission to dump the HMA mixture from the transportation vehicle, in a temporary location.
13. HMA shall not be placed on any wet surface, or when the surface temperature is less than 50°F. In general, HMA top course material shall only be placed between the period of May 1st, up to and including the third Saturday of October, weather permitting.
14. All HMA shall be compacted in accordance with subsection 402-3.07 "Compaction" of the NYSDOT Standard Specifications, and as otherwise directed by the ENGINEER. All proposed compaction equipment must be approved by the ENGINEER prior to the start of any work.
15. In general, the HMA mixture shall be spread, struck off, and surface irregularities adjusted prior to compaction. Roll the surface when the mixture is in the proper condition, and rolling does not cause undue displacement, cracking, or shoving of the HMA material. Initially roll all courses with the roller traveling parallel to the centerline of the pavement, beginning at the edge, and then working toward the center. Roll banked curves starting at the low side edge, and working toward the super-elevated edge. Correct any displacement occurring as a result of reversing the roller direction, or from other causes, by the use of rakes and the addition of fresh HMA material. All visible defects such as shallow ruts, ridges, roller marks, cracking, tearing, segregation, loose or broken HMA, HMA mixed with dirt,

or any other irregularities as determined by the ENGINEER, shall be corrected to the satisfaction of the ENGINEER, at the CONTRACTOR'S expense. The CONTRACTOR shall be required to remove and replace any part of the work not approved by the ENGINEER, as directed by the ENGINEER, at the CONTRACTOR'S expense.

D. Stone/Gravel Driveways and Parking Areas

1. The sub-grade shall be prepared as specified in Section 3.01 B above.
2. As specified by the Contract Documents, in all roadway, driveway, parking, and sidewalk areas, the sub-grade material shall be select backfill material, and shall be installed the full depth of the trench. Therefore, the sub-grade material and the subbase material shall be the same material in these areas, being well-graded crushed gravel, or well-graded crusher run stone, conforming to the requirements of the NYSDOT Standard Specifications Section 304-2.02, for Type 4 subbase material (NYSDOT Item No. 304.14).
3. Finish topping material for Stone/Gravel Driveways and Parking areas shall be 2" Crusher Run Limestone (compacted depth), meeting the requirements of NYSDOT 304-2.02, for Type 2 subbase material. Subbase material shall be removed, or added, such that 2" of the Crusher Run Limestone can be installed, while matching the desired line and grade.

E. Concrete Roadways

1. When required, concrete roadways shall be constructed in accordance with the applicable sub-sections of Section 02510 "Concrete Sidewalks, Curbs, and Driveways" of these Specifications, and as may be further specified by the Contract Documents, or the agency having jurisdiction over the roadway in which the restoration is proposed.

F. Gravel Shoulders

1. The sub-grade shall be prepared as specified in Section 3.01B above.
2. Shoulder material shall be placed such that a minimum compacted depth of 4" is achieved; or as otherwise specified by the Contract Documents, or as further directed by the ENGINEER.
3. Shoulder material shall be placed in horizontal layers not exceeding 6" prior to compaction, with each layer being compacted by mechanical means approved by the ENGINEER. Compaction shall continue until a minimum of 95% of Standard Proctor Maximum Density is obtained.

END OF SECTION

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SECTION 02510

CONCRETE SIDEWALKS, CURBS AND DRIVEWAYS

PART 1 - GENERAL

1.01 DESCRIPTION

A. The CONTRACTOR shall furnish all supervision, coordination, labor, materials, equipment and incidentals required to furnish and install concrete sidewalks, curbs, and driveways as shown, specified, and required to complete the Work.

1. The Work includes, but is not limited to the following:
   a. Concrete sidewalks.
   b. Concrete sidewalks at driveways.
   c. Concrete curbs -- cast-in-place.
   d. Concrete driveway aprons.
2. All sidewalks, curbs, gutters, and concrete driveways that are removed, damaged or disturbed during the construction Work under this project shall be replaced or restored.
3. This Section also includes new installations of sidewalks, curbs, gutters, and concrete driveways where shown and specified.
4. Restoration of these Items which were damaged or disturbed will only be allowed in areas where the ENGINEER determines that restoration Work can be accomplished in a satisfactory manner. If, in the opinion of the ENGINEER, the required results of restoration Work cannot be obtained, these items must be removed and replaced.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02221 - Excavation, Backfill, and Trenching for Utility Systems
B. Section 02500 - Paving and Surfacing
C. Section 03300 – Cast In Place Concrete

1.03 QUALITY ASSURANCE

A. Testing Services

1. General: Testing of materials for compliance with technical requirements of the Specifications shall be the duty of a testing laboratory provided by the CONTRACTOR.
2. Responsibilities and duties of CONTRACTOR: The use of the testing service shall in no way relieve the CONTRACTOR of his responsibility to furnish materials and construction in full compliance with the Drawings and Specifications. The CONTRACTOR will be required to:
   a. Secure and deliver to the ENGINEER and the testing laboratory representative samples of the materials he proposes to use and which are required to be tested.
   b. Furnish labor as is necessary to obtain and handle samples.
   c. Deliver samples to laboratory as required.

1.04 REFERENCE STANDARDS

A. Comply with the applicable provisions and recommendations of the following, unless otherwise shown or specified.

1. Standard Specifications for New York State Department of Transportation, latest edition.

1.05 SUBMITTALS

A. Shop Drawings

1. Shop Drawings shall contain concrete design mix including material performance data, source of manufacture, sieve analysis, admixture data, and compressive cylinder test data.
2. They shall also contain material certificates certifying compliance with specifications when requested by the ENGINEER.
3. Test reports shall be included.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Concrete material mixes: The source of materials shall be acceptable to the ENGINEER. Materials shall conform to the following:

1. The select backfill materials where required shall be as specified in Section 02221 of the Specifications.
2. Stone subbase material: The stone subbase material specified herein shall be No. 1 Crushed Stone Material meeting NYS DOT Standard Specification 703-0201 or approved equal.
3. Concrete materials: Concrete for construction of curbs, sidewalks, and driveways shall be of cast-in-place and machine formed concrete meeting the mix requirements of NYSDOT Standard Specification Section 500 for Class A concrete, having a minimum 28 day compressive strength equal to 4000 psi, and 5-8% air content, with a slump range of 2.5" – 3.5".
4. Reinforcing Bars (where required): Reinforcing bars shall conform to the requirements of ASTM A615 Grade 40. Reinforcing mesh shall conform to the requirements of ASTM A185 and shall be 6 x 6 x 10 gauge.
5. Expansion joint filler: The expansion joint filler material shall conform to ASTM D1752.

PART 3 – EXECUTION

3.01 GENERAL

A. Unless otherwise approved by the ENGINEER, concrete sidewalk and driveways shall be completed in accordance with the NYSDOT Standard Specification 608-3.01, applicable sections of the American Concrete Institute (ACI) Manual of Concrete Practices, and all applicable local standards and specifications.

3.02 REMOVAL OF EXISTING CONCRETE ITEMS

A. The CONTRACTOR shall remove and dispose of all existing concrete sidewalks, curbs, gutters, and driveways where shown, specified or required for installation of new concrete Work.

B. Disposal of all removed concrete items as outlined above shall be at an off-site location and at the expense of the CONTRACTOR.

C. Where sidewalks, curbs, or driveways require removal, the CONTRACTOR shall remove such items to the limits shown on the Drawings. After removal of these items, the edges of the remaining concrete Work shall be smooth and adequate to provide a tight joint with the new concrete Work.

D. The CONTRACTOR shall remove sections of concrete items to the next existing joint where possible or saw cut the existing concrete item where no existing joint is available. The CONTRACTOR shall remove total concrete sections to next available joint where possible.

E. The CONTRACTOR shall protect adjacent Work when removing concrete items. Any damage to adjacent Work shall be removed and replaced or repaired by the CONTRACTOR.

3.02 SUBGRADE PREPARATION

A. Concrete Work Installed Over a Proposed Pipeline

1. For construction of sidewalk, curbs, gutters or driveways over an installed pipeline, the backfill material over the pipe to the proposed subbase shall be select backfill material as specified in Section 02221.
2. Backfill, compaction and preparation of the proposed subgrade and subbase material shall be as specified in Section 02221.
3. Final elevation of select backfill subbase shall be adequate to install the proposed concrete Work to the required elevations as shown on the plans or as required to meet existing work in the field.

B. Concrete Work - New or Replacement Installations

1. For new installations of sidewalks, curbs, gutters, or driveways, or in areas where existing concrete items were removed and are being replaced, the following shall apply:
   a. The CONTRACTOR shall remove and dispose of existing concrete sidewalks, curbs, gutters, or driveways prior to subgrade and subbase work.
   b. The CONTRACTOR shall excavate to required subgrade elevation and remove and stockpile topsoil for use at a later date in areas where no sidewalks, curbs, or driveways previously existed.
   c. Excavate to subgrade elevation required to install full depth sidewalk section plus proposed sidewalk subbase stone material.
   d. The CONTRACTOR shall fill in areas requiring the elevations of the concrete items to be raised, where indicated on the Drawings or as required to meet field conditions.
   e. Excavated materials shall be used for fill in areas under sidewalks only. All fill material shall be dry, free from debris, frozen materials, boulders, rocks, concrete, etc. and shall be approved by the ENGINEER. If fill material does not meet the requirements outlined above, the CONTRACTOR shall remove and dispose of the material and shall furnish and install fill material meeting these requirements at his expense. Extra excavated materials not required for fill shall be removed and disposed of by the CONTRACTOR.

f. Fill materials used under concrete curbs, gutters, and driveways shall be select backfill material as specified in Section 02221.

g. All concrete work including sidewalks, curbs, or driveways, shall be laid on a four (4) inch subbase which shall be thoroughly and uniformly compacted and tamped and shall be of No. 1 Crushed Stone, minimum 4" thick, in accordance with 2.1-A above.

h. No concrete work shall be installed on subbases which are muddy, frozen or have water thereon.

i. The CONTRACTOR shall tamp the proposed subgrade with a mechanical type tamper before installation of proposed stone subbase material.

j. If the ENGINEER determines that the existing subgrade is suitable for installation of the proposed concrete work, in areas where existing concrete work was removed, the crushed stone subbase will not be installed. The CONTRACTOR shall credit the OWNER based on the quantity of subbase material not installed in these areas.

k. The CONTRACTOR shall carefully remove any tree roots encountered that may affect the Work to a depth of four (4) inches below subgrade.

l. The CONTRACTOR shall locate all facilities which exist in the location of the new construction including water and gas valve boxes, manholes, property line survey stakes and adjust all such facilities to conform to the finished grade of the sidewalk. If any existing facilities are broken or damaged, the CONTRACTOR shall repair or replace such facilities to the approval of the ENGINEER or the agency having jurisdiction.

3.03 CONSTRUCTION OF CONCRETE SIDEWALKS AND DRIVEWAYS

A. General: The following items apply to construction of concrete sidewalks and driveways:

1. Concrete walks and driveways shall be one course concrete.
2. All sidewalks shall be a minimum of 4-inch thickness. Width of sidewalk shall be as indicated on the Drawings, or the same as the existing sidewalk adjacent to the Work.
3. All sidewalks crossing driveways and all driveway aprons shall be a minimum of 6-inch thickness and shall have wire mesh reinforcing installed. Wire mesh shall conform to requirements specified in this Section.
4. Concrete sidewalks and driveways shall be installed in the locations shown on the Drawings and to the grades as shown on the Drawings or required to meet field conditions.
5. Installation of sidewalks and driveways shall conform to NYSDOT Specifications and as outlined herein.
6. Concrete used for sidewalk and driveway aprons shall be as specified herein.
7. Formwork for sidewalks and driveways shall conform to the requirements specified in this Section.
8. All concrete sidewalks shall be scoured or saw-cut for construction joints in approximately five foot (5') long slabs, 1/3 the total thickness of the concrete, and expansion joints shall be installed at spacing of approximately 20 feet and at each side of a driveway.
9. Expansion joint filler material shall conform to the requirements as specified in this Section, and shall be installed at all joints between sidewalk and curb, building, etc.
10. Each concrete slab installed shall be bounded on all sides by a troweled border 1-inch wide.
11. Formwork shall be set to lines and grades with a pitch of ¼-inch per foot slope toward existing roads.
12. Finishing required for sidewalks and driveways shall be as specified in this Section.

13. Handicap ramps shall be installed in sidewalks and at locations as specified in this Section.
14. Suitable transitions from the proposed sidewalks to the existing house walkways shall be provided. The CONTRACTOR shall replace sections of the house walks as may be required to provide a suitable transition between sidewalks up to a maximum of five (5) feet from the proposed sidewalk.
15. Final landscaping and restoration shall be as specified in Section 02480.

3.04 CONSTRUCTION OF CONCRETE CURBS AND GUTTERS

A. Concrete curbs:

1. Construction of concrete curbs may occur either in areas where existing curbs were removed or in areas where no curbs previously existed.
2. Existing curbs and gutters shall be removed and disposed of prior to subgrade work and subbase installation where required.
3. Concrete curbs shall be either Type "A" (single curb) or Type "B" (curb-gutter combination) type as indicated on the Drawings.
4. Type "A" curbs shall have a minimum depth of 18-inches, width at top of curb of 6-inches, exposed curb face of 6-inches and shall conform to details shown on the Drawings. Type "B" combination curb-gutter shall be as specified below.
5. Concrete curbs shall be cast-in-place or constructed by the use of a curb forming machine to the size and shape shown on the Drawings and at the lines and grades shown on the Drawings and approved by the ENGINEER.
6. Concrete curbs shall be installed as one course concrete.
7. The CONTRACTOR shall install premolded expansion joint filler material for expansion joints where concrete curbs and gutters abut sidewalks, catch basins, manholes, and other fixed objects unless otherwise indicated.
8. The CONTRACTOR shall install expansion joints every 20 feet along curb installation and at both edges of driveways or other fixed object. Extend joint filler full width and depth of joint. Joint filler shall be furnished in one-piece lengths wherever possible. Protect top edge of joint filler material during concrete placement. Joint filler material shall conform to Specifications outlined in this Section.
9. Where concrete curbs intersect a driveway or sidewalk, the CONTRACTOR shall install a drop curb section. Drop curb sections shall be constructed to provide a 2'-0" transition from the elevation of the driveway or sidewalk to the top of curb on both sides of the driveway or sidewalk. Drop curb sections shall conform to details as shown on the Drawings.
10. Drop curb sections shall also be installed at handicap ramp locations. Refer to Item 3.05 for additional information on handicap ramp construction.
11. Formwork for curbs shall conform to the specifications outlined in this Section and shall extend for full curb depth and shall be braced and secured adequately so that no displacement of alignment will occur during placement of concrete. Forms shall be used which provide smooth plane faces for all exposed curb faces.
12. The CONTRACTOR shall conform to all applicable NYSDOT Specifications.
13. Concrete used for concrete curbs and gutters shall be as specified herein.
14. The CONTRACTOR shall install construction joints at end of placements and at locations where placement operations are stopped for a period of more than ½-hour, except where such placements terminate at expansion joints.
15. Where Type "A" single curbs are installed, the CONTRACTOR is responsible to grade or restore the shoulder at the curb face. Grading shall allow for proper drainage along the shoulder at the curb face. All shoulder grading and restoration shall be approved by the ENGINEER.
16. Landscape restoration shall conform to the requirements outlined under Section 02480.

17. All curbs at the end of a curb section or curved radius shall be installed with a 1'-0" knockout which can be removed at a later date.

B. Combination gutter-curb

1. In addition to the requirements outlined above for concrete curbs, the following applies:
   a. Combination gutter-curbs shall only be installed where specifically indicated on the Contract Drawings or where required to replace a gutter-curb section removed.
   b. Combination gutter-curbs shall be installed as a cast-in-place unit for small sections or by the use of a curb-forming machine in large areas.
   c. Combination gutter-curb assemblies shall have a base width of 24-inches of which 18-inches shall be concrete gutter. The Width of curb at top shall be 6-inches and height of curb shall be 12-inches. Refer to details shown on the Drawings.
   d. Finishing of the combination gutter-curb shall consist of screeding and floating to produce a smooth surface. A hand method shall be used only where mechanical floating is not possible. The CONTRACTOR shall adjust floating to compact surface and produce uniform texture. After floating, the surface shall be tested for trueness with a 10-foot straightedge. Concrete shall be distributed as required to remove surface irregularities, and repaired areas shall be refloated to provide a continuous smooth surface. The CONTRACTOR shall work edges of slabs, butters, back top edge of curb and formed joints with an edging tool and round to 1/4-inch radius. Tool marks on exposed surfaces shall be eliminated.
   e. The CONTRACTOR shall provide a broom finish of final gutter by drawing a fine hair broom across concrete surface perpendicular to traffic. On inclined slab surfaces, The CONTRACTOR shall provide a course, non-slip finish by scoring surface with a stiff bristled broom, perpendicular to traffic.

3.05 HANDICAP RAMPS

A. All sidewalks replaced adjacent to curbs, sidewalks adjacent to parking lots, sidewalks adjacent to a private roads open to public motor vehicle traffic, or highways shall be constructed so as to allow reasonable access to pedestrian crosswalks for physically handicapped persons, in accordance with Section 330 of the New York State Highway Law.

B. The above requirement for sidewalk ramps shall apply for all new sidewalk installations and shall also apply for sidewalk replacements. Even if the existing sidewalk does not have a handicap ramp, the replacement section, if it meets the above requirements, shall be installed with handicap ramps.

C. If a handicap ramp is installed at any location within an intersection, then a matching handicap ramp shall be installed where there are adjacent sidewalks across the intersection so there will be a continuous, safe, accessible path of travel. This requirement also applies to "T" intersections, channelization within intersections, and mid-block crossings.

D. All costs associated with installation of the required handicap ramps shall be included in the applicable unit prices or lump sums bid for the Bid Items covering the sidewalk and curb replacement under this project.

3.06 FORMWORK

A. Forms shall be metal, shall conform to the shape, lines, and dimensions of the required concrete section and shall be sufficiently tight to prevent leakage of mortar.
B. The inside of forms shall be coated with non-staining mineral oil or other approved material to prevent adhesion of concrete to the forms.
C. All formwork shall be completed, set to required lines and grades, and inspected by the ENGINEER prior to placing of concrete.
D. Forms shall be removed in such a manner as to insure the complete safety of the installed concrete work.
E. In no case shall the forms be removed until the members have acquired sufficient strength to support safely their weight and the load thereon.
F. The results of suitable control tests may be used as evidence that the concrete has attained sufficient strength.
G. The minimum time for removal of forms will be subject to the approval of the ENGINEER; however, the structural integrity of the concrete is the responsibility of the CONTRACTOR.

3.07 EXPANSION JOINT FILLER

A. Expansion joints shall be installed where indicated on the Drawings and as specified herein.

3.08 WIRE MESH REINFORCING

A. All concrete sidewalks crossing driveways and all driveway aprons shall be installed with wire mesh reinforcing.

3.09 QUALITY AND PROTECTION OF CONCRETE WORK

A. Concrete shall be placed solidly in layers and against forms as to leave no voids. Every precaution shall be taken to make all concrete solid, compact, watertight, and smooth, and to prevent the formation of laitance and to avoid cold joints.
B. If for any reason the surfaces have voids, or are unduly rough, or are in any way defective, the CONTRACTOR will be required to remove the entire slab or section of Work in question.
C. All repairs ordered or permitted shall be to the satisfaction of the ENGINEER. Costs of all repairs shall be the responsibility of the CONTRACTOR.
D. Thin patches or plastering of surfaces as a method of repair will not be acceptable.
E. Any concrete which is defective, which in the opinion of the ENGINEER cannot be properly repaired as described above, shall be removed and replaced at the expense of the CONTRACTOR.
F. All exposed surfaces of finished or unfinished concrete shall be kept constantly moist by covering with moist burlap, applying a white liquid seal coat of a thin water-impervious membrane conforming to ASTM C309, or by other such means as may be approved for a period of not less than 7 days.
G. No exposed concrete Work shall be laid during rainstorms, and freshly laid concrete shall be protected during storms to prevent erosion. Sufficient coverings shall be provided and kept ready at hand for this purpose. All fresh Work shall be carefully protected from injury.
H. The CONTRACTOR is responsible to protect all freshly laid concrete in order to avoid vandalism. All precautions necessary to avoid damage to freshly laid concrete shall be taken by the CONTRACTOR including barricades, lights, blankets, plastic covers and watchmen if necessary until the concrete has hardened sufficiently to avoid damage to the surface and edges.
I. The CONTRACTOR shall also provide all means necessary to protect freshly laid concrete from both vehicle and pedestrian traffic to avoid damage.

3.10 FINISH

A. All horizontal surfaces shall be struck to the proper grade by moving a straight edge template back and forth across the placed surface in a sawing motion until the required grade is reached.

B. Shortly after the striking operation, while the surface is still plastic, it shall be floated with wood. This process shall bring the surface to the true required grade.

C. After the surface has reached the partial hardness stage, it may have to be floated to secure a proper surface.

D. Concrete sidewalks and driveway aprons shall be finished with a steel trowel finish. For steel trowel finishes, the concrete shall be allowed to harden further after floating until no water or fine material is brought to the surface.

E. Troweling may be done either by hand or machine with smooth steel trowels. The process shall be repeated as necessary to produce a smooth dense finish.

F. After initial troweling, a broomed finish is required to be installed on the surface with a stiff bristled brush.

G. All concrete surfaces shall be treated with an approved curing compound.

H. For concrete curbs, upon removal of the forms, the exposed faces of the curb shall be immediately rubbed to a uniform surface and shall receive a steel troweled finish. No plastering will be permitted.

END OF SECTION

SECTION 02618

CORRUGATED POLYETHYLENE PIPE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall furnish all labor, materials, equipment, and incidentals required to furnish and install corrugated polyethylene pipe and fittings as shown, specified and otherwise required to complete the work.
2. The extent of the piping is shown on the Drawings.
3. Piping shall conform in shape, size, dimension, materials, and other respects to the details shown or as ordered by the ENGINEER.

B. Coordination:

1. Review the work under other Sections and coordinate with the work that is related to this Section.

C. Related Work Specified Elsewhere:

1. Section 02221, Excavation, Backfill, and Trenching for Utility Systems

1.2 QUALITY ASSURANCE

A. Manufacturer Qualifications: The pipe for each service or system as specified herein shall be provided by a manufacturer who has thoroughly familiarized himself with the design intent of the overall system and will provide piping suitable for the service intended.

B. Source Quality Control: Pipe that has been designed for abnormal load conditions shall have special markings thereon which can be readily identified. The name or trademark of the manufacturer, and the date and place of manufacture shall also be stenciled on all of the pipe, fittings, and specials. Each type of pipe, fitting, and special shall be obtained from not more than one manufacturer.

C. Products provided under this Contract should be new and of the finest quality manufactured by a company involved in this type of manufacturing for at least five years.

1.3 SUBMITTALS

A. Submit for approval technical and material information for all piping products to be used on this project.

1.4 PRODUCT DELIVERY, HANDLING, AND STORAGE

A. Delivery: All necessary precautions shall be taken to prevent damage to pipe, fittings, and other materials during shipment and delivery. All materials shall be securely fastened to truck or rail car to prevent movement or damage during shipment. Inspector shall examine all materials before unloading.

B. Handling: All pipe materials shall be handled to prevent damage. Pipe and fittings shall not be dropped, rolled or pushed off from any height on delivery, storage or installation.

C. Storage: All pipe materials shall be stored off the ground. Pipe ends shall be secured by caps or plugs. Pipe shall be stored and blocked to prevent sagging or bending. Store under cover and in a dry location.

PART 2 - PRODUCTS

2.1 SMOOTH INTERIOR CORRUGATED POLYETHYLENE PIPE (SICPP)

A. SICPP for storm sewers 12" - 30" shall meet ASTM F2736.

B. Pipe shall be joined with a gasketed integral bell & spigot joint meeting the requirements of ASTM F2736, for applicable diameters. Pipe shall be watertight according to the requirements of ASTM D3212. Spigots shall have gaskets meeting the requirements of ASTM F477.

C. Fittings shall conform to ASTM F2736, for applicable diameters. Bell & Spigot connections shall utilize a spun-on, welded or integral bell and spigot with gaskets meeting ASTM F477. Fitting joints shall meet the watertight joint performance requirements of ASTM F2736 or ASTM D3212.

D. Pipe shall be supplied in 20' nominal lengths.

E. All pipe shall be labeled and marked by the manufacturer.

F. Corrugated polyethylene pipe, fittings and couplings shall be manufactured by one of the following:

1. Advance Drainage Systems, Inc. (ADS)- Heavy Duty corrugated polyethylene pipe and materials (Type N-12)
2. Hancor, Inc. , Hi-Q
3. or equal

2.2 END SECTIONS

A. End sections shall be installed where shown and shall be prefabricated flared end sections galvanized metal conforming to NYSDOT 707-02 specifications.

B. Provide suitable coupling as recommended by pipe manufacturer for connection between polyethylene and corrugated metal storm drainage piping and metal end section.

PART 3 - EXECUTION

3.1 GENERAL

A. Materials used shall be free of damage resulting from shipping or handling.

B. Storage of pipe products and appurtenances will be in a location suitable to the OWNER and the ENGINEER, and approved prior to delivery of any materials to the job site.

C. Install all storm drainage piping in accordance with the recommendations of pipe manufacturer.

D. After installation of end sections and pipe connections, the CONTRACTOR shall grade sections of existing ditches at outlets of storm drains as necessary to provide a smooth flow transition from the end section to the existing ditches. Ground around end sections shall be graded for a smooth flow and to minimize erosion around end sections.

END OF SECTION

SECTION 03100

CONCRETE FORMWORK

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope:

1. The CONTRACTOR shall furnish all labor, materials, tools, equipment and incidentals required to provide the concrete formwork as required and specified. The Work also includes:

a. Providing openings in formwork to accommodate the Work under this and other Sections and building into the formwork all items such as sleeves, anchor bolts, inserts 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 other Sections and coordinate the installation of items that must be installed with the formwork.

C. Related Work Specified Elsewhere:

1. Section 03200, Concrete Reinforcement.
2. Section 03300, Cast-in-Place Concrete.

1.02 QUALITY ASSURANCE

A. The CONTRACTOR shall examine the substratum and the conditions under which concrete formwork is to be performed and shall notify the ENGINEER in writing of unsatisfactory conditions. The CONTRACTOR shall not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to the ENGINEER.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:

1. ACI 301, Specifications for Structural Concrete for Buildings.
2. ACI 347, Recommended Practice for Concrete Formwork.
3. ACI 350, Environmental Engineering Concrete Structures.

C. Allowable Tolerances:

1. Construct formwork to provide completed concrete surfaces complying with tolerances specified in ACI 347, Chapter 3.3, except as otherwise specified.

D. All items for permanent or temporary facilities shall be used in accordance with manufacturer's instructions.

1.03 SUBMITTALS

A. Shop Drawings:

1. Submit for information purposes copies of manufacturer's data and installation instructions for proprietary materials, including form coatings, manufactured form systems, waterstops, ties and accessories.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. On delivery to job site, the CONTRACTOR shall place materials in area protected from weather.
B. The CONTRACTOR shall store materials above ground on framework or blocking. Wood for forms shall be covered with protective waterproof covering. Adequate air circulation or ventilation shall be provided.
C. The CONTRACTOR shall handle materials to prevent damage.

PART 2 - PRODUCTS

2.01 FORM MATERIALS

A. Forms for Exposed Finish Concrete:

1. Unless otherwise shown or specified, the CONTRACTOR shall construct formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood-faced or other panel type materials acceptable to ENGINEER to provide continuous, straight, and smooth as-cast surfaces. The CONTRACTOR shall furnish in the largest practical sizes to minimize the number of seams and to conform to the joint system shown or specified. The CONTRACTOR shall provide form material with sufficient thickness to withstand the pressure of newly placed concrete without bow or deflection.

B. Forms for Unexposed Finish Concrete:

1. The CONTRACTOR shall form concrete surfaces that will be unexposed in the finished structure with plywood, lumber, metal, or other acceptable material. The CONTRACTOR shall provide lumber that is dressed on at least 2 edges and l side.

C. Form Ties:

1. The CONTRACTOR shall provide factory-fabricated, removable or snap-off metal form ties designed to prevent form deflection, and to prevent spalling of concrete surfaces upon removal. Materials used for tying forms will be subject to approval by the ENGINEER.
2. Unless otherwise shown, the CONTRACTOR shall provide ties so that portion remaining within the concrete after the removal of exterior parts is at least l½-inch from the outer concrete surface. The CONTRACTOR shall provide form ties that will leave a hole at the surface at least 1-inch diameter and 1½-inch deep.
3. Ties for exterior walls and walls subject to hydrostatic pressure shall have waterstops.
4. The CONTRACTOR shall provide wood or plastic cones for ties, where concrete is exposed in the finish structure and in the interior of tanks.

D. Forms Coatings:

1. Provide commercial formulation form-coating compounds that will not bond with, stain, or adversely affect concrete surfaces, and will not impair subsequent treatment of concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds. Form coating should be non-toxic.

E. Waterstops:

1. Waterstops shall be provided for all construction joints below grade and below one foot above the maximum water level.
2. The CONTRACTOR shall provide Polyvinyl Chloride (PVC) waterstops with minimum 1750 psi tensile strength, minimum working temperature range of -40°F, and a width of 6-inches in slabs and walls, 4-inches in slab to wall joints.
3. Waterstops shall have a ribbed profile, preformed corner sections, be capable of heat welded field jointing, and be provided in maximum possible lengths.
4. Waterstop material shall be non-toxic and suitable for use in potable water.
5. Product and Manufacturer: Specification Grade/Ohio EPA Grade, 6-inch Type 706, 4-inch Type 701, by Greenstreak or equal.

2.02 DESIGN OF FORMWORK

A. The CONTRACTOR shall design, erect, support, brace and maintain formwork so that it shall safely support vertical and lateral loads that might be applied, until such loads can be supported by the concrete structure. Vertical and lateral loads shall be carried to the ground by formwork system or in-place construction that has attained adequate strength for this purpose. The CONTRACTOR shall construct formwork so that concrete members and structures are of correct size, shape, alignment, elevation and position.

B. The CONTRACTOR shall design forms and falsework to include values of live load, dead load, weight of moving equipment operated on formwork, 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.

C. The CONTRACTOR shall provide shores and struts with positive means of adjustment capable of taking up formwork settlement and deflection during concrete placing operations, using wedges or jacks or a combination thereof. The CONTRACTOR shall provide trussed supports when adequate foundations for shores and struts cannot be secured.

D. The CONTRACTOR shall support form facing materials by structural members spaced sufficiently close to prevent significant deflection. The CONTRACTOR shall 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, the CONTRACTOR shall provide camber in formwork as required for anticipated deflections resulting from weight and pressure of fresh concrete and construction loads.

E. The CONTRACTOR shall design formwork to be readily removable without impact, shock, or damage to concrete surfaces and adjacent materials.

F. The CONTRACTOR shall provide formwork sufficiently tight to prevent leakage of cement paste during concrete placement. The CONTRACTOR shall solidly butt joints and provide backup material at joints as required to prevent leakage and fins.

G. The CONTRACTOR shall provide observation ports to allow viewing of concrete settlement in confined areas.

PART 3 - EXECUTION

3.01 FORM CONSTRUCTION

A. General: Construct forms complying with ACI 347: 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. All joint locations shall conform to those shown on the Drawings. No joints shall be added or deleted without the ENGINEER'S written approval. Use selected materials to obtain required finishes. Finish shall be as determined by approved mock-up or sample panel, if specified.

B. Forms shall be fabricated for easy removal without damaging concrete surfaces. Crush plates for wrecking plates where stripping may damage cast concrete surfaces shall be provided. The CONTRACTOR shall provide top forms for inclined surfaces where the slope is too steep to place concrete with bottom forms only. The CONTRACTOR shall kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and assure ease of removal.

C. Falsework:

1. The CONTRACTOR shall erect falsework and support, brace and maintain it to safely support vertical lateral and asymmetrical loads applied until such loads can be supported by in-place concrete structures. The CONTRACTOR shall construct falsework so that adjustments can be made for take-up and settlement.
2. The CONTRACTOR shall provide wedges, jacks or camber strips to facilitate vertical adjustments. The CONTRACTOR shall carefully inspect falsework and formwork during and after concrete placement operations to determine abnormal deflection or signs of failure and shall make necessary adjustments to produce finished Work of required dimensions.

D. Forms for Exposed Concrete:

1. Metal cover plates for patching holes or defects in forms shall not be used.
2. The CONTRACTOR shall provide sharp, clean corners at intersecting planes, without visible edges or offsets. The CONTRACTOR shall back joints with extra studs or girts to maintain true, square intersections.
3. The CONTRACTOR shall use extra studs, walers and bracing to prevent bowing of forms between studs and to avoid bowed appearance in concrete. Narrow strips of form material that will produce bow shall not be used.
4. Forms shall be assembled so they may be readily removed without damage to exposed concrete surfaces.
5. The CONTRACTOR shall form molding shapes, recesses and projections with smooth-finish materials, and install in forms with sealed joints to prevent displacement.

E. Corner Treatment:

1. The CONTRACTOR shall form exposed corners of beams, walls, foundations, bases and columns to produce smooth, solid, unbroken lines, except as otherwise shown. Except as specified below for reentrant or internal corners, exposed corners shall be chamfered.
2. The CONTRACTOR shall form chamfers with 1-inch by 1-inch strips, unless otherwise shown, accurately formed and surfaced to produce uniformly straight lines and tight edge joints. The CONTRACTOR shall extend terminal edges to required limit and miter chamfer strips at changes in direction.
3. Re-entrant or internal corners and unexposed corners may be formed square.

F. Joints:

1. See Section 03251 of these Specifications for treatment of joints. Locate as shown and specified.

G. Openings and Built-In Work:

1. Openings in concrete formwork shown or required by other Sections or other contracts shall be provided. Refer to paragraph 1.1.B herein for the requirements of coordination.
2. Items to be built into forms shall be accurately placed and securely supported.

H. Cleaning and Tightening:

1. Forms and adjacent surfaces to receive concrete shall be thoroughly cleaned. The CONTRACTOR shall remove chips, wood, sawdust, dirt or other debris just before concrete is to be placed. The CONTRACTOR shall retighten forms immediately before concrete placement to eliminate mortar leaks.

3.02 FORM COATINGS

A. Form contact surfaces shall be coated with a non-staining form-coating compound before reinforcement is placed. Excess form coating material shall not be allowed to accumulate in the forms or to come into contact with surfaces which will be bonded to fresh concrete. The CONTRACTOR shall apply in compliance with manufacturer's instructions.
B. Steel forms shall be coated with a non-toxic, non-staining, rust-preventative form oil or otherwise protected against rusting. Rust-stained steel formwork is not acceptable.

3.03 INSTALLATION OF EMBEDDED ITEMS

A. General: Set and build into the formwork, anchorage devices and other embedded items, shown, specified or required by other Sections. Refer to paragraph 1.1.B herein for the requirements of coordination. Use necessary setting drawings, diagrams, instructions and directions.
B. Edge Forms and Screed Strips for Slabs:

1. The CONTRACTOR shall set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in the finished slab surface. The CONTRACTOR shall provide and secure units to support screeds.

3.04 FIELD QUALITY CONTROL

A. Before concrete placement, the CONTRACTOR shall check the formwork, including lines, ties, tie cones, and form coatings. He shall make corrections and adjustments to ensure proper size and location of concrete members and stability of forming systems.
B. During concrete placement the CONTRACTOR shall check formwork and related supports to ensure that the forms are not displaced and that completed work shall be within specified tolerances.
C. If the CONTRACTOR finds that forms are unsatisfactory in any way, either before or during the placing of concrete, the placement of concrete shall be postponed or stopped until the defects have been corrected, and reviewed by the ENGINEER.

3.05 REMOVAL OF FORMS

A. The CONTRACTOR shall conform to the requirements of ACI 301, Chapter 4 and ACI 347, Chapter 3.6.2.3, except as specified below.
B. The CONTRACTOR shall not remove supporting forms or shoring until the members have acquired sufficient strength to safely support their weight and the load upon them. Results of suitable control tests may be used as evidence that the concrete has attained sufficient strength.
C. The time for removal of all forms will be subject to the ENGINEER'S approval. However, the CONTRACTOR shall still be fully responsible for the structural integrity and the shape and dimension of the member.

3.06 PERMANENT SHORES

A. The CONTRACTOR shall provide permanent shores as defined in ACI 347 Chapter 3.7.
B. Reshores will not be permitted.

3.07 RE-USE OF FORMS

A. Surfaces of forms to be re-used in the Work shall be cleaned and repaired. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable. The CONTRACTOR shall apply new form coating compound material to concrete contact surfaces as specified for new formwork.
B. When forms are extended for successive concrete placement, the CONTRACTOR shall thoroughly clean surfaces, remove fins and laitance, and tighten forms to close all joints. Joints shall be aligned and secured to avoid offsets. “Patched" forms for exposed concrete surfaces shall not be used. Form surfaces shall be subject to the ENGINEER'S approval.

END OF SECTION

SECTION 03200

CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope:

1. The CONTRACTOR shall furnish all labor, materials, tools, equipment and incidentals required to provide concrete reinforcement as shown and specified.
2. The extent of concrete reinforcement is shown on the Drawings.
3. The Work includes fabrication and placement of reinforcement including bars, ties and supports, and welded wire fabric for concrete, and encasement.

B. Related Work Specified Elsewhere:

1. Section 03100, Concrete Formwork.
2. Section 03300, Cast-in-Place Concrete.

1.02 QUALITY ASSURANCE

A. The CONTRACTOR shall examine the substrate and the conditions under which concrete reinforcement is to be placed, and shall notify the ENGINEER in writing of unsatisfactory conditions. The CONTRACTOR shall not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to the ENGINEER.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:

1. Concrete Reinforcing Steel Institute, "Manual of Standard Practice", includes ASTM standards referred to herein.
2. ACI 318, "Building Code Requirements for Reinforced Concrete".
3. ACI 315, Manual of Standard Practice for Detailing Reinforced Concrete Structures.
4. Concrete Reinforcing Steel Institute, "Placing Reinforcing Bars."
5. ACI 350, Environmental Engineering Concrete Structures.

1.03 SUBMITTALS

A. Shop Drawings:

1. The CONTRACTOR shall submit Shop drawings for fabrication, bending, and placement of concrete reinforcement. He shall comply with ACI 315, Chapters 1 thru 8. For walls, elevations to a minimum scale of 1/4-inch to 1-foot shall be shown. For slabs, top and bottom reinforcing on separate plan views shall be shown. The CONTRACTOR shall show bar schedules, stirrup spacing, diagrams of bent bars, arrangements and assemblies, as required for the fabrication and placement of concrete reinforcement unless otherwise noted. Splices shall be kept to a minimum. The CONTRACTOR shall splice in regions of maximum tension stresses shall be avoided whenever possible.
2. The CONTRACTOR shall submit copies of manufacturer's specifications and installation instructions for all materials and reinforcement accessories.

1.04 DELIVERY, HANDLING AND STORAGE

A. The CONTRACTOR shall deliver concrete reinforcement materials to the site bundled, tagged and marked. The CONTRACTOR shall use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.

B. The CONTRACTOR shall store concrete reinforcement material at the site to prevent damages and accumulation of dirt or excessive rust. The CONTRACTOR shall store on heavy wood blocking so that no part of it will come in contact with the ground.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Reinforcing Bars: ASTM A 615, and as follows:

1. Provide Grade 60 for all bars and dowels.

B. Welded Wire Fabric: ASTM A185, 65 ksi yield strength.

C. Supports for Reinforcement: Bolsters, Chairs, spacers and other devices for spacing, supporting and fastening reinforcement in place.

1. Wire bar type supports complying with CRSI recommendations shall be used, except as specified below. Wood, brick, or other unacceptable materials shall not be used.
2. For slabs on grade, supports with sand plates or horizontal runners where base material will not support chair legs shall be used.
3. For all concrete surfaces, where legs of supports are in contact with forms, supports complying with CRSI "Manual of Standard Practice" shall be provided as follows:

a. Either plastic protected or stainless steel legs.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All reinforcing steel shall have the following cover:

1. Bottom of footings and mats -- 3-inches.
2. All other reinforcing bars -- 2-inches.
3. Welded wire fabric in slabs -- 3/4-inch.

B. Reinforcing bars shall be embedded in accordance with the following:

1. Tension development length.

	REQUIRED LENGTH (INCHES)	
BAR SIZE	TOP BARS	OTHER BARS
#3	14	12
#4	19	15
#5	23	18
#6	23	22
#7	28	25
#8	33	29

2. Tension lap splice length:

	REQUIRED LENGTH (INCHES)	
BAR SIZE	TOP BARS	OTHER BARS
#3	18	16
#4	24	19
#5	30	23
#6	36	28
#7	42	33
#8	48	37

3. Top bars shall be any horizontal bars with more than 12-inches of concrete cast below the bars.
4. Where continuous bars are indicated, they shall be continuous around corners, doweled into intersecting walls, lapped at necessary splices, and hooked at discontinuous edges.
5. Lap splices for welded wire fabric shall be a minimum of 12-inches. Embedment shall be of 2 cross wires with the closest wire not less than 2 inches from the critical section.
6. Reinforcing steel shall not be bent after being partially embedded in hardened concrete.

C. Bars shall be bent cold and shall not be heated for any reason.

D. Reinforcing bars shall not be welded, unless accepted by the ENGINEER.

E. Reinforcement accessories including spacers, chairs, ties, tie wire, and clips shall be of a type manufactured for the specific purpose intended. Wood blocks, CMU, stone, bricks, etc. are not permitted.

F. The CONTRACTOR shall comply with the applicable recommendations of specified codes and standards, and CRSI "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports.

G. The reinforcement shall be cleaned to remove loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.

H. The CONTRACTOR shall position, support, and secure reinforcement against displacement during formwork construction or concrete placement and grouting operations. The CONTRACTOR shall locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as required.

1. The CONTRACTOR shall arrange, space, and securely tie bars and bar supports together with 16 gage wire to hold reinforcement accurately in position during concrete placement operations. Wire ties shall be set so that twisted ends are directed away from exposed concrete surfaces.
2. Reinforcing steel shall not be secured to forms with wire, nails or other ferrous metal. Metal supports subject to corrosion shall not touch formed or exposed concrete surfaces.

I. The CONTRACTOR shall provide sufficient numbers of supports of strength required to carry reinforcement. Reinforcing bars shall not be placed more than 2 inches beyond the last leg of any continuous bar support. Supports shall not be used as bases for runways for concrete conveying equipment and similar construction loads.

3.02 INSPECTION OF REINFORCEMENT

A. Concrete shall not be placed until the reinforcing steel is inspected and permission for placing concrete is granted by the ENGINEER. All concrete placed in violation of this provision will be rejected.

B. The CONTRACTOR shall discontinue concrete placement or modify placement method when reinforcing steel is moved beyond tolerable limits. All displaced reinforcing shall be re-secured.

END OF SECTION

SECTION 03251

CONCRETE JOINTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope:

1. The CONTRACTOR shall furnish all labor, materials, equipment and incidentals required to provide concrete joints as shown and specified.
2. The types of concrete joints required include the following:
   a. Construction joints.
   b. Control joints.

B. Waterstops shall be provided for all construction joints below grade and below one foot above the maximum water level.

C. Related Work Specified Elsewhere:

1. Section 03100, Concrete Formwork.
2. Section 03200, Concrete Reinforcement.
3. Section 03300, Cast-In-Place Concrete.

1.02 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. ACI 301, Specifications for Structural Concrete for Buildings, Chapter 6, Joints and Embedded Items.
2. ASTM A 36, Structural Steel.

B. All manufactured items shall be installed in accordance with manufacturer's instructions.

1.03 SUBMITTALS

A. Samples: Submit for approval the following samples:

1. Polyvinyl Chloride waterstops and gasket material.

B. Shop Drawings: Submit for approval the following:

1. Manufacturer's specifications and installation instructions for all materials required.
2. Layout of all construction joint locations prior to the submittal of steel reinforcing drawings.

PART 2 - PRODUCTS

2.01 WATERSTOPS (Refer to Part 2.1.E of Section 03100)

2.02 EPOXY BONDING AGENT

A. The CONTRACTOR shall provide an epoxy-resin bonding agent, two components, polyamide type.

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

1. Sikadur Hi-Mod by Sika Chemical Corporation
2. Or equal.

PART 3 - EXECUTION

3.01 CONSTRUCTION JOINTS

A. The CONTRACTOR shall comply with ACI 301, Chapter 6, and as specified below.
B. The CONTRACTOR shall locate and install construction joints as shown.
C. Horizontal Joints:

1. The CONTRACTOR shall apply coating of epoxy bonding compound to joint surface before pouring new trench floor slabs.

D. Vertical Joints:

1. The CONTRACTOR shall apply coating of epoxy bonding compound to joint surface before pouring new trench.
2. At vertical construction joints in trench walls, the CONTRACTOR shall install polyvinyl chloride split flange waterstop material.
   a. Split flange shall be folded back against the form in the first section of wall to be poured.
   b. Prior to pouring adjacent section of wall, the split flange shall be folded out and joined using hog rings and adhesive. Flange shall be wire tied to adjacent reinforcing bars in wall to be poured.

3.02 WATERSTOPS

A. General:

1. The CONTRACTOR shall comply with ACI 301, Chapter 6, and as specified below. All joints shall be made in accordance with manufacturer's instructions.
2. The CONTRACTOR shall obtain ENGINEER'S approval for waterstop locations not shown.

B. Polyvinyl Chloride Waterstop:

1. The CONTRACTOR shall tie waterstop to reinforcement so that it is securely and rigidly supported in the proper position during concrete placement. The CONTRACTOR shall continuously inspect waterstops during concrete placement to insure their proper positioning.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. The CONTRACTOR shall furnish all supervision, coordination, labor, materials, tools, equipment and incidentals required to provide cast-in-place concrete as shown and specified.
2. 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, anchor bolts, inserts and all other items to be embedded.
b. Providing openings in concrete and building into the concrete all items such as sleeves, frames, anchor bolts, inserts and all other items required to be embedded.

B. Coordination:

1. The CONTRACTOR shall review installation procedures under other Sections and coordinate the installation of items that must be installed in the concrete.

C. Classes of Concrete:

1. Class "A" concrete shall be steel reinforced and includes, but is not limited to the following:

a. Foundations
b. Walls
c. Slabs

2. Class "B" concrete shall be placed without forms or with simple forms, with little or no reinforcing, and includes, but is not limited to the following:

a. Concrete fill
b. Sidewalks
c. Thrust blocks
d. Encasements

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with the applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. ACI 350, Environmental Engineering Concrete Structures.
2. ACI 301, Specification for Structural Concrete for Buildings, (includes ASTM Standards referred to herein).
3. ACI 318, Building Code Requirements for Reinforced Concrete.

4. ACI 304, Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
5. ACI 311, Recommended Practice for Concrete Inspection.
6. ACI 211.1, Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete.
7. ACI 214, Recommended Practice for Evaluation of Compression Test Results of Field Concrete.
8. ACI 305, Recommended Practice for Hot Weather Concreting.
9. ACI 306, Recommended Practice for Cold Weather Concreting.
10. ACI 309, Recommended Practice for Consolidation of Concrete.
11. AASHTO M 182, Burlap Cloth Made from Jute or Kenaf.

B. Concrete Testing Service:

1. The CONTRACTOR shall employ, at his own expense, a testing laboratory experienced in design and testing of concrete materials and mixes to perform material evaluation tests and to design concrete mixes.

    a. Testing agency shall meet the requirements of ASTM E 329.
    b. Selection of a testing laboratory is subject to the ENGINEER'S approval.
    c. The CONTRACTOR shall submit a written description of the proposed concrete testing laboratory giving qualifications of personnel, laboratory facilities and equipment, and other information which may be requested by the ENGINEER.

2. Materials and installed Work may require testing and retesting, as directed by the ENGINEER, at any time during the progress of the Work. Free access to material stockpiles and facilities shall be allowed at all times.

C. Qualifications of Water-Reducing Admixture Manufacturer:

1. Water-reducing admixtures shall not be used without specific written approval by the ENGINEER.
2. Water-reducing admixtures shall be manufactured under strict quality control in facilities operated under a quality assurance program. Furnish copy of manufacturer's quality assurance handbook to document the existence of the program. Manufacturer shall maintain a concrete testing laboratory that has been approved by The Cement and Concrete Reference Laboratory at the Bureau of Standards, Washington, D.C.
3. When requested by ENGINEER, provide a qualified concrete technician employed by the admixture manufacturer to assist in proportioning the concrete for optimum use of the admixture. The concrete technician, when requested, shall advise on proper addition of the admixture to the concrete and on adjustment of the concrete mix proportions to meet changing job site conditions.

D. Tests for Concrete Materials:

1. Written reports shall be submitted to the ENGINEER for each design mix sampled and tested prior to the start of the Work. The date of the tests shall be within one year of the use of the material. The Project identification name and number, date of report, name of CONTRACTOR, name of concrete testing service, source of concrete aggregates, material manufacturer and brand name for manufactured materials, values specified in the referenced specification for each material, and test results shall be provided. It shall be indicated whether or not material is acceptable for intended use.

1.3 SUBMITTALS

A. Samples: Submit samples of materials as specified and as otherwise may be requested by the ENGINEER, including names, sources and descriptions.

B. Shop Drawings: Submit for approval the following:

1. List of concrete materials and concrete mix designs proposed for use. Include the results of all tests performed to qualify the materials and to establish the mix designs.
2. The following information, if ready-mixed concrete is used.

a. Physical capacity of mixing plant.
b. Trucking facilities available.
c. Estimated average amount which can be produced and delivered to the site during a normal 8 hour day, excluding the output to other customers.

3. Copies of manufacturer's specifications with application and installation instructions for proprietary materials and items, including admixtures and bonding agents.

C. Laboratory Test Reports: Submit copies of laboratory test reports for concrete cylinders, materials and mix design tests. ENGINEER'S review will be for general information only. Production of concrete in compliance with specified requirements is the responsibility of the CONTRACTOR.

D. Notarized certification of conformance to referenced standards shall be submitted when requested by the ENGINEER.

E. Delivery Tickets: Furnish to ENGINEER copies of all delivery tickets for each load of concrete delivered to the site. Provide items of information as specified in ASTM C 94, Section 14.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. All materials used for concrete must be kept clean and free from all foreign matter during transportation and handling and kept separate until measured and placed in the mixer. Bins or platforms having hard clean surfaces shall be provided for storage. Suitable means shall be taken during hauling, piling and handling to insure that segregation of the coarse and fine aggregate particles does not occur and the grading is not affected.

PART 2 - PRODUCTS

2.01 CONCRETE MATERIALS

A. Cement:

1. Portland cement, ASTM C 150, Type II; or blended hydraulic cement, ASTM C 595, Type 1P, except that the pozzolan content shall not exceed 25 percent by weight of the cement plus pozzolan.
2. Portland cement made by a well-known acceptable manufacturer and produced by not more than one plant shall be used.
3. Cement which has deteriorated because of improper storage or handling shall not be used.

B. Aggregates: ASTM C 33 and as herein specified.

1. 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 shall not be used.
2. Fine Aggregate: Clean, sharp, natural sand free from loam, clay, lumps or other deleterious substances.
3. Coarse Aggregate: Clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter, as follows:

    a. Crushed stone, processed from natural rock or stone or gravel.
    b. Coarse Aggregate Size: Size to be ASTM C 33, No. 67 for all concrete members greater than 4-inches thick. Size to be ASTM C 33, No. 8 for all concrete members 4-inches thick and less.

C. Water: Clean, free from injurious amounts of oils, acids, alkalis, organic materials or other substances that may be deleterious to concrete or steel.

2.02 CONCRETE ADMIXTURES

A. Admixtures produced by established reputable manufacturers shall be provided, and used in compliance with the manufacturer's printed instruction. Admixtures which have not been incorporated and tested in the accepted mixes, unless otherwise authorized in writing by the ENGINEER shall not be used. All admixtures shall be from a single manufacturer.
B. Air-Entraining Admixtures: ASTM C 260.
C. Water-reducing Admixture: Do not use water reducing admixtures unless otherwise authorized in writing by the ENGINEER. If water reducing admixture is authorized, it shall conform to ASTM C 494, Type A or ASTM C618 for Pozzolans.

1. The CONTRACTOR shall proportion all concrete with non-air entraining, normal setting, water-reducing, aqueous solution of a modification of the salt of polyhydroxylated organic acids. The admixture shall not contain more chloride ions than are contained in municipal drinking water.

D. Calcium Chloride: Do not use calcium chloride in concrete, unless otherwise authorized in writing by the ENGINEER. Do not use admixtures containing calcium chloride where concrete is placed against galvanized steel.

2.03 PROPORTIONING AND DESIGN OF MIXES

A. The CONTRACTOR shall prepare design mixes of concrete. The same design mix shall be used for both classes of concrete. Mixes shall be subject to the following limitations:

1. Minimum 28-day Compressive Strength: 4,000 psi.
2. Maximum Water-Cement ratio by Weight: 0.45.

Coarse Aggregate Number	Minimum Cement Content Pounds/Cubic Yard	Percent Air Content
67	564	6 +/- 1%
8	610	7 +/- 1%

B. An independent testing facility acceptable to the ENGINEER shall be used for preparing and reporting proposed mix designs.

1. The testing facility shall not be the same as used for field quality control testing.

C. Mixes shall be proportioned by either laboratory trial batch or field experience methods, using materials to be employed on the Project for concrete required. The CONTRACTOR shall comply with ACI 211.1 and report to the ENGINEER the following data:

1. Complete identification of aggregate source of supply.
2. Tests of aggregates for compliance with specified requirements.
3. Scale weight of each aggregate.
4. Absorbed water in each aggregate.
5. Brand, type and composition of cement.
6. Brand, type and amount of each admixture.
7. Amounts of water used in trial mixes.
8. Proportions of each material per cubic yard.
9. Gross weight and yield per cubic yard of trial mixtures.
10. Measured slump.
11. Measured air content.
12. Compressive strength developed at 7 days and 28 days, from not less than 3 test cylinders cast for each 7-day and 28-day test, and for each design mix.

D. The CONTRACTOR shall submit written reports to the ENGINEER of proposed mix of concrete at least 15 days prior to start of Work. Concrete production shall not be started until mixes have been approved by the ENGINEER.

E. Laboratory Trial Batches: When laboratory trial batches are used to select concrete proportions, prepare test specimens and conduct strength tests as specified in ACI 301, Chapter 3 - Proportioning, Method 1

F. Field Experience Method: When field experience methods are used to select concrete proportions, establish proportions as specified in ACI 301, Chapter 3. Proportioning based on empirical data.

G. Water-Cement Ratio Methods: If suitable data from field experience or laboratory trial batches cannot be obtained, concrete proportions may be established as specified in ACI 301, Chapter 3. Proportioning based on empirical data.

H. Adjustment to Concrete Mixes: Mix design adjustments may be requested by CONTRACTOR when characteristics of materials, job conditions, weather, test results, or other circumstances warrant at no additional cost to the OWNER and as approved by the ENGINEER. Laboratory test data for revised mix designs and strength results must be submitted to and approved by the ENGINEER before using the revised mixes.

I. Admixtures:

1. Use air-entraining admixture in all concrete, except interior slabs subject to abrasion, unless otherwise shown or specified. Add air-entraining admixture at the manufacturer's prescribed rate to result in concrete at the point of placement having air content within the prescribed limits.
2. Use amounts of admixtures as recommended by the manufacturer for climatic conditions prevailing at the time of placing. Adjust quantities and types of admixtures as required to maintain quality control.

J. Slump Limits:

1. Proportion and design mixes to result in concrete slump at the point of placement of not less than 1-inch and not more than 4-inches.

2.04 EPOXY BONDING AGENT

A. Refer to Part 2.2 of Section 03251.

2.05 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. Moisture-Retaining Cover: one of the following, complying with ASTM C 171:

1. Waterproof paper.
2. Polyethylene film.
3. White burlap-polyethylene sheet.

C. Curing and Sealing Compound: Federal Spec TT C-800A, 30 percent solids content minimum. A chlorinated rubber or acrylic compound.

D. Curing and Hardening Compound: ASTM C 309 (Water Retention Requirements).

PART 3 - EXECUTION

3.1 CONCRETE MIXING

A. General:

1. Concrete may be produced at batch plants or it may be produced by the transit mix process. Batch plants shall comply with the recommendations of ACI 304, and shall have sufficient capacity to produce concrete of the qualities specified, in quantities required to meet the construction schedule. All plant facilities are subject to testing laboratory inspection and acceptance of the ENGINEER.
2. Mixing:

a. Mix concrete with an approved rotating type batch machine, except where hand mixing of very small quantities may be permitted.
b. Remove hardened accumulations of cement and concrete frequently from drum and blades to assure acceptable mixing action.
c. Replace mixer blades when they have lost 10 percent of their original height.
d. Use quantities such that a whole number of bags of cement is required, unless otherwise permitted.

B. Ready-Mix Concrete:

1. Comply with the requirements of ASTM C 94, and as herein specified. Proposed changes in mixing procedures, other than herein specified, must be accepted by the ENGINEER before implementation.

a. Plant equipment and facilities: Conform to National Ready-Mix Concrete Association "Plant and Delivery Equipment Specification."
b. Mix concrete in revolving type truck mixers which are in good condition and which produce thoroughly mixed concrete of the specified consistency and strength.
c. Do not exceed the proper capacity of the mixer.
d. Mix concrete for a minimum of two minutes at full speed after arrival at the job site, after the addition of any water and/or as recommended by the mixer manufacturer.
e. Mix at proper speed until concrete is discharged.
f. Maintain adequate facilities at the job site for continuous delivery of concrete at the required rates.
g. Provide access to the mixing plant for the ENGINEER at all times.

h. At the CONTRACTOR'S option, water may be added to the mix at the project site if the observed or measured slump is less than the maximum specified value and the water-cement ratio has not been exceeded. After complete mixing, additional water may be added if the slump and water-cement limits are not exceeded. Once more than 1/2 cubic yard has been discharged, no more water may be added. The entire load of concrete shall be rejected by the CONTRACTOR if the slump or water-cement limits are exceeded.

C. Maintain equipment in proper operating condition, with drums cleaned before charging each batch. Schedule rates of delivery in order to prevent delay of placing the concrete after mixing, or holding dry-mixed materials too long in the mixer before the addition of water and admixtures.

3.02 TRANSPORTING CONCRETE

A. Transport and place concrete not more than 90 minutes after water has been added to the dry ingredients.
B. Take care to avoid spilling and separation of the mixture during transportation
C. Do not place concrete in which the ingredients have been separated.
D. Do not retemper partially set concrete.
E. Use suitable and approved equipment for transporting concrete from mixer to forms.

3.03 CONCRETE PLACEMENT

A. General: Place concrete continuously so that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints. Deposit concrete as nearly as practical to its final location to avoid segregation due to rehandling or flowing. Do not subject concrete to any procedure which will cause segregation.

1. Screed concrete which is to receive other construction to the proper level to avoid excessive shimming or grouting.
2. Do not use concrete which becomes non-plastic and unworkable, or does not meet the required quality control limits, or which has been contaminated by foreign materials. Do not use retempered concrete. Remove rejected concrete from the job site and dispose of it in an acceptable location.
3. Do not place concrete until all forms, bracing, reinforcement, and embedded items are in final and secure position.
4. Do not place footings in freezing weather unless adequate precautions are taken against frost action.
5. Do not place footings, piers or pile caps on frozen soil.
6. Unless otherwise approved, place concrete only when ENGINEER is present.
7. Allow a minimum of 7 days before placing concrete against a new slab or wall already in place.

B. Concrete Conveying:

1. Handle concrete from the point of delivery and transfer to the concrete conveying equipment and to the locations of final deposit as rapidly as practical by methods which will prevent segregation and loss of concrete mix materials.
2. Provide mechanical equipment for conveying concrete to ensure a continuous flow of concrete at the delivery end. Provide runways for wheeled concrete conveying equipment from the concrete delivery point to the 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 approved in writing by the ENGINEER.

    a. Provide sketches showing methods by which chutes will be employed when requesting such approval.
    b. Design chutes, if permitted, with proper slopes and supports to permit efficient handling of the concrete.

4. Pumping of concrete shall be permitted and shall conform to methods specified in the ACI Code.

C. Placing Concrete into Forms:

1. Deposit concrete in wall forms in horizontal layers not deeper than 18 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place concrete at such a rate that concrete which is being integrated with fresh concrete is still plastic.
2. Do not permit concrete to free fall within the form from a distance exceeding 4 feet. Use "elephant trunks" to prevent free fall and excessive splashing on forms and reinforcement.
3. Remove temporary spreaders in forms when concrete placing has reached the 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 consolidation of concrete in accordance with the applicable recommended practices of ACI 309. Vibration of forms and reinforcing will not be permitted, unless otherwise accepted by the ENGINEER.
5. 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 machine. Place vibrators to rapidly penetrate the layer of concrete and at least 6-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 the time necessary to consolidate the concrete and complete embedment of reinforcement and other embedded items without causing segregation of the mix.
6. Do not place concrete in beam and slab forms until the concrete previously placed in columns and walls is no longer plastic.
7. Force concrete under pipes, sleeves, openings and inserts from one side until visible from the other side to prevent voids.

D. Placing Concrete Slabs:

1. Deposit and consolidate concrete slabs in a continuous operation, within the limits of construction joints, until the placing of a panel or section is completed.
2. Consolidate concrete during placing operations using mechanical vibrating equipment, so that concrete is thoroughly worked around reinforcement 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 for formed concrete structures.
4. Bring slab surfaces to the correct level. Smooth the surface, leaving it free of humps or hollows. Do not sprinkle water on the plastic surface. Do not disturb the slab surfaces prior to beginning finishing operations.

E. Bonding for Next Concrete Pour: Roughen surfaces of set concrete at all joints, except where bonding is obtained by use of a concrete bonding agent. Clean surfaces of laitance, coatings, loose particles, and foreign matter. Roughen surfaces in a manner to expose

bonded aggregate uniformly and to not leave laitance, loose particles or aggregate, or damaged concrete at the surface.

1. Prepare for bonding of fresh concrete to new 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 2-inch layer of mortar, 1 part sand and 1 part cement with water over the hardened concrete surface.
    c. Place fresh concrete before the mortar has attained its initial set.

2. Bonding of fresh concrete to fully-cured hardened concrete or existing concrete shall be accomplished by using an epoxy-resin bonding agent except if fully-cured hardened concrete was roughened during finished.

F. Quality of Concrete Work:

1. Make all concrete solid, compact and smooth, and free of laitance, cracks and cold joints.
2. All concrete for liquid retaining structures, and all concrete in contact with earth, water, or exposed directly to the elements shall be watertight.
3. Cut out and properly replace to the extent ordered by the ENGINEER, or repair to the satisfaction of the ENGINEER, surfaces which contain cracks or voids, are unduly rough, or are in any way defective. Thin patches or plastering will not be acceptable.
4. All leaks through concrete, and cracks, holes or other defective concrete in areas of potential leakage, shall be repaired and made watertight by the CONTRACTOR.
5. Repair, removal, and replacement of defective concrete as ordered by the ENGINEER shall be at no additional cost to the OWNER.

G. Cold Weather Placing:

1. Protect all concrete Work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with the requirements of ACI 306 and as herein specified.
2. When the air temperature has fallen to or may be expected to fall below 40°F, provide adequate means to maintain the temperature, in the area where concrete is being placed, at between 50°F and 70°F for at least seven days after placing. Provide temporary housings or coverings including tarpaulins or plastic film. Maintain the heat and protection, if necessary, to insure that the ambient temperature does not fall more than 30°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°F, uniformly heat all water and aggregates before mixing as required to obtain a concrete mixture temperature of not less than 55°F and not more than 85°F at point of placement.
4. Do not use frozen materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. Ascertain that forms, reinforcing steel, and adjacent concrete surfaces are entirely free of frost, snow and ice before placing concrete.
5. Do not use salt and other materials containing anti-freeze agents or chemical accelerators, or set-control admixtures, unless approved by the ENGINEER, in mix designs.

H. Hot Weather Placing:

1. When hot weather conditions exist that would seriously impair the quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.
2. Cool ingredients before mixing to maintain concrete temperature at time of placement below 80°F when the temperature is rising and below 85°F when the temperature is falling. Mixing water may be chilled, or chopped ice may be used to control the concrete temperature provided the water equivalent of the ice is calculated in the total amount of mixing water.
3. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that the steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
4. Wet forms thoroughly before placing concrete.
5. Do not place concrete at a temperature so as to cause difficulty from loss of slump, flash set, or cold joints.
6. Do not use set-control admixtures unless approved by the ENGINEER in mix designs.
7. Obtain ENGINEER'S approval of other methods and materials proposed for use.

3.04 FINISH OF FORMED SURFACES

A. Form Finish:

1. Standard form finish shall be the concrete surface obtained through the use of form materials which will impart a smooth, dense, hard, uniform texture. Tie holes and defective areas shall be repaired and patched with mortar of 1 part cement to 1-1/2 parts sand and all fins and other projections completely removed and smoothed.
2. Provide a form finish for the following:

   a. Exterior vertical surfaces.
   b. Interior exposed vertical surfaces of liquid containers.
   c. Interior and exterior exposed beams and undersides of slabs.
   d. Other areas shown.

B. Related Uniform Surfaces:

1. At horizontal offsets and similar unformed surfaces occurring adjacent to formed surfaces, except tops of walls, strike off smooth and finish with a texture matching the adjacent formed surfaces. Continue the final surface treatment of formed surfaces uniformly across the adjacent unformed surfaces, unless otherwise shown.

3.05 FINISH OF OTHER SURFACES

A. Float Finish:

1. After placing concrete slabs, do not work the surface further until ready for floating. Begin floating when the surface water has disappeared or when the concrete has stiffened sufficiently. Use a wood float only. Check and level the surface plant to a tolerance not exceeding 1/8-inch in 10-feet when tested with a 10-foot straightedge placed on the surface at not less than 2 different angles. Cut down high spots and fill all low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat the surface to a uniform, smooth, granular texture.
2. Use float finish for the following:

a. Interior exposed horizontal surfaces of liquid containers.
b. Exterior below grade horizontal surfaces.
c. Surfaces to receive additional finishes, except as shown or specified.

B. Trowel Finish:

1. After floating, begin the first trowel finish operation. Begin final troweling when the surface produces a ringing sound as the trowel is moved over the surface.
2. Consolidate the concrete surface by the final hand troweling operation. Finish shall be free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 1/8-inch in 10- feet when tested with a 10-foot straight edge. Grind smooth surface defects which would telegraph through applied floor covering system.
3. Use trowel finish for the following:

a. Interior exposed slabs unless otherwise shown or specified.
b. Tops of walls.

C. Non-Slip Broom Finish:

1. Apply non-slip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as shown on the Drawings or in schedules.
2. Immediately after trowel finishing, slightly roughen the concrete surfaces by brooming in the direction perpendicular to the main traffic route. Use fiber-bristle broom unless otherwise directed. Coordinate the required final finish with the ENGINEER before application.

3.06 CONCRETE CURING AND PROTECTION

A. General:

1. Protect freshly placed concrete from premature drying and excessive cold or hot temperature, and maintain without drying at a relatively constant temperature for the period of time necessary for hydration of the cement and proper hardening of the concrete.
2. Start initial curing after placing and finishing concrete as soon as free moisture has disappeared from the concrete surface. Keep continuously moist for not less than 72 hours.
3. Begin final curing procedures immediately following initial curing and before the concrete has dried. Continue final curing for at least 7 days. For concrete sections over 30-inches thick, continue final curing for an additional 7 days, minimum. Avoid rapid drying at the end of the final curing period.
4. Perform curing in accordance with ACI 301 and ACI 308, Standard Practice for Curing Concrete.

B. Curing Methods:

1. Perform curing of concrete by moist curing, or by moisture-retaining cover curing, by curing compound, or by combinations thereof, as herein specified.

a. For curing, use water that is free of impurities that could etch or discolor exposed, natural concrete surfaces.

2. Provide moisture curing by any of the following methods:

a. Keeping the surface of the concrete continuously wet by covering with water.
b. Continuous water-fog spray.
c. Covering the concrete surface with the specified absorptive cover, thoroughly saturating the cover with water, and keeping the absorptive cover continuously wet with sprinklers or porous hoses. Place absorptive cover so as to provide coverage of the concrete surfaces and edges, with a 4-inch lap over adjacent absorptive covers.

3. Provide moisture-retaining cover curing as follows:

a. Cover the concrete surfaces with the specified moisture-retaining cover for curing concrete, placed in the widest practical width with sides and ends lapped at least 3-inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during the curing period using cover material and waterproof tape.

4. Provide liquid curing compound as follows:

a. Apply the specified curing and sealing compound. The compounds shall be applied immediately after final finishing in a continuous operation by power spray equipment in accordance with the manufacturer's directions. Recoat areas that are subject to heavy rainfall within 3 hours after initial application. Maintain the continuity of the coating and repair damage to the coat during the entire curing period. For concrete surfaces that will be in contact with potable water, the manufacturer shall certify that the curing compound used is non-toxic.

C. Curing Formed Surfaces:

1. Cure formed concrete surfaces, by moist curing with the forms in place for the full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

D. Curing Unformed Surfaces:

1. Initially cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by applying the specified curing compound.
2. Final cure unformed surfaces, unless otherwise specified, by any of the methods specified above, as applicable.

E. Temperature of Concrete During Curing:

1. When the atmospheric temperature is 40°F and below, maintain the concrete temperature between 59°F and 70°F continuously throughout the curing period. When necessary, make arrangement before concrete placing for heating, covering, insulation or housing as required to maintain the specified temperature and moisture conditions continuously for the concrete curing period. Provide cold weather protection complying with the requirements of ACI 306.
2. When the atmospheric temperature is 80°F and above, or during other climatic conditions which will cause too rapid drying of the concrete, make arrangements before the start of concrete placing for the installation of wind breaks or shading, and for fog spraying, wet sprinkling, or moisture-retaining covering. Protect the concrete continuously for the concrete curing period. Provide hot weather protection complying with the requirements of ACI 305, unless otherwise specified.

3. Maintain concrete temperature as uniformly as possible, and protect from rapid atmospheric temperature changes. Avoid temperature changes in concrete which exceed 5°F in any one hour and 50°F in any 24 hour period.

F. Protection from Mechanical Injury:

1. During the curing period, protect concrete from damaging mechanical disturbances including load stresses, heavy shock, excessive vibration, and from damage caused by rain or flowing water. Protect all finished concrete surfaces from damage by subsequent construction operations.

3.07 FIELD QUALITY CONTROL

A. The CONTRACTOR shall employ a testing laboratory to perform field quality control testing. The testing laboratory will make slump tests and will direct the number of tests and cylinders required. ACI certified technician shall make standard compression test cylinders and entrained air tests as specified below, under direct observation by the ENGINEER. The CONTRACTOR shall furnish all necessary assistance required by the ENGINEER. The CONTRACTOR shall also furnish all labor, material, and equipment required including cones, rods, molds, air tester, thermometer, curing in a heated storage box, and all other incidentals required. Above will be subject to approval by the ENGINEER.

B. Quality Control Testing During Construction:

1. Perform sampling and testing for field quality control during the placement of concrete as follows:

a. Sampling Fresh Concrete: ASTM C 172. Samples shall be taken from middle one-third of load.
b. Slump: ASTM C143; one test for each concrete load at point of discharge; and one for each set of compressive strength test specimens. Tests shall be taken after addition of all water.
c. Air Content: ASTM C 231; one for every other concrete load at point of discharge, or when required by an indication of change.
d. Compression Test Specimens: ASTM C 39; one set of compression cylinders for each 50 cubic yards or fraction thereof, of each mix design placed in any one day or for each 2,500 square feet of surface area placed; 1 specimen tested at 7 days, and 2 specimens tested at 28 days.
    1) Adjust mix if test results are unsatisfactory and resubmit for ENGINEER'S approval.
    2) Concrete which does not meet the strength requirements is subject to rejection and removal from the Work, or to other such corrective measures as directed by the ENGINEER, at the expense of the CONTRACTOR.
e. Compression Test Specimens: ASTM C 31; make one set of 3 standard cylinders for each compressive strength test, unless otherwise directed.
    1) Cast, store and cure specimens as specified in ASTM C 31.
f. Concrete Temperature: Test hourly when air temperature is 40°F and below, and when 80°F and above; and each time a set of compression test specimens is made.
g. Ambient Temperature: Record temperature when concrete is placed and three times per day during the curing period.

2. The testing laboratory shall submit certified copies of test results directly to the ENGINEER and the CONTRACTOR within 24 hours after tests are made. All tests shall be certified by a registered New York State Professional Engineer.

C. Evaluation of Quality Control Tests:

1. Do not use concrete delivered to the final point of placement that has slump or total air content outside the specified values.
2. Compressive strength tests for laboratory-cured cylinders will be considered satisfactory if the averages of all sets of three consecutive compressive strength tests results equal or exceed the 28 day design compressive strength of the type or class of concrete and no individual strength test falls below the required compressive strength by more than 500 psi.

    a. Where questionable field conditions may exist during placing concrete or immediately thereafter, strength tests of specimens cured under field conditions will be required by the ENGINEER to check the adequacy of curing and protecting of the concrete placed. Specimens shall be molded at the same time and from the same samples as the laboratory-cured specimens.
        1) Provide improved means and procedures for protecting concrete when the 28-day compressive strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders.
        2) When laboratory-cured cylinder strengths are appreciably higher than the minimum required compressive strength, field-cured cylinder strengths need not meet the 85 percent criterion if they exceed the required compressive strength by at least 500 psi.
        3) 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 assure that the load-bearing capacity of the structure is not jeopardized. If the likelihood of low-strength concrete is confirmed and computations indicate the load-bearing capacity may have been significantly reduced, tests of cores drilled from the area in question will be required at the CONTRACTOR'S expense.
    b. If the compressive strength tests fail to meet the minimum requirements specified, the concrete represented by such tests will be considered deficient in strength and subject to replacement, reconstruction or to other action approved by ENGINEER.

D. Testing Concrete Structure for Strength:

1. When there is evidence that the strength of the in-place concrete does not meet specification requirements, CONTRACTOR shall employ at his expense the services of a concrete testing service to take cores drilled from hardened concrete for compressive strength determination. Tests shall comply with ASTM C 42 and the following:

    a. Take at least 3 representative cores from each member or suspect area at locations directed by ENGINEER.
    b. Strength of concrete for each series of cores will be considered satisfactory if their average compressive strength is at least 85 percent and no single core is less than 75 percent of the 28-day required compressive strength. Cores shall be tested after soaking 42 hours in a lime solution.

c. Report test results in writing to ENGINEER on the same day that tests are made. Include in test reports the Project identification name and number, date, name of CONTRACTOR, name of concrete testing service, location of test core in the structure, 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 the concrete as placed, and the moisture condition of the core at time of testing.

2. Fill core holes solid with patching mortar, and finish to match adjacent concrete surfaces.
3. Conduct static load test and evaluations complying with ACI 318 if the results of the core tests are unsatisfactory, or if core tests are impractical to obtain, as directed by ENGINEER.

3.08 MISCELLANEOUS CONCRETE ITEMS

A. Filling-In:

1. Fill in holes and openings left in concrete structures for the passage of work by other contractors, unless otherwise shown or directed, after the work of other CONTRACTORS is in place. Mix, place and cure concrete as herein specified, to blend with in-place construction. Provide all other miscellaneous concrete filling shown or required to complete the Work.

B. Chamfer:

1. All exposed concrete edges shall have a 1-inch chamfer, unless otherwise indicated.

C. No backfill, fill, or filter material shall be placed against any wall until that wall has attained the specified strength based on cylinder test results.

3.09 CONCRETE REPAIRS

A. Repair of Formed surfaces:

1. Repair exposed-to-view formed concrete surfaces that contain defects that adversely affect the appearance of the finish. Surface defects that require repair include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, and holes left by tie rods and bolts; fins and other projections on the surface; and stains and other discoloration that cannot be removed by cleaning.
2. Repair concealed formed concrete surfaces that may contain defects that adversely affect the durability of the concrete. Surface defects that require repair include cracks in excess of 0.01 inch wide, cracks of any width and other surface deficiencies which penetrate to the reinforcement or completely through non-reinforced sections, honeycomb, sand veins, rock pockets, holes left by tie rods and bolts, and spalls except minor breakage at corners.
3. Pressure grout structural cracks, and cracks in water-holding structures by one of the following:

a. Sikadur Hi-Mod L.V. and GEL by Sika Chemical Company
b. Or equal.

4. Repair and patch defective areas with cement mortar immediately after removal of forms and as directed by ENGINEER.
5. Cut out honeycomb, rock pockets, voids over 1/2-inch diameter, and holes left by tie rods and bolts, down to solid concrete but, in no case, to a depth of less than 1-inch. Make edges of cuts perpendicular to the concrete surface. Before placing the cement mortar, thoroughly clean, dampen with water, and brush-coat the area to be patched with the specified bonding agent.

    a. For exposed-to-view surfaces, blend white Portland cement and standard Portland cement so that, when dry, the patching mortar color will match the color of the surrounding concrete. CONTRACTOR shall 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 the patching. Compact mortar in place and strike off slightly higher than the surrounding surface.

6. Fill holes extending through concrete by means of a plunger-type gun or other suitable device from the least exposed face, using a flush stop held at the exposed face to ensure completely filling.
7. Sandblast 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.

B. Repair of Unformed Surfaces:

1. Test unformed surfaces, such as monolithic slabs, for smoothness and to verify surface plane to the tolerances specified for each surface and finish. Correct low and high areas as herein specified.
2. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having the required slope. Correct high and low areas as herein specified.
3. Repair finish of unformed surfaces that contain defects that adversely affect the durability of the concrete. Surface defects include crazing, cracks in excess of 0.01-inch wide or which penetrate to the reinforcement or completely through non-reinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.
4. Grout structural cracks, and cracks in water holding structures.
5. Correct high areas in unformed surfaces by grinding after the concrete has cured sufficiently so that repairs can be made without damage to adjacent areas.
6. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out the low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete.
7. Repair defective areas, except random cracks and single holes not exceeding 1-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. Dampen all concrete surfaces in contact with patching concrete and brush with the specified bonding agent. Place patching concrete before grout takes its initial set. Mix patching concrete of the same materials and proportions to provide concrete of the same type or class as the original adjacent concrete. Place, compact and finish as required to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.
8. Repair isolated random cracks and single holes not over 1-inch diameter, by the dry-pack method. Groove the top of cracks, and cut out holes to sound concrete and clean of dust, dirt and loose particles. Dampen all cleaned concrete surfaces and brush with the specified bonding agent. Place dry-pack before the cement grout takes its initial set. Mix dry-pack, consisting of 1 part Portland cement to

2-1/2 parts fine aggregate passing a 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 not less than 72 hours.

9. Assure that surface is acceptable for flooring material to be installed in accordance with manufacturer's recommendations.
10. Repair methods not specified above may be used if approved by the ENGINEER.

END OF SECTION

CONCRETE MIX DESIGN SUBMITTAL FORM

Project:
City:
General Contractor:
Concrete Contractor:
Concrete Strength (Class):
Use(describe):

Design Mix Information

	Please check one
Based on Field Experience (Standard Deviation)	
Based on Trial Mix Test Data	

Design Characteristics

Density	pcf	
Strength psi (28		days)
Air % specified		

If trial mixes are used, the Mix Design is proportioned to achieve f'cr = f'c + 1200 psi (1400 psi for strength higher than 5000 psi at 28 days)

Materials	Type/ Source	Specific Gravity	Weight (pounds)	Absolute Vol. (cu. Ft.)
Portland Cement				
Coarse Aggregate				
Fine Aggregate				
Water				
Other				
		TOTAL		27.0 cu. ft.

*Water/Cement Ratio (lbs. water / lbs. cement) = %

Admixtures	Manufacturer	Dosage (oz/cwt)
Water Reducer		
Air Entraining Agent		
Mid Range Water Reducer		
High Range Water Reducer		
Non-Corrosive Accelerator		
Other		

Slump before MRWR/HRWR inches
Slump after MRWR/HRWR inches

Field Experience Standard Deviation Analysis

# of Test Cylinders Evaluated:	
Standard Deviation:	

f'cr = larger of, f'c + 1.34s or f'c + 2.33s - 500
(Refer to ACI 301 for increased deviation factor when less than 30 tests are available)

Trial Mix laboratory Test Data

Compressive Strength

Age (days)	Mix #1	Mix#2	Mix#3
7	psi	psi	psi
7	psi	psi	psi
28	psi	psi	psi
28	psi	psi	psi
28 average	psi	psi	psi

Required Attachments:

Please check

Course Aggregate Gradation Report	
Fine Aggregate Gradation Report	
Concrete Compressive Strength Data or	
Trial Mixture Test Data Admixture Compatibility certification letter	

Submitted_By:
Name:
Address:
Phone#:
Main Plan Location:
Miles from Project:
Secondary Plant Location:
Miles from Project:
Date:

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SECTION 03400

PRECAST CONCRETE STRUCTURES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope:

1. The CONTRACTOR shall furnish all supervision, labor, materials, equipment, and incidentals required to furnish and install all precast concrete structures as shown, specified and otherwise required to complete the Work.
   a. The Work includes, but is not limited to the following:
      1) Precast concrete structures
      2) Frames, covers, and grates
2. Structures shall conform in shape, size, dimension, material, and other respects to the details shown or as ordered by the ENGINEER.

B. Coordination:

1. Review the work under other sections and coordinate with the work that is related to this Section.

C. Related Work Specified Elsewhere:

1. Section 02221, Excavation, Backfill, and Trenching for Utility Systems
2. Section 03300, Cast-In-Place Concrete
3. Section 15066, Sanitary Sewers
4. All other related sections for piping, appurtenances and specials.

1.02 QUALITY ASSURANCE

A. Reference Standards:

1. ASTM A 48, Gray Iron Castings.
2. ANSI A 14.3, Safety Requirements for Fixed Ladders.
3. ASTM B 221, Aluminum Alloy Extended Bars, Rods, Wire Shapes and Tubes.
4. ASTM C 478, Precast Reinforced Concrete Manhole Sections.
5. ASTM C32 Sewer and Manhole Brick (made from clay or shale

1.03 SUBMITTALS

A. Shop Drawings:

1. Submit for approval Shop Drawings of design and construction details of all precast concrete.
2. Submit for approval manufacturer's certification of brick, block, gaskets, precast sections, frames, covers, and all other accessories required.
3. Shop Drawings for the fabrication and erection of all casting assemblies and miscellaneous metal work.
4. Copies of manufacturers specifications, load tables, dimension diagrams, anchor diagrams, and installation instructions for products to be used for miscellaneous metal works and casting assemblies.
5. All precast concrete structures shall be designed by a currently licensed New York State Registered Professional Engineer. Each drawing for design shall be stamped and signed by the Licensed New York State Professional Engineer.

1.04 PRODUCT DELIVERY, HANDLING AND STORAGE

A. Delivery: All necessary precautions shall be taken to prevent damage to precast concrete sections, cones, bases, frames and covers and other materials during shipment and delivery. All materials shall be securely fastened to truck or rail car to prevent movement or damage during shipment. Inspector shall examine all materials before unloading.

B. Handling: All precast concrete materials shall be handled to prevent damage. Precast concrete sections shall not be dropped, rolled, or pushed off from any height on delivery, storage or installation.

C. Storage: All precast concrete materials shall be stored in such a manner as to safely protect the structures at all times.

PART 2 - PRODUCTS

2.01 PRECAST CONCRETE STRUCTURES

A. General: The following requirements apply to all precast concrete structures furnished on this project.

1. The CONTRACTOR shall field verify all dimensions of the precast structures prior to placing an order.
2. Precast Concrete structures shall be manufactured in accordance with ASTM C478, latest revision, and shall be designed for HS-20 live load, latest revision.
3. Precast concrete structures shall be of approved design and of sufficient strength to withstand the loads to be imposed upon them.
4. Mark date of manufacture and name or trademark of manufacturer on inside of structure.
5. All concrete in precast units shall be stone aggregate and develop a strength of 4000 psi at 28 days and shall conform to the following specifications:
   a. All concrete furnished for precast concrete manholes and structures shall be in accordance with ACI 318 Code for reinforced concrete.
   b. Materials
      1) Cement: Portland cement, ASTM C150, Type I or Type II.
      2) Admixtures: Admixtures other than air entraining admixture shall not be used. Air entraining admixture shall conform to ASTM C260. Air content of concrete with 3/4-inch maximum size aggregate shall be 6 percent plus or minus 1 percent volume.
   c. Water: Clean and free from injurious amounts of oils, acids, alkalis, organic materials or other substances.
   d. Aggregates: Aggregates shall conform to ASTM C33, latest revision. Course aggregate shall be size number 67 (nominal 3/4-inch to No. 4).
   e. Proportions: Proportions of materials in concrete and strength of concrete shall be subject to the following conditions:
      1) Minimum 28-day compressive strength - 4,000 psi
      2) Maximum water to cement ratio by weight - 0.45
      3) Minimum cement content (pounds per - 600 lbs/cubic yard)
7. All precast concrete shall be manufactured by wet cast methods only, and shall be approved design.
8. All precast concrete shall be steel reinforced. Reinforcing shall be designed for all applicable loads and forces encountered. Steel reinforcing shall be ASTM A496-A, 615, Grade 60-60 KSI.
9. Lifting holes or lugs shall be cast into the manhole sections.
10. The tops of the pre-cast manholes shall be eccentric cone sections or flat slabs (if required on shallow depths) of approved design suitable for incorporation into the

work.

11. The manhole barrel sections and bases shall be provided with bell and spigot type joints. The reinforcing shall extend into the bell and spigot ends of all joints. Bell and spigot joints shall be equipped with rubber o-ring gaskets and shall utilize a butyl sealant of a design approved by the ENGINEER. The joint sealant shall be of a flexible butyl rubber.
12. The pre-cast bases shall be equipped with a flanged base slab as shown on the Plans.
13. A water tight pipe to manhole connection shall be made using a Boot Seal. Assembly components shall meet or exceed all of material specifications of ASTM C-923. All hardware shall be of stainless steel.
14. Grade rings or riser ring extensions shall be manufactured of pre-cast concrete, and shall be supplied in thicknesses equal to 6" or 12". These "donuts" shall have an inside diameter of 24" minimum, and an outside diameter of 40" maximum, and shall be steel reinforced.
15. The inside and outside face of all manhole joints shall be filled with "Preco-Patch", "Waterplug", or approved equal.
16. Prior to backfilling, all below grade exterior faces of the precast concrete manholes and structures installed shall be painted with two-coats of sealer. The sealer shall be as manufactured by Koppers Company Bitumastic 300-M, or a comparable grade of Carboline, or equal.
17. If cast-in-place bases are required, the concrete and reinforcing shall conform to the Specifications as outlined under Section 03300.
18. All holes and cutouts for adjacent piping shall be no less than 6-inches from any joint in the structure at either the top or bottom of the line on any branch piping.
19. All precast structures shall contain a corner sump pit minimum size as indicated on the Contract Drawings. The floor shall slope to drain.
20. Product and Manufacturer:
    a. Precast concrete vaults shall be furnished as follows:
    1) Kistner Concrete Products
    2) Or approved equal.

2.02 PRECAST CONCRETE CATCH BASINS

A. In addition to the general requirements for precast concrete structures outlined above, the following shall apply:

1. Precast concrete catch basins shall be manufactured as a one- or two-piece unit with integral bottom and walls cast in one pour per piece so that there are no joints present in the sections.
2. Catch basin base and walls shall be of acceptable design and of sufficient strength to safely support HS-20 loading.
3. For precast concrete base section, the minimum thickness of base slab shall be 6-inch thickness.
4. Precast concrete walls for catch basins shall be 6-inch thickness except at knockouts where the minimum thickness shall be 2-inch.
5. Pipe connections to catch basins for storm drainage piping shall consist of a knockout in the catch basin wall for installation of the proposed piping. The void existing between the proposed pipe and the wall of the catch basin shall be grouted with a cement-mortar grout and shall be approved by the ENGINEER.
6. Product and manufacturer:
    a. Precast concrete catch basins shall be manufactured by:
        1) Kistner Concrete Products
        2) Or approved equal.

2.03 FRAME AND COVERS:

A. Provide frames and covers as follows:

1. Made from best merchantable gray cast iron, tough, even-grained, and free from all flaws and injurious or unsightly defects, ASTM A48, Class 30, cast iron.
2. Frame and covers shall be rated for HS-20 loading, latest revision.
3. All covers for catch basins shall be bicycle safe type covers.
4. Letters to be casts on every manhole cover as shown on the Drawings. If not detailed on drawings, covers for manhole vaults shall be provided with the designation "water."
5. Machined to insure proper fit and even bearing in all positions.
6. Properly clean castings and coat with asphaltic varnish applied by immersion, while the coating is hot.
7. Product and manufacturer:
   a. Provide one of the following:
      1) Valve Manhole Vaults
         a) Neenah Foundry Co., Model R1916-C Watertight Manhole Frame and Cover.
         b) Or equal.
      2) Catch Basins
         a) Neenah Foundry Co., Catch Basin Frame and Cover - Grate Top - Model No. R4832B, Bicycle Proof.
         b) Or equal.

2.04 MISCELLANEOUS

A. Steps and Ladder Rungs

1. Approved aluminum steps as follows:
   a. Aluminum-magnesium-silicide type alloy conforming to ASTM Specification B221.
   b. Drop front design with grooved step surface.
   c. Conform to details shown on Drawings.
   d. Aluminum surfaces in contact with dissimilar materials shall be painted with an approved bitumastic paint.

PART 3 - EXECUTION

3.01 INSTALLING PRECAST CONCRETE STRUCTURES

A. The CONTRACTOR shall observe all OSHA standards regarding confined space entry, and shall have the appropriate equipment, and trained personal on site at all times when performing confined space entries.

B. Manholes shall be constructed at the location shown in the Plans in accordance with the details on the Plans. Pre-cast concrete bases shall be placed at proper elevations on a firm-stable bedding mat (foundation) as shown on the Plans.

C. The manhole "foundation" shall be constructed of crushed limestone, or other select material as approved by the ENGINEER, compacted to a minimum of 95% of its proctor by approved mechanical means. It shall have a minimum depth of 12-inches, and shall extend under, and a minimum of 4-feet beyond the outside diameter, of the manhole to be installed. The bottom of the excavation shall be made reasonably level and to sufficient depth to allow the minimum amount of bedding as shown on the plans. Excavation deeper than that which is required to provide the minimum depth of bedding material may be required as directed by the ENGINEER when unsuitable materials are encountered. Geotextile fabric shall be placed over the bottom of the excavation to provide additional stability, and prevent mixing of select

foundation material with surrounding native material. In locations where pre-cast doghouse manhole bases are specified, care shall be taken not to disturb or damage the existing sanitary sewer pipe in which the base shall set over.

D. After manhole base is properly aligned and plumbed, the sanitary sewer pipe shall be inserted into the joint assembly and set in accordance with the manufacturer's recommendations.

E. Barrel sections shall be installed plumb and level. Use proper barrel sections to provide the fewest number of joints. Immediately prior to installing the barrel sections or top slab, the joint surfaces shall be cleaned and a joint sealant installed in accordance with the manufacturer's recommendations. The ends of the sealant shall butt neatly and tightly. No overlaps or gaps shall be permitted. After placement, the joints shall be checked to insure that the sealant has not been displaced. All joints shall fit properly as designed.

F. Use cone and/or riser sections to bring the manhole cover to proper grade as shown on the Plans. There shall be at least one 6" ring to allow for future grade adjustments. No more than 12" of concrete adjusting rings will be allowed. The adjusting ring joints shall be made with an approved cement mortar or sealant. The outside of the adjusting rings from casting to cone shall be sealed with an approved mortar or sealant.

G. The manhole frame and cover shall be set in an asphalt seal on top of the top adjusting ring. Mortar or other approved sealant shall be placed on the outside of the frame and down over the asphalt seal to the adjusting ring. In general, rim elevations as shown on the Plans are approximate. Final rim elevations will be approved by the ENGINEER at the work site. All manhole rims will be set to prevent the entrance of storm water runoff flowing across the manhole cover and into the manholes. Rim elevations in field or lawn area shall be as shown on the Plans, or as otherwise directed by the ENGINEER. When occurring in pavement areas, the rim elevations shall be flush with the adjacent grade, unless otherwise directed by the ENGINEER.

H. Manholes shall be assembled with steps centered under manhole opening.

I. The CONTRACTOR shall form invert channels in the manholes using Class a concrete, with a minimum compressive strength of 4000 psi. The CONTRACTOR shall provide a steel trowel finish. Where possible a half of a section of sewer pipe shall be set into the concrete to form the invert (such as straight through manholes). Channels shall be smooth and semi-circular in cross-section. Changes in direction of the flow shall be made with a smooth curve with as long a radius as possible. The invert channel shall be formed directly in the concrete. The bench, or the floor of the manhole outside the channel, shall be smoothed and sloped at a rate of 1/2" per foot toward the channel. All concrete shall be tooled smooth with a steel trowel finish.

J. Backfill around the manholes shall proceed in accordance with applicable portions of these Specifications. Backfill shall be placed uniformly around the manhole as backfilling proceeds upwards to prevent eccentric loading of the manhole and subsequently dislodging the manhole from plumb. When detailed by the plans and specifications, or when unsuitable native/excavated material is encountered for use in backfilling, as directed by the ENGINEER, the manhole shall be backfilled with approved select backfill material.

K. When a sanitary sewer manhole drop is required, the drop shall be constructed as detailed by the plans and specifications, and unless otherwise stated, shall be inside the manhole. Drop piping shall be SDR 35 PVC, and shall be attached/supported to the manhole wall be approved means. Each drop shall be constructed with a "tee-cutout" at the top of the drop, versus solid elbow pieces.

3.02 WATERTIGHTNESS

A. All manholes and catch basins shall be free of visible leakage. Each manhole or catch basin shall be tested for leaks and inspected, and all leaks shall be repaired in a manner subject to the ENGINEER'S approval.

B. After installing manhole sections and making O-ring joints, CONTRACTOR shall trowel on inside and outside face of joint mortar coating, "PRECO-PATCH" or equal.

3.03 PIPE JOINT

A. For pipe joint connections to valve manhole vaults an approved flexible water tight joint shall be provided between each pipe entering and exiting a structure. This may be accomplished by the installation of suitable joint seals and flexible pipe couplings as shown on the Drawings.

B. Materials required for pipe stubs shall be of the same make and manufacture, including lining and coating of the main adjoining piping.

3.04 CONNECTIONS TO EXISTING CATCH BASINS

A. The CONTRACTOR shall make connections between the proposed catch basins and the existing catch basins where shown on the Drawings.

B. The CONTRACTOR shall core drill into the existing catch basin at the locations shown on the Drawings and at the elevations shown on the Drawings and at such an angle so that no reverse flow conditions will be created and so that the core drilling does not interfere with the existing pipes.

C. Diversion of the water flow shall only be done with the approval of the ENGINEER and the agency involved.

3.05 GRADING RINGS

A. Grading rings shall be used for all precast where required. Grading rings shall be a minimum of 6-inches, but shall not exceed 12-inches in height, constructed on the roof slab or cone section on which the frame and cover shall be placed. The height of the grading rings shall be such as is necessary to bring the frame to the proper grade. However, no more than 3 grade rings will be allowed.

3.06 GRADING VAULTS

A. All vaults in unpaved areas shall be built as shown or directed to an elevation 6-inches higher than the original ground.

B. The ground surface shall be graded to drain away from the vault. Fill shall be placed around them to the level of the upper rim of the manhole frame, and the surface evenly graded to a 1 to 5 slope to the exiting surrounding ground unless otherwise shown. The slope shall be covered with 4-inches of topsoil, seeded and maintained until a satisfactory growth is obtained.

3.07 REMOVAL OF EXISTING MANHOLES

A. When the Contract Drawings call for the removal of an existing manhole, the manhole shall be removed in its individual sections, and disposed of off-site by the CONTRACTOR, unless otherwise directed by the ENGINEER.

B. All pipe being received by the manhole shall first be cut so that whole sections of the existing pipe are not "pulled" out of place while removing the manhole.

C. In all locations where the manhole is removed in grass or field areas (as further described by these specifications), the resulting hole shall be backfilled with on-site material in accordance with Section 02221 of these specifications, or as otherwise directed by the ENGINEER. In all locations where the manhole shall be removed in roadways, the CONTRACTOR shall first saw-cut the pavement to provide for a neat edge while excavating. The CONTRACTOR shall then be required to backfill the resulting hole with select backfill material in accordance with these specifications.

3.08 ABANDON EXISTING MANHOLE IN-PLACE

A. When the Contract Drawings call for the abandonment of an existing manhole, the frame and cover, top cone section, and ladder shall be removed and disposed of off-site by the CONTRACTOR, unless otherwise directed by the ENGINEER. The remainder of the existing manhole shall be abandon in-place.

B. In all locations where the manhole is abandon in grass or field areas, the resulting hole shall be backfilled with stone to the top of the abandoned manhole sections and then backfilled to grade with on-site material in accordance with Section 02221 of these specifications, or as otherwise directed by the ENGINEER. In all locations where the manhole shall be removed in roadways, the CONTRACTOR shall first saw-cut the pavement to provide for a neat edge while excavating. The CONTRACTOR shall then be required to backfill the resulting hole with select backfill material in accordance with these specifications.

END OF SECTION

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SECTION 03600

GROUT

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope:

1. The CONTRACTOR shall furnish all supervision, labor, materials, tools, equipment, and incidentals required to provide grout as shown and specified.
2. Grout shall be placed at the following locations:
   a. Inserts.
   b. Where indicated on the Contract Drawings.
3. The types of grout include the following:
   a. Non-shrink, epoxy type.
   b. Non-shrink, non-metallic type.
   c. Ordinary cement-sand.

B. Related Work Specified Elsewhere:

1. Section 03300, Cast-In-Place Concrete.

1.02 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. ASTM C 144, Aggregate and Masonry Mortar
2. ASTM C 150, Portland Cement
3. ASTM C 109, Compressive Strength of Hydraulic Cement Mortars (using 2-in. or 50 mm. Cube Specimens).
4. ASTM C 191, Time of Setting of Hydraulic Cement by Vicat Needle.
5. CRD-C-5898, Specifications for Non-Shrink Grout.

1.03 SUBMITTALS

A. Shop Drawings:

1. Submit copies of manufacturer's specifications and installation instructions for all proprietary materials.

B. Reports and Certificates:

1. For proprietary materials, submit copies of reports on quality control tests.
2. For nonproprietary materials, submit certification that materials meet specification requirements.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials: Grout materials from manufacturers shall be delivered in unopened containers and shall bear intact manufacturer's labels.
B. Storage of Materials: Grout materials shall be stored in a dry shelter and shall be protected from moisture.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Non-shrink, non-metallic grout for structural applications including bearing plates, base plates, and anchor rods.

1. Grout shall be NSF approved.
2. Grout shall have the following minimum property values in accordance with test standard:
   a. 28-day compressive strength (flowable state): 8,100 psi (CRD C-621).
   b. 28-day flexural strength (flowable state): 1,300 psi (ASTM C-580).
   c. 28-day bond strength (flowable state): 2,500 psi (ASTM C-882 modified).
3. Product and manufacturer: Sikagrout 212 by Sika, or equal.

B. Chemical grout for repair of cracks, joints, and voids in concrete.

1. Grout shall be NSF approved.
2. Grout shall have the following minimum property values in accordance with test standards:
   a. Density: 14 lbs/CF (ASTM D3574-86).
   b. Tensile strength: 80-90 psi (ASTM D3574-86).
   c. Elongation: 700-800% (ASTM D3574-86).
   d. Shrinkage: 18% linear shrinkage maximum (ASTM D756 procedure D and ASTM D1042).
3. Product and Manufacturer: Scotch-Seal Chemical grout 5600 by 3M, or equal.

C. Ordinary Cement-Sand Grout for Applications Approved by ENGINEER:

1. Except where otherwise specified use 1 part cement to 3 parts sand complying with the following:
   a. Cement: ASTM C 150, Type II
   b. Sand: ASTM C 33.
2. Where water repelling and shrinkage reducing requirements are shown or specified, use admixtures.
   a. Product and Manufacturer: Provide one of the following:
      1) Integral Waterpeller by the Euclid Chemical Company
      2) HydrocidePower by Sonneborn-Contech
      3) Or equal.

D. Epoxy Grout for Pump Placment

1. Comply with the following:
   a. ASTM C-881
2. Product and Manufacturer: Provide the following:
   a. Sikadur 32, Hi-Mod LPL as manufactured by Sika.

E. Water:

1. Use clean, fresh, potable water free from injurious amounts of oils, acids, alkali's, or organic matter.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. Place grout as shown and in accordance with manufacturer's instructions. If manufacturer's instructions conflict with the Specifications do not proceed until ENGINEER provides clarification.
2. Manufacturers of proprietary products shall make available upon 72 hours notification the services of a qualified, full time employee to aid in assuring proper use of the product under job conditions.
3. Placing grout shall conform to temperature and weather limitations in Section 03300 and to manufacturer recommendations.

END OF SECTION

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SECTION 04100

MORTAR

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall furnish all labor, materials, equipment and incidentals required to provide mortar in a color to match existing mortar as shown and specified.
2. This Section specifies the mortar for masonry materials specified in the following:
   a. Section 04220, Concrete Unit Masonry

B. Related Work Specified Elsewhere:

1. Section 04150, Masonry Accessories
2. Section 04200, Unit Masonry Construction

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Wherever a fire-resistance classification is shown or scheduled for unit masonry construction (3-hour, 2-hour and similar designations), provide mortar and proportions complying with the requirements established by UL and the New York State Building Code.

B. Source Quality Control: Do not change source or brands of mortar materials during the course of the Work.

C. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. ASTM C 5, Quicklime for Structural Purposes
2. ASTM C 91, Masonry Cement
3. ASTM C 144, Aggregate for Masonry Mortar
4. ASTM C 150, Portland Cement
5. ASTM C 207, Hydrated Lime for Masonry Purposes
6. ASTM C 270, Mortar for Unit Masonry
7. UL, Design Numbers U901 through U908

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials: Manufactured materials, such as cement and lime, shall be delivered and stored in their original containers, plainly marked with identification of materials and manufacturer.

B. Storage of Materials:

1. Store mortar materials off the ground in a dry location and under a properly constructed shelter using tarpaulins, felt paper, or polyethylene sheets.

2. Protect liquid admixtures from freezing.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portland Cement:

1. ASTM C 150, Type I, non-staining, without air entraining and of natural color.
2. Use ASTM C 150, Type III, high early strength, for laying masonry when outside temperature is less than 50°F.

B. Hydrated Lime: ASTAM C 207, Type S, or lime putty ASTM C 5.

C. Sand Aggregates: ASTM C 144, except for joints less than 1/4-inch use aggregate graded with 100 percent passing the No. 16 sieve.

D. Water: Free from injurious amounts of oils, acids, alkalis, or organic matter, and clean, fresh and potable.

2.2 MORTAR MIXES

A. General:

1. Anti-Freeze Admixture or Agents: Not permitted.
2. Calcium Chloride: Not permitted.

B. Fire Resistant Mortar:

1. Standard: UL Design Numbers 0901, 0902, 0903, 0904, 0905, 0906, 0907, and 0908.
2. Proportion: Use 1 part Portland cement, 3 parts clean sand, and 15 percent hydrated lime (by cement volume).

C. Mortar for All Unit Masonry, except as specified under "2.2.B." above: Comply with ASTM C 270, Table 2, except limit materials to those specified herein, and limit cement to lime ratio by volume as follows:

1. Type S: Not more than ½ part lime per part of Portland Cement.

D. Stearate Additive: Add to mix in amount equal to not more than 3 percent by the weight of cement.

PART 3 - EXECUTION

3.1 PREPARATION

A. Measurement of Materials:

1. Mortar Cement and Hydrated Lime: Batched by the bag.
2. Sand: Batched by volume in suitable calibrated containers, provided proper allowance is made 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: Not permitted.

B. Mortar Mixing:

1. Type of Mixer: Machine mix in approved mixer in which the quantity of water is accurately and uniformly controlled.

2. Mixing Time: Not less than five minutes with approximately two minutes for mixing the dry materials and not less than three minutes of continued mixing after water has been added.
3. Hydrated Lime for Mortar requiring Lime Content: Use dry-mix method. Turn over together the materials for each batch until the even color of the mixed, dry materials indicate that cementitious materials have been thoroughly distributed throughout the mass, then add water to obtain required plasticity.
4. Lime putty if approved for use shall be prepared in accordance with ASTM C 5.

3.2 INSTALLATION

A. Refer to the following:

1. Section 04200, Unit Masonry Construction

END OF SECTION

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SECTION 04150

MASONRY ACCESSORIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall furnish all labor, materials, equipment and incidentals required to provide masonry accessories as shown and specified.
2. The types of masonry accessories required include the following:

a. Continuous horizontal wire reinforcing and ties.
b. Individual metal ties.
c. Anchoring devices.
d. Masonry control joints.
e. Expansion joints.
f. Miscellaneous accessories.

3. This Section specifies the masonry accessories for Work under the following Sections.

a. Section 04100, Mortar
b. Section 04200, Unit Masonry Construction

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Wherever a fire-resistance classification is shown or scheduled for unit masonry construction (3-hour, 2-hour and similar designations), provide accessories complying with the requirements established by UL and the New York State Building Code.
B. Reference Standards: Comply with applicable provisions and recommendations of the following, except where otherwise shown or specified.

1. ASTM A82, Cold-Drawn Steel Wire for Concrete Reinforcement.
2. ASTM A 153, Zinc-Coating (Hot Dip) on Iron and Steel Hardware.
3. ASTM A 615, Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
4. ASTM A 176, Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip.
5. UL, Design Numbers U901 through U908.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval to ENGINEER copies of manufacturer's specifications and installation instructions for each masonry accessory required. Include data substantiating that materials comply with specified requirements.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials: Deliver accessories in original packages, plainly marked with identification of materials and manufacturer.
B. Storage of Materials: Store and cover materials to prevent corrosion and deterioration.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Continuous Wire Reinforcing and Ties for Masonry: Welded wire units prefabricated in straight lengths of not less than 10 feet, with matching corner "L" and intersection "T" units. Fabricate from cold-drawn steel wire complying with ASTM A 82, with deformed continuous 9 gage side rods and plain 9 gage cross rods, crimped for cavity wall construction, if any, with unit width of 1-1/2 to 2 inches less than thickness of wall or partition. All reinforcing shall be hot dipped galvanized after fabrication with 1.5 ounces per square foot of zinc coating complying with ASTM A 153, Class B-2 unless otherwise specified.

1. For masonry, use units fabricated as follows:

a. Truss type fabricated with single pair of side rods and continuous diagonal cross-rods spaced not more than 16-inches on centers.
b. Product and Manufacturer: Provide one of the following:

1) Dur-O-Wall by Dur-O-Wall, Inc.
2) Blok-Truss AA600 by AA Wire Products Company
3) Or equal.

B. Individual Wire Ties for Masonry: Fabricate from 3/16-inch cold-drawn steel wire complying with ASTM A 82, with 1.5 ounces per square foot of hot-dip coating complying with ASTM A 153, Class B-2 of the length required for proper embedment in wythes of masonry shown, or crimped if used in cavity wall construction.

1. For use with hollow masonry units laid with cells vertical, provide adjustable ties.
2. Product and Manufacturer: Provide one of the following:

a. AA303 Adjustable Tie by AA Wire Products Company.
b. Or equal.

C. Anchoring devices for Masonry Veneer: Fabricate from 3/16-inch cold-drawn steel wire complying with ASTM A-82, with 1.5 ounces per square foot of hot-dip coating complying with ASTM A153, Class B-2 of the length required for proper embedment in wythes of masonry shown.

1. For use with existing masonry or concrete walls and proposed brick facing, provide veneer anchors and ties.
2. Product and Manufacturer: Provide one of the following:

a. Veneer Anchor and Tie by AA Wire Products Company.
b. Or equal.

D. Anchoring Devices for Column to Masonry: Provide dovetail anchor slots and anchors. Dovetail slots to be fabricated from not less than 26-gage steel. Anchors to be fabricated from not less than 16 gage steel.

1. For use with concrete column to concrete block or brick anchorage.
2. Product and manufacturer: Provide one of the following:

a. Dovetail Slots and Anchors by Dur-O-Wall.
b. Or equal.

E. Masonry Control Joints: Provide cross-type masonry control joints in cavity wall at locations shown on the drawings.

1. For use in cavity wall construction in locations indicated on the drawings.
2. Product and manufacturer: Provide one of the following:

a. Masonry Control Joint by Greenstreak.
b. Masonry Control Joint by Dur-O-Wall.
c. Or equal.

F. Miscellaneous Masonry Accessories:

1. Reinforcing Bars: Deformed steel, ASTM A 615, Grade 60 of the sizes shown.
2. Cavity Fill Mesh: Provide hot dip galvanized 1/2-inch mesh hardware cloth, backed with asphalt impregnated cloth below. Install below all block courses that are to be filled with mortar.
3. Weep Holes: Wick filled.
4. Cleaning Solutions: Non-acidic, not harmful to masonry work or adjacent materials.
5. Compressible filler: Provide polyurethane open cell foam in accordance with ASTM D-1564 and ASTM D-3574. Installation shall be in accordance with manufacturer's recommendations for each particular application or in accordance with subsection 3.4.E. of Section 04200, Everlastic 1320 Series by Williams Products, Inc., or equal.
6. Flashing: Provide flashings where shown and specified. Flashing shall be manufactured from galvanized steel to the profiles as shown on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to the following:

1. Section 04200, Unit Masonry Construction

END OF SECTION

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SECTION 04200

UNIT MASONRY CONSTRUCTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall furnish all labor, materials, tools, equipment and incidentals required to provide unit masonry construction as shown and specified. The Work also includes:

a. Providing openings in masonry to accommodate the Work under this and other Sections and building into the masonry all items such as sleeves, anchor bolts, inserts, and all other items to be embedded in masonry for which placement is not specifically provided under other Sections.
b. Providing openings in masonry to accommodate the work under other contracts and assisting other contractors in building into the masonry all items required to be embedded in masonry under other contracts.

2. This Section specifies the installation of unit masonry specified in the following:

a. Section 04220, Concrete Unit Masonry

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the masonry.
2. Notify other contractors in advance of the construction of the masonry to provide the other contractors with sufficient time for the installation of items included in their contracts that must be installed with the masonry.

C. Related Work Specified Elsewhere:

1. Section 04100, Mortar
2. Section 04150, Masonry Accessories

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Wherever a fire-resistance classification is shown or scheduled for unit masonry construction (4-hour, 3-hour, and similar designations), comply with applicable requirements for materials and installation established by UL and the New York State Building Code.
B. Codes: Comply with the applicable requirements of governing authorities and New York State Building Code for the types of masonry construction shown.
C. Construction Tolerances:

1. Variation from Plumb: For lines and surfaces of columns, walls and arises, do not exceed 1/4-inch in 10 feet, or 3/8-inch in a story height or 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 in Drawings 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.

D. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. ASTM C67, Brick and Structural Clay Tile, Sampling and Testing.
2. Brick Institute of America, "Technical Notes on Brick and Tile Construction."
3. Brick Institute of America, Technical Bulletin 1A, "Construction and Protection Recommendations for Cold Weather Masonry Construction".
4. Brick Institute of America, Technical Notes on "Cleaning Clay Products Masonry".
5. National Concrete Masonry Association, "Guide Specifications" and "Technical Bulletins".

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval to ENGINEER a layout drawing indicating the location of all proposed joints and reinforcing.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Storage of Materials: Protect masonry materials during storage and construction with a properly erected shelter from wetting by rain, snow or groundwater and from soilage or intermixture with earth or other materials.
B. Handling Materials: Handle materials in a manner that minimizes chips, cracks, voids, discolorations or other defects which might be visible or cause staining in finished work.

1.5 JOB CONDITIONS

A. Environmental Requirements: Do not place any masonry when air temperature is 40^{o}F and falling. Masonry may be placed when air temperature is 32^{o}F and rising. In either case, it may not be placed if temperature is expected to drop below 32^{o}F during 72 hours following placement, unless adequate protection is provided as specified in Paragraph 1.5.B.4.b of this Section.

B. Protection:

1. Protect partially completed masonry against weather, when work is not in progress, by covering top of walls with strong, waterproof, non-staining membrane. Extend membrane at least 2 feet down both sides of walls and hold securely in place.
2. Do not apply uniform floor or roof loading for at least three days after completing masonry walls.
3. Do not apply concentrated loads for at least seven days after completing masonry walls.
4. Cold Weather Protection.

a. When surrounding air temperature is 48°F to 40°F, protect masonry construction from rain or snow for a minimum of 48 hours by covering with non-staining weathertight membrane.
b. When surrounding air temperature is 40°F and below, maintain masonry construction temperature above 40°F for a minimum of 48 hours by enclosure and supplementary heat, electric heating blankets, infrared lamps, or other methods acceptable to the ENGINEER.
c. Comply with governing codes and review the "Construction and Protection Recommendations for Cold Weather Masonry Construction" of the Technical Notes on Brick and Tile Construction by the Brick Institute of America. Comply with recommendations except where superseded by this Section.
d. Frozen Materials: Do not use frozen materials or materials mixed or coated with ice or frost.
e. Frozen Work: Do not build on frozen work. Remove and replace masonry work damaged by frost or freezing as directed by the ENGINEER.

5. Hot Weather Protection: Protect masonry construction, by methods acceptable to ENGINEER, from direct exposure to wind and sun when the surrounding air temperature is 99°F in the shade with relative humidity less than 50 percent.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Refer to the following section for required masonry materials:
1. Section 04100, Mortar
2. Section 04150, Masonry Accessories
3. Section 04220, Concrete Unit Masonry

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR and his installer shall examine areas and conditions under which the Work is to be performed and advise the ENGINEER in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to the ENGINEER.

3.2 PREPARATION

A. Wetting of Masonry Units:

1. Except for absorbent units specified to be wetted, lay masonry units dry. Do not wet concrete masonry units.

3.3 INSTALLATION, GENERAL

A. Thickness: Build walls to the full thickness shown.
B. Build chases and recesses as shown or required by others. Refer to Paragraph 1.1.B of this Section for the requirements of coordination with others. Provide not less than 8-inches of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.

C. Leave openings for equipment, piping, and other items to be installed subsequent to starting of masonry Work. After installation of said items, complete masonry Work to match work immediately adjacent to openings.

D. Cut masonry units using motor driven 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 wherever possible.

3.4 LAYING MASONRY WALLS

A. General:

1. Mortar Types: Unless otherwise indicated, use mortar as specified in Section 04100, Mortar. Do not use mortar which has begun to set or if more than ½ hour has elapsed since initial mixing. Retemper mortar during the 1/2 hour period only as required to restore workability.
2. Layout walls in advance for accurate spacing of surface pattern bond with uniform joint widths and to properly locate openings, expansion joints, returns and offsets. Avoid the use of less than half size units at corners, jambs and wherever 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 interior masonry in running bond with vertical joint in each course centered on units in courses above and below.
    b. Bond and interlock each course with each wythe at corners.
    c. Do not use units with less than 4-inch horizontal face dimensions at corners or jambs.

B. 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.

    a. Maintain joint widths shown, except for minor variations required to maintain pattern bond alignment. If not shown, lay walls with 3/8-inch joints.

3. Cut joints flush for masonry walls that are to be concealed or to be covered by other materials, unless otherwise shown.
4. Tool exposed joints slightly concave, unless otherwise required to match existing joint treatment. Rake out mortar in preparation for application of caulking or sealants where required.
5. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners at jambs to fit stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.

C. Stopping and Resuming Work: Rake back 1/2 brick 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.

D. Built-in Work:

1. As the work progresses, build in items shown, specified or required by others. Refer to paragraph 1.1.B of this Section for the requirements of coordination with others. Fill cores in one block width solidly with masonry around built-in items.
2. Fill space between hollow metal frames and masonry solidly with mortar.
3. Where built-in items are to be embedded in cores of masonry units, place a layer of cavity fill mesh in the joint below and rod mortar or grout into core.

E. Structural Bonding of Masonry:

1. Non-Load-Bearing interior Partitions: Build full height of story to underside of structure above, unless otherwise shown.
2. Insert compressible filler, specified in Section 04150, Masonry accessories, in all horizontal and vertical joints where masonry terminates. Insert filler 3/4-inches from both faces of masonry. Use filler four times as thick as the widest part of the joint. Thickness of filler shall be a minimum of 4 times the compressed thickness. Compress filler to less than thickness of joint and insert. At splices, overlap strips by 3-inches and compress ends to form tight joints. Finish with backer rod and sealant.

F. Horizontal Joint Reinforcing:

1. Provide continuous horizontal joint reinforcing as shown and specified. Refer to Section 04150, Masonry Accessories, for type of reinforcing units required. Fully embed longitudinal side rods in mortar for their entire length with a minimum cover of 5/8-inch on exterior side of walls and 1/2-inch at other locations. Lap reinforcement a minimum of 6 inches at ends of units. Do not bridge control and expansion joints with reinforcing.
2. Reinforce all walls with continuous horizontal joint reinforcing unless specifically noted or specified to be omitted.
3. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend units in accordance with manufacturer's written instructions for continuity at returns, offsets, pipe enclosures and other special conditions.
4. Space continuous horizontal reinforcing as follows:

    a. 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 code but not more than 16-inches on-centers vertically.

5. Reinforce masonry openings greater than 12-inches wide, with horizontal joint reinforcing placed in two horizontal joints approximately 8-inches apart, immediately above the lintel and immediately below the sill. Extend reinforcing a minimum of 24-inches beyond jambs of the opening.
6. In addition to wall reinforcing, provide additional reinforcing at openings as required to comply with the above.

B. Anchoring Masonry Work:

1. Provide anchoring devices of the type shown and as specified under Section 04150, Masonry accessories. If not shown or specified, provide standard type for facing and back-up involved.

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 3/8-inch in width between masonry and structural member, unless otherwise shown. Keep open space free of mortar or other rigid materials.

H. Control Joints:

1. Provide vertical expansion, control and isolation joints with masonry where shown. Build in related items as the masonry Work progresses. Rake out mortar in preparation for application of caulking sealants and compressible filler.

   a. Provide items specified under Section 04150, Masonry Accessories, where shown.

      1) Build flanges of factory fabricated expansion joint strips into masonry. Refer to Section 04150, Masonry Accessories.
      2) Build in compressible fillers specified under Section 04150, Masonry Accessories, where shown or specified. Install in accordance with manufacturer's written instructions.

2. Control Joint Spacing: Locate control joints as shown. Where location of control joints are not shown, place vertical joints spaced not to exceed 20 feet-0 inches on centers if not reinforced. Locate control joints at points of natural weakness in the Work including the following:

   a. 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 6 feet-0 inches wide and at both sides for openings over 6 feet-0 inches wide.
   b. At vertical chases, recesses and other points of reduction in wall thickness.
   c. Submit joint locations to ENGINEER for approval.

I. Lintels:

1. Provide masonry lintels where shown and wherever openings of 16-inches or more are shown without structural steel lintels. Provide formed-in-place masonry lintels.

   a. Unless otherwise shown provide one horizontal number six deformed reinforcing bar for each 4-inches of wall thickness.
   b. Use specifically formed "U" shaped lintel units with reinforcing bars placed as shown filled with grout fill specified in Section 04100, Mortar. Temporarily support formed-in-place lintels.

2. Provide minimum bearing for masonry lintels at each jamb, of 8-inches.
3. Increase minimum bearing of masonry lintels to maintain joint pattern of wall and install masonry lintels to be indistinguishable from masonry joint pattern of surrounding masonry.

END OF SECTION

SECTION 04220

CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall furnish all labor, materials, tools, equipment and incidentals required to furnish and install concrete unit masonry as shown and specified.
2. The extent of concrete unit masonry work is shown on the Drawings.
3. The type of concrete masonry unit required is as follows:

a. Lightweight, hollow load bearing units.

B. Related Work Specified Elsewhere:

1. Section 04100, Mortar
2. Section 04150, Masonry Accessories
3. Section 04200, Unit Masonry Construction

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Wherever a fire-resistance classification is shown or scheduled for concrete unit masonry construction (3-hour, 2-hour and similar designations), provide units complying with the requirements established by the UL and the New York State Building Code.
B. Codes: Comply with applicable requirements of governing authorities and New York State Building Code for type of concrete unit masonry shown.
C. Source Quality Control: Obtain units from one manufacturer, cured by one process and of uniform texture and color.
D. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. ASTM C 33, Concrete Aggregates
2. ASTM C 90, Hollow Load-Bearing Concrete Masonry Units
3. ASTM C 331, Lightweight Aggregates for concrete Masonry Units
4. UL Design Numbers U901 through U908.

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

A. OWNER shall provide the concrete masonry units in original packages and pallets, plainly marked with identification of materials and manufacturer, delivered to the site
B. Storage of Materials: Store and cover concrete masonry units to prevent damage such as chipping and staining.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Size: Manufacturer's standard units with nominal face dimensions of 16-inches long by 8-inches high by 8-inches in width (15-5/8-inches by 7-5/8-inches by 7-5/8-inches actual).

2.2 CONCRETE MASONRY UNITS

A. General: Where concrete masonry units are shown, comply with the following classification, weight, grade, curing, and other requirements as specified.
B. Hollow Load Bearing Concrete Masonry Units: ASTM C 90, Grade N.
C. Weight: Provide lightweight units using aggregate complying with ASTM C 331 producing dry net weight of not more than 105 pounds per cubic foot, unless otherwise specified.

D. Curing:

1. Cure units in a moisture controlled atmosphere or in an autoclave at a minimum temperature of 350^{o}F, and a minimum pressure of 125 pounds per square inch.
2. Limit moisture absorption to 50 percent of saturation during delivery and until time of installation.

E. Exposed Faces: Provide manufacturer's standard color and texture.

PART 3 - EXECUTION

3.1 INSTALLATION

A. See Section 04200, Unit Masonry Construction.

END OF SECTION

SECTION 05500

ANCHOR BOLTS, EXPANSION ANCHORS AND CONCRETE INSERTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall furnish all labor, materials, tools, equipment, and incidentals required to provide anchor bolts, expansion anchors and concrete inserts as shown, specified and as required for proper installation of all equipment.

B. This Section includes all bolts, anchors and inserts required for the work but not specified under other Sections.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with the applicable provisions and recommendations of the following, except as otherwise shown and specified.

1. ASTM A 325, carbon steel externally and internally threaded standard fasteners.

B. Expansion anchors and inserts shall be UL or FM approved.

1.3 SUBMITTALS

A. Submit in accordance with Section 01340.
B. Samples: Submit for approval of the following:

1. Representative samples of bolts, anchors and inserts as may be requested by the ENGINEER. His review will be for type and finish only. Compliance with all other requirements is exclusive responsibility of CONTRACTOR.

C. Shop Drawings: Submit for approval the following:

1. Setting drawings and templates for location and installation of anchorage devices.
2. Copies of manufacturer's specifications, load tables, dimension diagrams and installation instructions for the devices.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

A. When the size, length or load carrying capacity of an anchor bolt, expansion anchor, or concrete insert is not shown on the drawings, provide the size, length and capacity required to carry the design load times a minimum safety factor of four.

B. Determine design loads as follows:
1. For equipment anchors, use the design load recommended by the manufacturer and approved by the ENGINEER.

2. For pipe hangers and supports, use one half the total weight of pipe, fittings, valves, accessories and water contained in pipe, between the hanger or support in question and adjacent hangers and supports on both sides.
3. Allowances for vibration are included in the safety factor specified above.

2.2 MATERIALS

A. Anchor Bolts:

1. Provide bolts complying with ASTM A 325 with heavy hex nuts and washers.
2. In buried or submerged locations, or where bolts may be subjected to direct or atmospheric contact with chemicals, provide stainless steel bolts complying with ASTM A 320, AISI Type 316. Other AISI types may be used subject to ENGINEER'S approval.

B. Expansion Head Anchors:

1. Provide zinc-plated anchors. Anchors shall be of the size required for the concrete strength specified. Provide stud type (male thread) or flush type (female thread), as required.
2. Product and Manufacturer: Provide anchors by one of the following:

a. Ramset/Red Head
b. Hilti, Incorporated
c. Or equal.

3. In buried or submerged locations, or where anchors may be subjected to direct or atmospheric contact with chemicals, provide stainless steel anchors complying with ASTM A 320, AISI Type 316. Other AISI types may be used, subject to the ENGINEER'S approval.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Drilling equipment used and installation of expansion anchors shall be in accordance with manufacturer's instructions.
B. Assure that embedded items are protected from damage and are not filled in with concrete.

END OF SECTION

SECTION 06100

ROUGH CARPENTRY

PART 1 – GENERAL

1.01 DESCRIPTION

A. Scope:

1. Wood framing.
2. Wood blocking.

1.02 SUBMITTALS

A. Wood treatment data, including instructions for handling, storing, installing, and finishing treated materials, and the following:

1. Certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.
2. Statement that moisture content of treated materials was reduced to levels indicated before shipment to Project site.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Lumber Standards: Manufacturer lumber to comply with PS 20 "American Softwood Lumber Standard" and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.

B. Grade Stamps: Factory-mark each piece of lumber with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.

1. For exposed lumber apply grade stamps to ends or back of each piece, or omit grade stamps entirely and issue certificate of grade compliance from inspection agency in lieu of grade stamp.

C. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, for moisture content specified for each use.

1. Provide seasoned lumber with 19 percent moisture content at the time of dressing and shipment, for sizes 2 inches or less in thickness.

D. Preservative Treated Materials: Comply with applicable requirements of AWPA C2 (lumber) and AWPA C9 (plywood). Mark each treated item with the Quality Mark Requirements of an inspection agency approved by ALSC's Board of Review.

1. Pressure treat aboveground items with waterborne preservatives to a minimum retention of 0.25 lb/cu. ft. After treatment, kiln-dry lumber and plywood to a maximum moisture content of 19 and 15 percent, respectively. Treat indicated items and the following:

a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
b. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
c. Wood framing members less than 18 inches (460 mm) above grade.
d. Wood floor plates installed over concrete slabs directly in contact with earth.

2. Pressure treat wood members in contact with ground or freshwater with waterborne preservatives to a minimum retention of 0.40 lb/cu. ft. (6.4kg/cu. m).
3. Approved Manufacturers: Provide treatment chemicals produced by one of the following: Baxter: J. H. Baxter Co., Chemical Specialties, Inc., Continental Wood reservers, Inc., Hickson Corp., Hoover Treated Wood Products, Inc., Osmose Wood Preserving, Inc., or approved equal.

E. Complete fabrication of treated items before treatment, where possible. If cut after treatment, apply field treatment complying with AWPA M4 to cut surfaces. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

F. Fire Resistant Treated Lumber and Plywood: Where indicated, provide "Osmose" "Flame Proof LHC" or equal.

1. Provide fire resistant lumber in each application, unless otherwise indicated.

G. Dimension Lumber: Provide lumber of the following product classification and species indicated:

1. Concealed Boards: Standard grade, any species graded under WWPA rules or No. 3 grade Southern Pine graded under SPIB rules.
2. Lumber for Miscellaneous Uses: Standard grade lumber for support of other work, including bucks, nailers, blocking, furring, stripping and similar members.

H. Plywood: Provide plywood of APA grade B-C, exterior glue, southern pine veneer for use in concealed locations.

1. Plywood Backing Panels: For mounting electrical equipment, provide fire-retardant treated plywood panels with grade designation APA C-D PLUGGED INT with exterior glue, and in thickness indicated, or if not otherwise indicated, not less than 23/32-inch.

I. Fasteners and Anchorages: Provide size, type, material and finish as indicated and as recommended by applicable standards, complying with applicable Federal Specifications for nails, staples, screws, bolts, nuts, washers and anchoring devices. Provide metal hangers and framing anchors of the size and type recommended by the manufacturer for each use including recommended nails.

1. Where rough carpentry work is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners and anchorages with a hot-dip zinc coating (ASTM A 153).

PART 3 – EXECUTION

3.01 INSTALLATION

A. Discard units of material with defects which might impair quality of work, and units which are too small to use in fabricating work with minimum joints or optimum joint arrangement.

B. Set carpentry work to required levels and lines, with members plumb and true to line and cut and fitted.

C. Install rough carpentry work to comply with recommendations of manufacturer of product involved for use intended. Set carpentry work to required levels and lines, with members plumb and true and cut to fit.

D. Securely attach carpentry work. Install fasteners without splitting wood: fasten panel products to allow for expansion at joints unless otherwise indicated.

1. Countersink nail heads on exposed carpentry work and fill holes.

END OF SECTION

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SECTION 07210

BUILDING INSULATION

PART 1 – GENERAL

1.01 DESCRIPTION

A. This section specifies thermal and acoustical insulation for buildings.

1.02 SUBMITTALS

A. Submit in accordance with Section 01340, the following:

1. Insulation, each type used
2. Adhesive, each type used.
3. Tape
4. Certificates: Stating the type, thickness and "R" value (thermal resistance) of the insulation to be installed.

1.03 STORAGE AND HANDLING:

A. Store insulation materials in weathertight enclosure.

B. Protect insulation from damage from handling, weather and construction operations before, during, and after installation.

1.04 APPLICABLE PUBLICATIONS:

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.

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

C516-02	Vermiculite Loose Fill Thermal Insulation
C552-2000	Cellular Glass Thermal Insulation.
C578-01	Rigid, Cellular Polystyrene Thermal Insulation
C591-01	Unfaced Preformed Rigid Cellular Polyisocynurate Thermal Insulation
C612-00	Mineral Fiber Block and Board Thermal Insulation
C665-01	Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
E84-03	Surface Burning Characteristics of Building Materials
F1667-02	Driven Fasteners: Nails, Spikes and Staples.

PART 2 - PRODUCTS

2.01 INSULATION – GENERAL

A. Where thermal resistance ("R" value) is specified or shown for insulation, the thickness shown on the drawings is nominal. Use only insulation with actual thickness that is not less than that required to provide the thermal resistance specified.

B. Where "R" value is not specified for insulation, use the thickness shown on the drawings.

C. Where more than one type of insulation is specified, the type of insulation for each use is optional, except use only one type of insulation in any particular area.

2.02 PERIMETER INSULATION IN CONTACT WITH SOIL

A. Polystyrene Board: ASTM C578, Type IV, V, VI, VII, or IX where covered by soil or concrete.

2.03 EXTERIOR FRAMING OR FURRING INSULATION

A. Batt or Blanket: Optional.
B. Mineral Fiber: ASTM C665, Type II, Class C, Category I where framing is faced with gypsum board.
C. Mineral Fiber: ASTM C665, Type III, Class A where framing is not faced with gypsum board.

2.04 RIGID INSULATION

A. On the face of exterior walls, and where shown.
B. Polyiscyanurate Board: ASTM C591, (Thermax with foil face)

2.05 MASONRY FILL INSULATION

A. Vermiculite Insulation: ASTM C516, Type II.

2.06 FASTENERS

A. Staples or Nails: ASTM F1667, zinc-coated, size and type best suited for purpose.
B. Screws: ASTM C954 or C1002, size and length best suited for purpose with washer not less than 50 mm (two inches) in diameter.
C. Impaling Pins: Steel pins with head not less than 50 mm (two inches) in diameter with adhesive for anchorage to substrate. Provide impaling pins of length to extend beyond insulation and retain cap washer when washer is placed on the pin.

2.07 ADHESIVE

A. As recommended by the manufacturer of the insulation.

2.08 TAPE

A. Pressure sensitive adhesive on one face.
B. Perm rating of not more than 0.50.

PART 3 - EXECUTION

3.01 INSTALLATION - GENERAL

A. Install insulation with the vapor barrier facing the heated side, unless specified otherwise.
B. Install rigid insulating units with joints close and flush, in regular courses and with cross joints broken.
C. Install batt or blanket insulation with tight joints and filling framing void completely. Seal cuts, tears, and unlapped joints with tape.
D. Fit insulation tight against adjoining construction and penetrations, unless specified otherwise.

3.02 PERIMETER INSULATION

A. Vertical insulation:

1. Fill joints of insulation with same material used for bonding.
2. Bond polystyrene board to surfaces with adhesive or Portland cement mortar mixed and applied in accordance with recommendations of insulation manufacturer.

B. Horizontal insulation under concrete floor slab:

1. Lay insulation boards and blocks horizontally on level, compacted and drained fill.
2. Extend insulation from foundation walls towards center of building not less than 600 mm (24 inches) or as shown.

3.03 EXTERIOR FRAMING OR FURRING BLANKET INSULATION

A. Pack insulation around door frames and windows and in building expansion joints, door soffits and other voids. Pack behind outlets around pipes, ducts, and services encased in walls. Open voids are not permitted. Hold insulation in place with pressure sensitive tape.
B. Lap vapor retarder flanges together over face of framing for continuous surface. Seal all penetrations through the insulation.
C. Fasten blanket insulation between metal studs or framing and exterior wall furring by continuous pressure sensitive tape along flanged edges.
D. Fasten blanket insulation between wood studs or framing with nails or staples through flanged edges on face of stud. Space fastenings not more than 150 mm (six inches) apart.

3.04 RIGID INSULATION ON SURFACE OF EXTERIOR WALLS, FLOORS, AND UNDERSIDE OF FLOORS

A. On the face of solid masonry and concrete walls, beams, beam soffits, underside of floors, and to the face of studs for interior wall finish where shown.
B. Bond to solid vertical surfaces with adhesive as recommended by insulation manufacturer. Fill joints with adhesive cement.
C. Use impaling pins for attachment to underside of horizontal surfaces. Space fastenings as required to hold insulation in place and prevent sagging.

D. Fasten board insulation to face of studs with screws, nails or staples. Space fastenings not more than 300 mm (12 inches) apart. Stagger fasteners at joints of boards. Install at each corner.

3.05 MASONRY FILL INSULATION

A. Pour fill insulation in voids of masonry units from tops of walls, or from sill where windows or other openings occur.
B. Pour in lifts of not more than 6 m (20 feet).

END OF SECTION

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SECTION 07311

ASPHALT ROOF SHINGLES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope

1. The CONTRACTOR shall provide all supervision, labor, materials, tools, equipment and incidentals as indicated on the Contract Drawings, specified, and required to furnish and install all asphalt shingle roofing Work.
2. The extent of roofing is indicated on the Contract Drawings.
3. Roofing Work required includes, but is not necessarily limited to, the following:

a. Asphalt shingles.
b. Underlayment.
c. Miscellaneous materials.

B. Coordination

1. Review requirements and procedures under other Sections and coordinate the installation of items that must be installed with the roofing.
2. Notify other contractors in advance of the installation of the roofing to provide the other contractors with sufficient time for the installation of items included in their contracts that must be installed before the roofing.

C. Related Work Specified Elsewhere:

1. Section 07619, Flashing and Trim.

1.02 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies

1. Conform to applicable code for UL850 wind uplift for shingle types specified.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. ANSI/ASTM D226, Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
2. ANSI/ASTM D2178, Asphalt Impregnated Glass (Felt) Mat Used in Roofing and Waterproofing.
3. ANSI/ASTM D2822, Asphalt Roof Cement.
4. ANSI/ASTM D3018, Class A Asphalt Shingles Surfaced with Mineral Granules.
5. UL 580, Test for Wind Uplift Resistance of Roof Assemblies.
6. UL 790, Tests for Fire Resistance of Roof Covering Materials.

1.03 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Copies of Drawings showing completely dimensioned plans and details of construction and erection, including all flashing details coordinated with Section 07619, Flashing and Trim, all roof penetration locations, roof penetration details and mechanical clip locations.
2. Manufacturer's specifications indicating product information correlated to specified requirements, manufacturer's installation instructions, maintenance instructions and other data as may be required by ENGINEER.

B. Statement of Application: Upon completion of the Work, submit a statement to ENGINEER signed by CONTRACTOR and roofing installer stating that the Work complies with the requirements of these Specifications and the installation methods comply with the manufacturer's printed instructions and were proper and adequate for the condition of installation and use.

C. Guarantee

1. CONTRACTOR shall execute his own written guarantee direct to ranting all roofing and flashing weather and watertight and perfect for a period ten years after date of conditional acceptance thereof by OWNER. Imperfections, by reason of defective materials, workmanship or arrangement of the various parts shall be made good to the satisfaction of OWNER at CONTRACTOR'S expense.
2. Warranty period for shingles furnished under this section shall be not less than 25 years for shingle products.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's original, unopened containers and rolls with labels intact and legible. Materials requiring fire resistance classification shall be delivered to the job with labels attached and packaged as required by labeling service. Deliver materials in sufficient quantity to allow continuity of work.
B. Handle rolled goods so as to prevent damage to edge or ends. Select and operate material handling equipment so as not to damage existing construction or applied roofing.
C. Store materials on clean raised platforms with weather protective covering when stored outdoors. Store rolled goods on end.
D. Provide continuous protection of materials against wetting, moisture absorption and damage by construction traffic. Remove wet materials from project site. Comply with fire safety regulations. Store liquid materials in temperature between 50^{o} F and 75^{o}F.
E. Comply with manufacturer's instruction for storage and handling.

1.05 JOB CONDITIONS

A. Weather Condition Limitations: Proceed with roofing and associated Work only when weather conditions will permit unrestricted use of materials and quality control of the Work, complying with the requirements and recommendations of the roofing materials manufacturer. Proceed only when the installer is willing to guarantee the Work as required and without additional reservations and restrictions.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Roofing

1. Asphalt Shingles: ANSI/ASTM D3018, Class A with Type I – Self Sealing; UL Rating of A and Wind Resistance Label, glass fiber mat base, mineral granule surface type, 325 lbs./square; self sealing type, square type; color selected by OWNER.
2. Manufacturer: Provide products as manufactured by:

a. Owens-Corning, Inc.;
b. Certainteed Corporation;
c. Georgia-Pacific Corporation;
d. or approved equal;

B. Underlayment

1. Cellulose fiber building paper, water repellent breather type, asphalt saturated organic felt.
2. Manufacturer: Provide products as manufactured by:

a. Owens-Corning, Inc.;
b. Certainteed Corporation;
c. Georgia-Pacific Corporation;
d. or approved equal;

2.02 ACCESSORIES

A. Nails: Standard round wire shingle type, hot dipped zinc coated steel minimum 13/64 inch head diameter and 0.080 inch shank diameter, 1-1/4 inch long.
B. Plastic Cement: ANSI/ASTM D2822, asphalt type with mineral fiber components, free of toxic solvents, capable of setting within 24 hours at temperatures of 75°F.
C. Lap Cement: Fibrated cutback asphalt type, recommended for use in application of underlayment, free of toxic solvents.

2.03 END VENTS

A. 12" x 12" Square Vent

1. Manufacturer: Provide products as manufactured by:

a. Mid-America Building Products;
b. Owens-Corning, Inc.;
c. Air Vent, Inc.;

PART 3 - EXECUTION

3.01 PREPARATION

A. Clean the substrate of dust, debris, substances and interference's detrimental to the Work. Where necessary to remove sharp projections, concrete surfaces shall be ground.

B. Fill voids, joints and rough areas in the substrate with elastomeric sealant or other underlayment compound recommended by the manufacturer.

3.02 INSTALLATION

A. Protective Underlayment

1. Place one ply of underlayment over area not protected by eave protection, with ends and edges weather lapped minimum 4 inches. Stagger end laps of each consecutive layer. Nail in place.
2. Install protective underlayment perpendicular to slope of roof and weather lap minimum 4 inches over eave protection.
3. Weather lap and seal watertight with plastic cement, items projecting through or mounted on roof.

B. Metal Flashing

1. Weather lap joints minimum 2 inches and seal weather tight with plastic cement.
2. Secure in place with nails at 8 inches oc. Conceal fastenings.
3. Flash and seal work projecting through or mounted on roofing with plastic cement, weather tight.

C. Asphalt Shingles

1. Install shingles in accordance with manufacturer's instruction.
2. Place shingles in straight coursing pattern with 5-inch weather exposure to produce double thickness over full roof area.
3. Project first course of shingles ¾-inch beyond facia boards.
4. Cap hips and ridges with individual shingles, maintaining 5-inch weather exposure. Place to avoid exposed nails.
5. After installation, place one daub of plastic cement, one-inch diameter under each individual shingle tab exposed to weather, to prevent lifting.
6. Coordinate installation of roof mounted components or work projecting through roof with weathertight placement of counter flashings.
7. Complete installation to provide weathertight service.

3.03 PROTECTION OF FINISHED WORK

A. Do not permit traffic over finished roof surface.

END OF SECTION

SECTION 07619

FLASHING, TRIM, AND GUTTERS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope:

1. The CONTRACTOR shall furnish all supervision, labor, materials, equipment and incidentals required to provide flashing and trim as shown and specified. The Work also includes:

a. Providing openings in flashing to accommodate the Work under this and other Sections and building into the flashing all items such as sleeves, anchor bolts, inserts and all other items to be embedded in flashing for which placement is not specifically provided under other Sections.
b. Providing openings in flashing to accommodate the Work under other contracts and assisting other contractors in building into the flashing, anchor bolts, inserts and all other items required to be embedded in flashing under other contracts.

2. The extent of the flashing and trim Work is shown on the Drawings.
3. Flashing, trim and gutter Work required include the following:

a. Flashing and counter flashing at penetrations in roofing.
b. Counter flashing for roofing.
c. Miscellaneous flashing not supplied by other Sections.
d. Aluminum soffits.
e. Fascia materials.
f. Aluminum gutters and downspouts.
g. Downspout flash blocks.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the flashing and trim.
2. Notify other contractors in advance of the installation of the flashing and trim to provide them with sufficient time for the installation of items included in their contracts that must be installed before the flashing trim.

C. Related Work Specified Elsewhere:

1. Section 07311, Asphalt Shingles.

1.02 QUALITY ASSURANCE

A. Installer Qualifications:

1. Engage a single installer who is recognized contractor, skilled and experienced in the type of flashing, trim, and gutter work required, and equipped to perform workmanship in accordance with recognized standards so that there will be

undivided responsibility for the performance of the Work. Submit name and qualifications to ENGINEER.

B. Design Criteria:

1. Flashing, trim, and gutters shall be permanently watertight, and not deteriorate in excess of manufacturer's published limitations.

C. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. AA (Aluminum Association) – Aluminum Construction Manual: Aluminum Sheet Metal Work and Building Construction.
2. AISI (American Iron and Steel Institute) – Stainless Steel – Uses in Architecture.
3. ANSI/ASTM B32 – Solder Metal
4. ASTM A167 – Stainless and Heat-Resisting Chromium-Nickel Steel Plate.
5. ASTM A525 – Steel Sheet, Zinc Coated, (Galvanized) by the Hot-Dip Process.
6. ASTM B209 – Aluminum and Aluminum Alloy Sheet and Plate.
7. ASTM D226 – Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
8. ANSI/ASTM A446 - Sheet Steel, Zinc Coated (galvanized) by the hot dip process, structural (physical) quality.
9. ANSI/ASTM B32 - Solder Metal.
10. ASTM A 525 - General Requirements for Sheet Steel, Zinc Coated (galvanized) by the hot dip process.
11. ASTM B209 - Aluminum and Aluminum Alloy Sheet and Plate.
12. FS SS-C-153 – Cement, Bituminous, Plastic.
13. NAAMM – Metal Finishes Handbook.
14. NRCA (National Roofing Contractors Association) – Roofing Manual.
15. SMACNA – Architectural Sheet Metal Manual.

1.03 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Shop Drawings showing the manner of forming, jointing and securing the metal to form flashings and trim. Show joint details and waterproof connections to adjoining work and at obstructions and penetrations.
2. Copies of manufacturer's specifications, installation instructions and general recommendations for flashing and trim required. Include manufacturer's data substantiating that the materials comply with the requirements.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials: Deliver flashing and trim materials in manufacturer's original, unopened containers and rolls with labels intact and legible.

B. Storage of Materials:

1. Store materials in an area protected from construction traffic.
2. Store materials in same package in which they were shipped.

C. Handling of Materials: Protect materials from dents, scratches, warps or bends.

1.05 JOB CONDITIONS

A. Scheduling:

1. Do not proceed with the flashing and trim Work until curb and substrate construction, cant strips, blocking, reglets and other construction to receive the Work is completed.
2. Schedule the installation of flashing and trim to coincide with the installation of roofing, waterproofing drains, piping, blocking, nailers, reglets, framing at openings, curbs, parapets and other adjoining and substrate work.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Aluminum Sheet: ASTM B209, 6063 alloy 0.080 inch thick; shop precoated with baked enamel coating of color to match finish.

1. Manufacturer: Provide products as manufactured by:
   a. Cheney Flashing Company
   b. Fry Reglet Corporation
   c. O'Keeffe's, Inc.

B. Metal Drip Edge: Brake-Formed sheet metal with at least 2-inch roof deck flange and 1½-inch fascia flange with ⅜-inch drip at lower edge. Lengths of 8 or 10 feet white color.

2.02 ACCESSORIES

A. Fastener: Finish exposed fasteners same as flashing metal.
B. Underlayment: ASTM D266; No. 15 asphalt saturated roofing felt.
C. Protective Backing Paint: Bituminous.
D. Slip Sheet: Rosin sized building paper.
E. Plastic Cement: FSSS-C-153, Type I-asphaltic base cement.

2.03 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
B. Fabricate cleats and starter strips of same material as sheet, minimum two (2) inches wide, interlockable with sheet.
C. Form pieces in longest practical lengths.
D. Hem exposed edges on underside ½-inch (13 mm); miter and seam corners.
E. Form material with standing seam.
F. Fabricate corners from one piece with minimum 18-inch long legs; seam for rigidity, seal with sealant.
G. Fabricate vertical faces with bottom edge formed outward ¼-inch (6 mm) and hemmed to form drip.

2.04 FINISH

A. Backpaint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

2.05 ALUMINUM SOFFIT

A. Aluminum soffit shall be furnished and installed by CONTRACTOR as shown on the Drawings.
B. Aluminum soffit shall be standard grade vented soffit materials. Provide all J-channel and attachment devices for soffit installation. White color.

2.06 FASCIA MATERIALS

A. Aluminum fascia, PVC coated, white color, matching aluminum soffit and other trim work.

2.07 GUTTERS

A. "K" - Style profile manufactured from .032 gauge aluminum, non-rusting and non-staining. Troughs shall be 6 inches wide.
B. Downspouts: Rectangular profile, 3" × 4" size, manufactured from .032 gauge aluminum, non-rusting and non-staining.
C. Colors for gutters and downspouts shall be selected by OWNER from manufacturers standard colors.
D. Eng caps, downspout outlets, gutter and downspout straps, support brackets, strainers: Profiled to suit gutter and downspout installations.
E. Downspout splash blocks: Furnish standard size splash blocks as indicated on the Contract Drawings.

PART 3 – EXECUTION

3.01 INSPECTION

A. CONTRACTOR and his installer shall examine the substrate and the conditions under which the flashing and trim Work is to be performed, and notify the ENGINEER in writing of unsatisfactory conditions. Do not proceed with flashing and trim Work until unsatisfactory conditions have been corrected in a manner acceptable to the ENGINEER.

3.02 PREPARATION

A. Before installing flashing and trim, verify shapes, and dimensions to be covered.
B. Prepare substrates as recommended by the manufacturer.
C. Installer starter and edge strips, and cleats before starting installation.

3.03 INSTALLATION

A. Secure flashing in place using concealed fasteners use exposed fasteners only in locations approved by Architect/ENGINEER.
B. Seam and seal all joints.
C. Apply plastic cement compound between metal flashings and felt flashings.
D. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
E. Seal metal joints watertight.

3.04 ADJUSTMENT AND CLEANING

A. Protect flashing and trim until final acceptance of the Work.

B. Do not permit workmen, or others, to step directly on flashing sheets in place, or to place or move equipment over flashing and trim surfaces. Protect surfaces during installation of permanent covering work and adjoining Work.

C. Clean exposed surfaces of every substance that is visible or might cause corrosion or prevent uniform oxidation of the metal surfaces.

END OF SECTION

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SECTION 07920

JOINT SEALANTS

PART 1 - GENERAL

1.01 SCOPE

A. Extent of each type of joint sealant is indicated on drawings and by provisions of this Section.
B. Types of sealants include:

1. Weather-proofing joint sealants.
2. Interior joint and seam sealers.
3. Sanitary joint sealers.
4. Fire-proofing joint sealers.

1.02 SUBMITTALS

A. Submit product data for each product indicating compliance with requirements.
B. Submit one sample tube of each approved sealant product specified for exterior applications.
C. Fire-Proofing Sealant Schedule: Submit a schedule indicating, for each application (penetration condition or joint type), the manufacturer, product name, and UL Design number of the proposed fire-proofing sealant system to be used.

1. Submit manufacturer's data and certification as required in the "Quality Assurance" Article of this Section.

1.03 QUALITY ASSURANCE

A. Fire-Proof Sealant Design and Test Criteria: Unless a specific product or system is otherwise indicated, select fire-proof sealant system recommended by the manufacturer for each specific application indicated, and to comply with requirements indicated in the "Fire-Proofing Sealant Systems" Article of this Section. Provide only fire-proofing systems that have been tested and listed by Underwriter's Laboratories (UL) in the applications indicated.

1. Provide fire-proof sealant systems with fire-ratings equal to the fire-rated assembly into which the sealant system is incorporated.
2. Coordinate fire-proof sealant system selections with the construction detail and opening size of the fire-rated assembly; and the size, location, configuration, and material of the penetrating element (if any), to ensure full compliance with each detail of each UL Design.
3. Where an indicated application has not been tested and listed, provide a written proposal, prepared by the manufacturer of the fire-proofing system, showing materials and methods to be used, and certifying that fire-resistance rating of the fire-proofing sealant system will not be less than that of the surrounding assembly.

PART 2 – PRODUCTS

2.01 MATERIALS

A. SEALANTS – GENERAL

1. Compatibility: Provide joint sealers, fillers and related materials compatible with one another and with joint substrates under conditions of service and application.
2. Colors: Provide color of exposed joint sealers indicated or, if not indicated, as selected by Owner from manufacturer's standard colors.

B. ELASTOMERIC JOINT SEALANTS

1. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing elastomeric sealants that comply with ASTM C 920 and other requirements indicated, including those requirements referencing ASTM C 920 classifications for Type, Grade, Class, and Uses.

2. One-Part Mildew-Resistant Silicone Sealant: Subject to compliance with requirements, provide one of the following, or manufacturer's equivalent two-part sealant:

   a. Dow Corning 786 - Dow Corning Corp.
   b. SCS 1702 Sanitary - General Electric Co.
   c. No. 345 White - Pecora Corp.
   d. Spectrem 1 - Tremco Inc.

3. One-Part Clear Building and Glazing Sealant: Subject to compliance with requirements, provide one of the following:

   a. Dow Corning 999A - Dow Corning Corp.
   b. Construction 1201 - General Electric Co.

4. One-Part Nonsag Urethane Sealant: Subject to compliance with requirements, provide one of the following, or manufacturer's equivalent two-part sealant:

   a. Chem-Calk 900 - Bostik Construction Products Div.
   b. Permapol RC-1 - Products Research and Chemical Corp.
   c. Sikaflex-1a - Sika Corp.
   d. Dymonic - Tremco Inc.

C. LATEX JOINT SEALANTS

1. General: Provide manufacturer's standard one-part, nonsag, mildew-resistant, paintable latex sealant of formulation indicated that is recommended for exposed applications on interior and protected exterior locations and that accommodates indicated percentage change in joint width existing at time of installation without failing either adhesively or cohesively.
2. Acrylic-Emulsion Sealant: Provide product complying with ASTM C 834 that accommodates joint movement of not more than 5 percent in both extension and compression for a total of 10 percent.
3. Silicone Emulsion Sealant: Provide product complying with ASTM C 834 and, except for weight loss measured per ASTM C 792, with ASTM C 920 that accommodates joint movement of not more than 25 percent in both extension and compression for a total of 50 percent.

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

   a. Acrylic-Emulsion Sealant: Chem-Calk 600; Bostik Construction Products Div.; AC-20; Pecora Corp.; Sonolac; Sonneborn Building Products Div.; ChemRex, Inc.; Tremco Acrylic Latex 834; Tremco, Inc.
   b. Silicone-Emulsion Sealant: Trade Mate Paintable Glazing Sealant; Dow Corning Corp.

D. PREFORMED FOAM SEALANTS

1. Preformed Foam Sealants: Manufacturer's standard preformed, precompressed, impregnated open-cell foam sealant manufactured from high-density urethane foam impregnated with a nondrying, water repellent agent; factory-produced in precompressed sizes and in roll or stick form to fit joint widths indicated and to develop a watertight and airtight seal when compressed to the degree specified by manufacturer; and complying with the following requirements:

   a. Properties: Permanently elastic, mildew-resistant, nonmigratory, nonstaining, and compatible with joint substrates and other joint sealants.
   b. Impregnating Agent: Manufacturer's standard.
   c. Density: Manufacturer's standard.
   d. Backing: Pressure-sensitive adhesive factory applied to one side with protective wrapping.
   e. Products: Subject to compliance with requirements, provide one of the following: Emseal Greyflex - Emseal Corp.; Polytite Standard - Polytite Manufacturing Corp.; Wil-Seal 250 - Wil-Seal Construction Foams Div., Illbruck.

E. JOINT SEALANT BACKING

1. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
2. Plastic Foam Joint Fillers: Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding strips of flexible plastic foam of material indicated below and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

   a. Open-cell polyurethane foam.

3. Bond-Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

F. MISCELLANEOUS MATERIALS

1. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealant substrate tests and field tests.
2. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming in any way joint substrates and adjacent nonporous surfaces, and formulated to promote optimum adhesion of sealants with joint substrates.

3. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

G. FIRE-PROOF SEALANT SYSTEMS

1. Fire-Proofing Sealant System(s): Unless otherwise indicated, provide only the manufacturer's UL tested and listed sealant and accessory system(s) designed for use in each indicated application.
2. For through-floor pipe and duct penetrations, and where sleeves extend less than 4-inches above the finished floor level, provide fire-proof sealants that are water-resistant and that will not deteriorate when routinely wetted.
3. For applications subject to movement, including joints between structural elements, walls, floors, and curtain walls, and adjacent elements, provide elastomeric sealants capable of a sustaining the expected range of movement without failure.
4. For application to backs of switch and outlet boxes, provide intumescent pads.
5. Approved Manufacturers: Listed manufacturers do not necessarily provide all products required. Subject to compliance with requirements, provide applicable systems of one of the following: Bio-Fire Shield; Dow Corning Corp.; General Electric Corp.; Metacaulk; Rectorseal Corp.; 3M Corp.; Tremco Inc.; Hilti Corp. CP 680 Cast-In Firestop Device.

PART 3 – EXECUTION

3.01 INSPECTION

A. Examine joints indicated to receive joint sealers, with installer present, for compliance with requirements for joint configuration, installation tolerances and other conditions affecting joint sealer performance. Do not proceed with installation of joint sealers until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean out joints immediately before installing joint sealers to comply with recommendations of joint sealer manufacturers and the following requirements:

1. Remove all foreign material from joint substrates which could interfere with adhesion of joint sealer.
2. Clean masonry, unglazed surfaces of ceramic tile and similar porous joint substrate surfaces. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.
3. Clean metal, glass, porcelain enamel, surfaces of ceramic tile; and other nonporous surfaces by chemical cleaners or other means which are not harmful to substrates or leave residues capable of interfering with adhesion of joint sealers.

B. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealer manufacturer based on prior experience. Apply primer to comply with joint sealer manufacturer's recommendations.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces.

3.03 SEALANT INSTALLATION

A. Installation: Comply with joint sealer manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.

B. Elastomeric Sealant Installation Standard: ASTM C 962.

C. Acrylic Emulsion Sealant Installation Standard: ASTM C 790.

D. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:

1. Provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths which allow optimum sealant movement capability.
2. Remove absorbent joint fillers which have become wet prior to sealant application and replace with dry material.

E. Install bond breaker tape between sealants and joint fillers, compression seals, or back of joints where adhesion of sealant to surfaces at back of joints would result in sealant failure.

F. Install sealants to directly contact and fully wet joint substrates, completely fill recesses, and providing uniform, cross-sectional shapes and depths relative to joint widths which allow optimum sealant movement capability.

G. Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated. Remove excess sealants; do not use tooling agents which discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

1. Provide concave joint configuration per Figure 6A in ASTM C 962, unless otherwise indicated.

H. Clean off excess sealants of sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealers and of products in which joints occur.

I. Protect joint sealers during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes. Cut out and remove damaged or deteriorated joint sealers immediately and reseal joints with new materials to produce repaired areas indistinguishable from original work.

3.04 FIRE-PROOFING SEALANT SYSTEM INSTALLATION

A. Installation of Fire-Proof Sealant Systems: Install sealant system, including forming, packing, and other accessory materials to fill openings in fire-rated assemblies. Comply with installation requirements of the relevant UL Design number, and in accordance with manufacturer's recommendations.

3.05 JOINT SEALER SCHEDULE

A. Exterior Joints (Exposed to Weather): Install indicated sealants at each scheduled joint condition:

1. Perimeter joints between concrete or masonry and metal frames of louvers and windows:
   a. One-part nonsag urethane.
2. Perimeter joints between masonry and wood door and window frames:

a. One-part nonsag urethane.

3. Other joints as indicated.
   a. As indicated, or if not indicated, provide nonsag urethane sealant.

B. Interior Joints (In Conditioned Spaces): Install indicated sealants at each scheduled joint condition:

1. Perimeter joints of exterior openings where shown, or if not shown, where exterior caulking is indicated:
   a. One- or two-part nonsag urethane.
   b. Acrylic emulsion sealant.
2. Perimeter joints between interior wall surfaces and frames of interior doors, and windows.
   a. Acrylic emulsion sealant.
3. Perimeter joints of toilet fixtures and urinals, at pipe penetrations through ceramic tile, and similar applications:
   a. One-part mildew resistant silicone sealant.
4. Other joints as indicated.

3.06 FIRE-PROOFING SEALANT SYSTEM SCHEDULE

A. Provide manufacturer's UL tested and approved sealant systems in each of the following applications:

1. Through-penetrations of new or existing fire-rated wall and floor assemblies by pipe, ducts, conduit, or other mechanical and electrical system elements.
2. Joints between the tops of new fire-rated walls and structural deck above.
3. Joints between fire-rated walls and floors and exterior building curtain wall.
4. Joints between fire-rated assemblies or within fire-rated assemblies as required to maintain indicated fire-rating of the assembly.
5. At the backs of switch and outlet boxes within fire-rated drywall walls.
6. Other joints as shown on drawings.

END OF SECTION

SECTION 08110

STEEL DOORS AND FRAMES

PART 1 – GENERAL

1.01 DESCRIPTION

A. Extent of steel doors and frames is indicated on drawings and in schedules.

B. Types of hollow metal work includes:

1. Steel doors.
2. Steel door frames.
3. Steel window frames.

1.02 SUBMITTALS

A. Product Data: Mfr's standard details and specifications for steel doors and door and window frames.

B. Shop Drawings: Indicate application of products to project.

1.03 QUALITY ASSURANCE

A. Standards: Comply with Steel Door Institute (SDI) "Recommended Specifications for Standard Steel Doors and Frames" for materials quality, metal gages, and construction details for Grades and Models indicated in Part 2 of this Section.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following: Amweld Building Products, Inc.; Ceco Corp.; Curries Co.; Pioneer Builders. Products Corp./Div. CORE Industries, Inc.; Republic Builders Products; Steelcraft/Div. American Standard Co.

2.02 STEEL DOORS AND FRAMES

A. Materials: Steel doors and frames; hot-rolled, pickled and oiled per ASTM A 569 and A 568; cold-rolled per ASTM A 366 and A 568.

1. Fabricate doors and frames located in exterior walls (exposed to weather) of galvanized sheet metal.

B. Steel Doors, General: Provide doors complying with material and construction requirements of ANSI/SDI-100 for the indicated Grades and Models:

1. Grade II, heavy-duty (Level B); 1-3/4-inch thick; min. 18 gage face sheets.
2. Grade III, Extra Heavy-duty (Level A); 1-3/4-inch thick; min. 16 gage face sheets.
3. Model 3, Seamless - Hollow Steel Construction; or Model 4, Seamless - Composite Construction as standard with door manufacturer or to comply with other specified requirements of this Section.

4. Provide steel doors located in exterior walls (exposed to weather) with thermally insulating core.

C. Steel Frames, General: Provide frames complying with material and construction requirements of ANSI/SDI-111A, and as follows:

1. Metal Thickness: Min. 16 gage.
2. Metal Thickness: Min. 18 gage.
3. Type: Welded (masonry walls and partitions).
4. Type: Drywall Slip-On (drywall walls and partitions).

D. Fire-rated Assemblies: Provide units that are labeled and listed for rating indicated, by Underwriters' Laboratories or Warnock-Hersey.

E. Anchors and Accessories: Manufacturer's standard units. Use galvanized items for units built into exterior walls, complying with ASTM A 153.

F. Door Signs: Door signs (where required) shall be of vinyl composition with a minimum thickness of 4 mil and an adhesive backing to secure the sign to the door. Door signs shall be greater than, or equal to 7" x 10" in size.

G. Door Closer: Where specified on the plans, doors shall be equipped with a hydraulic heavy duty door closer, Norton 7500ST x 689, or approved equal.

H. Door Stop: All exterior and interior doors shall be equipped with a Glynn-Johnson Hold Open Model 90H-US32D Stainless Steel door stop/hold open device, or approved equal.

2.03 FABRICATION

A. Fabricate units to be rigid, neat in appearance, and free from defects, warp or buckle. Weld exposed joints continuously, grind, dress, and make smooth, flush and invisible.

B. Prepare steel doors and frames to receive mortised and concealed finish hardware, including cutouts, reinforcing, drilling and tapping, complying with ANSI A 115 "Specifications for Door and Frame Preparation for Hardware".

1. Prepare frames to receive 3 silencers on strike jambs of single-swing frames and on heads of double-swing frames.
2. Provide 26-gage steel mortar boxes, welded to frame, at back of hardware cutouts where installed in concrete, masonry or plaster openings.

C. Locate finish hardware per DHI "Recommended Locations for Builder's Hardware".

D. Shop paint exposed surfaces of doors and frame units, including galvanized surfaces, using manufacturer's standard baked-on rust inhibitive primer.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Placing Frames: Comply with provisions of SDI 105, unless otherwise indicated. Set frames, with spreaders, accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.

1. Except for frames located in existing concrete, masonry, or gypsum board assembly construction, place frames before constructing enclosing walls and ceilings.
2. In masonry construction, install at least 3 wall anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry T-shaped anchors.

3. At existing concrete or masonry construction, install at least 3 completed opening anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Set frames and secure to adjacent construction with bolts and masonry anchorage devices.
4. In steel-stud partitions, install at least 3 wall anchors per jamb at hinge and strike levels; attach wall anchors to studs with screws.
5. In in-place gypsum board partitions, install knock-down, slip-on, drywall frames.
6. Install fire-rated frames according to NFPA 80.

B. Door Installation: Fit hollow-metal doors accurately in frames, within clearances specified in ANSI/SDI 100.

1. Fitting Clearances for Non-Rated Doors: Provide 1/8-inch at jambs and heads; 1/16-inch per leaf at meeting stiles for pairs of doors; and 1/2-inch from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/8-inch clearance from bottom of door to top of threshold.
2. Fire-Rated Doors: Provide minimum clearances as indicated for non-rated doors and maximum clearances specified in NFPA 80.
3. Smoke-Control Doors: Comply with NFPA 105.

3.02 ADJUSTING AND CLEANING

A. Prime Coat Touchup: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.
B. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.
C. Vinyl Sign Application: After protective wrappings are removed from doors, vinyl signs shall be adhered to door exteriors where required. Prior to adhesion, doors shall be cleaned with isopropyl alcohol, lint-free wipes and allowed to dry.

END OF SECTION

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SECTION 08710

DOOR HARDWARE

PART 1 – GENERAL

1.01 DESCRIPTION

A. Extent of door hardware is indicated on drawings and in schedules.

B. Types of door hardware include: Hinges, Closers, Locksets, Stops, Silencers, Push/pull sets, Exit device, Astragals, Flush bolts, Kickplates, Sweep seals, Jamb seals, Thresholds.

1.02 SUBMITTALS

A. Submit the following:

1. Manufactures product literature.
2. Schedule of hardware showing application to project.
3. Furnish templates to each fabricator of doors and frames, as required for preparation to receive hardware.

1.03 QUALITY ASSURANCE

A. Standards: Where base material and quality of finish are not otherwise specified, comply with ANSI A 156 series standards applicable to each particular type of hardware.

1. Where door assemblies are indicated to be fire-rated, provide hardware that meets indicated rating.

PART 2 – PRODUCTS

2.01 HARDWARE, GENERAL

A. Finish of Hardware: Unless otherwise indicated, provide hardware with the following finish:

1. US 32D (satin stainless).

2.02 HINGES

A. Provide 5-knuckle, 2 ball-bearing hinges; swaged; inner leaf beveled; with square corners; nonremovable pin, complete with set screw (knurled pin not acceptable); and as follows:

1. Type: Full-mortise.
2. Base Metal: Stainless Steel.
3. Finish: To match "Finish of Hardware" requirements of this Section.
4. Size and Weight: Provide hinges sized as follows:

a. Doors not wider than 3 feet 6 inches nor taller than 7 feet 6 inches:
- Size: 4-1/2 inches by 4-1/2 inches; 0.180-inch thick.

b. Doors wider than 3 feet 6 inches or taller than 7 feet 6 inches:
- Size: 5 inches by 4-1/2 inches; 0.190-inch thick.

c. Doors 1-3/8 inches thick and not wider than 3 feet nor taller than 7 feet:
- Size 4-1/2 inches by 4 inches; 0.134-inch thick.

5. Manufacturer of Butts: Subject to compliance with requirements, products of Hager, Stanley, or approved equal.

2.03 CLOSERS

A. Provide closers with field-adjustable, full-range sizing feature capable of complying with manufacturer's size recommendations for application indicated; and complying with applicable portions of the Americans with Disabilities Act (ADA).

1. Manufacturer/Model: 4000 Series "Smoothee"; LCN only.

a. Series No.: 4010 series (mounted on pull side of door).
b. Series No.: 4020 series (mounted above door on push side).

B. Unless otherwise indicated, mount closer bodies on room side (not corridor side) of doors. Refer doubtful conditions to Architect for decision.

1. Closing Mechanism: Power-assisted spring operated.
2. Mounting:
3. Manual Operation: Requires less than 50 lbf to set door in motion when power is off, according to ANSI/BHMA A156.10.

2.04 LOCKS AND LATCHES

A. Locks and Latches: Provide mortise type, lever handle lock and latch sets equipped with 7-pin removable core type lock cylinders, in a masterkey system to be designed by Owner. With each lockset, furnish companion strike as indicated, for installation on door jamb. Keying is the responsibility of the Contractor; and shall be performed by the cylinder supplier.

1. Provide lock and latchsets on doors to hazardous areas with knurled handle surfaces. Hazardous areas include mechanical rooms, elevator machine rooms, electrical closets and substation rooms, and stairways.
2. Manufacturer/Model of Lock/Latch Sets: Provide the following units, or equivalent products of Corbin, Russwin, or Schlage:

a. Office Lockset: Sargent LNJ x 8205.
b. Passage Lockset: Sargent LNJ x 8215.
c. Service/Store Room Lockset: Sargent LNJ x 8204.

B. Strike Plates: Provide handed-type strike plates with curved lip; flat (non-handed) strikes are not permitted.

1. Provide strike plates with extended lips where required to protect door frame and trim from being marred by latchbolt. Provide strike plates that project not more than 1/8 inch beyond door frame trim at single doors; and flush with face of doors at double (pair) door applications.
2. Manufacturer/Model of Cylinders: Provide cylinders by the following manufacturer (Contact University of Michigan Key Office for cylinder information):

a. Best
b. Schlage Everest
c. of approved equal

C. Construction Locks: In each exterior door, provide temporary cylinders, installed simultaneously with the lock. Temporary cylinders shall remain for the duration of construction.

2.05 STOPS

A. Provide rubber exposed resilient parts; size and mount units to comply with manufacturer's recommendations for the exposure condition. Reinforce the substrate as recommended.

1. Color of Resilient Parts: Black.
2. Manufacturer/Model of Stops: Rockwood model indicated, or equivalent products of Brookline, Builder's Brass Works, Glynn-Johnson, Stanley.

a. Model No.: 442 (floor mounted).
b. Model No.: 440 (floor mounted, limited door bottom clearance).
c. Model No.: 409 (wall mounted, hollow wall expansion anchor).
d. Model No.: 410 (wall mounted, plastic).

2.06 SILENCERS

A. Provide manufacturer's standard profile silencers of 1/8-inch thick hard rubber for metal door frames as follows:

1. Manufacturer: Glynn-Johnson, or approved equal.

2.07 PUSH/PULL SET

A. Provide pull handles and push plates with concealed mounting fasteners wherever possible, and as follows:

1. Material: Solid stainless steel.
2. Finish: Satin.
3. Color: Clear and transparent.
4. Manufacturer/Model of Push/Pull Set: Subject to compliance with requirements, provide the following, or equivalent products of Baldwin, Brookline, Builder's Brass Works, Corbin, Glynn-Johnson, Sargent, Stanley.

a. Push Plates: EXAMPLE Rockwood; No. 71 (6 inches by 15 inches).
b. Pulls: EXAMPLE Rockwood; No. 112 (13 inches by 1 inch diameter.; and No. 71 (6 inches by 15 inches) base plate.

2.08 EXIT DEVICE (PANIC SET)

A. Non-Fire-Rated Rim Type Exit Device: Rim type units activated by a partial-width touch-bar, complete with accessories, including strike and hex-key operated dogging device mounted on mechanism housing to hold the touch-bar depressed and the latch bolt in the open position.

1. Manufacturer/Model of Exit Devices: Von Duprin model 98NL with 990NL-R trim; or approved equal.
2. Manufacturer/Model of Exit Devices: Von Duprin model 98DT with 990DT trim; or approved equal.
3. Manufacturer/Model of Exit Devices: Von Duprin model 98EO; or approved equal.

4. Manufacturer/Model of Exit Devices: Von Duprin model 98NL-OP with 110NL trim; or approved equal.

B. Fire-Rated Rim Type Exit Device: Fire-rated, UL listed, rim type units activated by a partial-width touch-bar, complete with accessories including strike.

1. Manufacturer/Model of Exit Devices: Von Duprin model 98NL-F, 992L-rigid trim, and optional no. 03 lever; or approved equal.
2. Manufacturer/Model of Exit Devices: Von Duprin model 98L-F, 992L-double cylinder function trim and standard no. 06 lever; or approved equal.
3. Manufacturer/Model of Exit Devices: Von Duprin model 98L-F-BE, 992L-R with optional no. 03 lever; or approved equal.

2.09 ASTRAGALS

A. Manufacturer/Model of Astragals: EXAMPLE Pemko; No. 357SP, or equivalent products of National Guard, Reese, Zero.

2.10 FLUSH BOLTS

A. Manual Flush Bolts: Mortise units, UL listed and rated for indicated application, with spring loaded snap action levers for manual operation.

1. Manufacturer/Model of Manual Flush Bolts: Provide Glynn-Johnson or equivalent products, as follows:

a. Metal Doors: FB6, both top and bottom bolts.
b. Dust Proof Strike: DP1 (threshold mounting).
c. Dust Proof Strike: DP2 (floor or threshold mounting).

B. Constant Latching Flush Bolts: Mortise units, UL listed and rated for indicated application, with automatically retracting bottom bolt, and manually released top bolt when active leaf is opened.

1. Manufacturer/Model of Constant Latching Flush Bolts: Provide Glynn-Johnson, or approved equal.
a. Metal Doors: FB9 set, (FB9A top and FB7A bottom bolt).
b. Dust Proof Strike: DP1 (threshold mounting).
c. Dust Proof Strike: DP2 (floor or threshold mounting).

2.11 KICKPLATES

A. Provide solid metal units as follows:

1. Material: Stainless steel.
2. Finish: Satin.
3. Size: 1 1/2 inches less than door width on push side, 1/2 inch less than door width on pull side, by 8 inches high, by 0.050-inch thick.
4. Manufacturer/Model of Kickplates: EXAMPLE Rockwood, 8 inches high.

2.12 SWEEP SEALS

A. Provide manufacturer's standard weatherstripping of type, size and profile indicated, continuous at bottom edges of each indicated door. Provide non-corrosive fasteners.

1. Manufacturer/Model Sweep Seals: EXAMPLE Pemko; No. 318AV, or equivalent products of National Guard, Reese, Zero, or approved equal.

2.13 JAMB SEALS

A. Provide manufacturer's standard weatherstripping of type, size and profile indicated, continuous at head and jamb edges of each indicated door opening. Provide non-corrosive fasteners.

1. Manufacturer/Model Jamb Seals: EXAMPLE Pemko; No. 315AR, or equivalent products of National Guard, Reese, Zero, or approved equal.

2.14 THRESHOLDS

A. Provide manufacturer's standard, extruded, anodized aluminum units of type, size, and profile indicated. Provide units continuous across bottom of door openings. Provide non-corrosive fasteners.

1. Manufacturer/Model: Pemko No. 277AR, or equivalent products of National Guard, Reese, Hager, or Zero, or approved equal.

PART 3 – EXECUTION

3.01 INSTALLATION

A. General: Install each hardware item to comply with manufacturer's printed installation instructions and recommendations for application indicated, unless otherwise indicated by referenced standard or by provisions of this Section.
B. Hardware Mounting Heights: Door and Hardware Institute "Recommended Locations for Builder's Hardware for Custom Steel Doors and Frames".
C. Silencers: Install silencers as follows:

1. Single Door Frames: Install three, equally spaced silencers on the latch jamb of new hollow metal door frames.
2. Double Door Frames: Install two silencers on the head of each new hollow metal double door frame.
3. Existing Door Frames: Where new doors are scheduled to be installed in new frames, or where new hardware is scheduled to be installed on existing doors, inspect existing silencers and replace damaged and defective units.

D. Hardware Adjustment: Return to project one month after Owner's occupancy, and adjust hardware to proper operation and function. Instruct Owner's personnel in proper maintenance and adjustment.

END OF SECTION

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SECTION 09900

PAINTING

PART 1 - GENERAL

1.01 SCOPE

A. The CONTRACTOR shall furnish all coordination, supervision, labor, materials, equipment, and incidentals necessary and required to provide field painting as indicated on the Contract Drawings and/or specified herein.

B. The Work shall include, but not be limited to, the painting of all ferrous interior and exterior items and surfaces indicated.

1. All interior piping.
2. Shop primed interior staircase, handrail, and guardrail.
3. Interior Steel supports.
4. Doors and frames.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 09980, Coatings for Concrete and Masonry

1.03 QUALITY ASSURANCE

A. Applicator Qualifications:

1. Submit the name and experience record of the painting applicator. Include a list of utility or industrial installations painted, responsible official, architect or engineer concerned with the project, and the approximate contract price.
2. Painting applicators whose submissions indicate that they have not had the experience required to perform the Work shall not be approved.

B. Unless otherwise Approved, all paint products shall be supplied by a single manufacturer.

C. Comply with the applicable provisions and recommendations of the following reference standards, except where otherwise shown or specified.

1. ANSI A13.1, Scheme for the Identification of Piping Systems.
2. Recommended Standards for Water Works (Ten State Standards), latest edition, recommended paint scheme for potable water piping.
3. OSHA 1910.144, Safety Color Code for Marking Physical Hazards.
4. SSPC Volume 2, Systems and Specifications, Surface preparation Guide and Paint Application Specifications.

1.04 SUBMITTALS

A. Shop Drawings: Submit for Approval the following:

1. Copies of technical information printed by the product manufacturer, including label analysis and application instructions for each material proposed for use. Furnish sufficient data to prove compliance with the technical specification.
2. Copies of the proposed protection procedure, prepared by the CONTRACTOR, for each area of the Work.
3. List each material and cross-reference to the specific paint and finish system and application.

4. Copies of complete color charts, as printed by the manufacturer, for each coating system.
5. List of application method (i.e. brush, roller, sprayer, etc.) for each product.
6. When applicable, include a list of wording, letter size, color coding, and printed technical data for piping identification.

B. If necessary, submit For Information Only, the CONTRACTOR plan and list of equipment required for proper temperature and humidity control of the Work area.

C. No substitutions shall be considered that decreases the film thickness, the number of coats, or the type of coating specified. The Approved manufacturers shall furnish the same color selection as the specified manufacturers, including accent and custom colors in all coating systems.

D. Upon substantial completion of the Work and prior to application for final payment, submit for Approval a detailed maintenance manual which shall include, at a minimum:

1. Product name and catalog number.
2. Name, address, and telephone number of manufacturer and local distributor.
3. Detailed procedures for routine maintenance and cleaning.
4. Detailed procedures for light repairs such as dents, scratches, and staining.

1.05 COORDINATION

A. Existing Conditions

1. The CONTRACTOR and the painter shall examine the areas and conditions under which the Work is to be performed and notify the ENGINEER, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.
2. Notify other Contractors in advance of the field painting to provide sufficient time for installation of items included in their contracts that must be field painted in this Section.
3. Coordinate the painting of areas that are inaccessible once equipment has been installed.
4. Review other sections of the specifications in which primers are to be provided to ensure compatibility of the total coatings systems for the various substrates. The CONTRACTOR shall be responsible for the compatibility of all finished coats with shop primed items. Provide barrier coats over incompatible primers. Notify the ENGINEER, in writing, of anticipated problems using the coating systems as specified with substrates primed by others.

1.06 WORK EXCLUDED

A. The following categories of work are not included as part of the field-applied finish Work of this Section, are included in other technical specification sections of this Specification, or are in other Contracts.
1. Do not paint pre-finished items furnished with factory finishes such as baked-on enamel, porcelain, ceramic tile, or other similar finish.
2. Do not paint plastic and/or fiberglass surfaces unless otherwise specified.
3. Do not paint corrosion resistant materials such as stainless steel, aluminum, copper, or brass or galvanized surfaces such as electrical conduit, floor grates, HVAC ductwork, etc.
4. Do not paint finished mechanical and/or electrical equipment such as light fixtures, starter or adjustable speed drive enclosure, panelboards, motors, or pumps.

PART 2 - PRODUCTS

2.01 GENERAL

A. The term "paint", as used herein, shall mean all coating systems applied to ferrous material surfaces and shall include, but not be limited to, pretreatments, primers, emulsions, enamels, epoxies, stains, sealers, fillers, and other applied materials whether used as prime, intermediate, or finish coats.

B. Field surface preparation, priming, and coats of paint specified herein are in addition to shop priming and surface treatment specified under other Sections of the Work.

C. Color of finish coat shall be as indicated, or if not indicated, as selected by the OWNER.

1.	Raw Water:	Olive Green
2.	Settled or Clarified Water:	Aqua
3.	Finished or Potable Water:	Dark Blue
4.	Sprinklers:	Dark Red
5.	Suction Line (Pump Stations):	Mid Blue
6.	Pressure Line (Pump Stations):	Safety Blue
7.	Gas Pipe:	Yellow

2.02 MATERIAL

A. Provide manufacturer's best grade of the various types of coatings suitable for use in the conditions specified as regularly manufactured by acceptable paint materials manufacturers. Materials not displaying the manufacturer's identification as a standard, best-grade product will not be acceptable.

B. Provide primers produced by the same manufacturer as the finish coats. Use only thinners recommended by the paint manufacturer and use only to recommended limits.

C. Provide paints of durable and washable quality. Use materials which will withstand normal washing as required to remove grease, oil, chemicals, etc., without discoloration, loss of finish, staining, or other damage.

D. All color finishes shall be pure, non-fading, applicable types to suit the substrates and service indicated.

E. All colors and finish type shall be as chosen by the OWNER from the standard color charts of the paint manufacturer, or as otherwise indicated on the Contract Drawings, or as directed by the Engineer.

F. At a minimum, all piping, staircases, handrails, guardrails, doors, door frames, and steel beams and supports shall be painted with the following products, as manufactured by Sherwin Williams:

1. For all applicable components within areas in direct contact with potable water:

   a. MACROPOXY 646 PW Potable Water Epoxy
   b. MACROPOXY 920 Pre-Prime Penetrating Epoxy Pre-Primer (as required)
   c. STEEL-SEAM FT910 Epoxy Patching and Surfacing Compound (as required)

2. For all applicable components in all other areas:

   a. MACROPOXY 646 Fast Cure Epoxy
   b. MACROPOXY 920 Pre-Prime Penetrating Epoxy Pre-Primer (as required)
   c. STEEL-SEAM FT910 Epoxy Patching and Surfacing Compound (as required)

**** The minimum and maximum dry film thickness (DFT) of the coating shall be specified by the manufacturer. DFT shall be in compliance with SSPC PA 2.**

G. Additional manufacturers offering paints that may be equal to the paints noted above, and upon approval, may be incorporated into the Work, include:

1. Du Pont
2. Pratt & Lambert
3. Tnemec Company
4. Or Approved Equal.

2.02 PIPING LABELS

A. When indicated on the Contract Drawings, include piping identification labels as manufactured by Brady, Seton, Stranco, or equal.

1. Pipe content description labels (i.e. compressed air, natural gas, raw water, potable water, etc.) shall be water, oil, and weather resistant, self adhesive, flexible vinyl.
2. Band each end of the labels with 2" heavy duty (5 mil) self adhesive laminated vinyl tape complete with arrows for flow indication.

B. The minimum location of labels complete with directional arrows shall be:

1. On all horizontal and/or vertical pipe runs; place at twenty five foot (25') intervals.
2. Adjacent to each side of a valve.
3. Adjacent to each side of a "T" connection.
4. At each branch or riser connections/takeoffs.
5. At each pipe passage through a wall, floor, or ceiling.

PART 3 - EXECUTION

3.01 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials to the job site in original, new, and unopened packages and containers bearing the factory applied label of the manufacturer. The label shall include, at a minimum:

1. Name of the manufacturer.
2. Title of material.
3. Stock number and date of manufacture.
4. Contents by volume.
5. Thinning instructions where recommended.
6. Application instructions.
7. Color name and number.

B. Storage of Materials:

1. Store only acceptable project materials on the project site.
2. Store in a clean, dry, and accessible location.
3. Comply with health and fire regulations including the Occupational Safety and Health Act.

C. Handling of Materials:

1. Handle materials carefully to prevent inclusion of foreign materials.
2. Do not open containers or mix components until necessary preparatory Work has been completed and application Work will start immediately.

3.02 PREPARATION

A. Perform all preparation and cleaning procedures as specified herein and in strict accordance with the paint manufacturer's instructions for each particular substrate and atmospheric condition.

B. The Contractor shall be solely responsible for the proper removal and disposal of all removed paint systems, to include all materials used for removal. Removal transportation, and disposal of said materials shall be in conformance with all Federal, State, and local regulations governing this work. It shall be the Contractors sole responsibility to be aware of the applicable regulations, and to make sure all work is performed in accordance. The Contractor will be solely responsible for any and all costs associated with the improper removal and disposal of existing paint systems.

C. Remove all hardware, accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish painted; or provide surface applied protection prior to surface preparation and painting operations. Remove, if necessary, for the complete painting of the items and adjacent surfaces. Following completion of painting of each space or area, reinstall the removed items by workmen skilled in the trades involved.

D. Protection:

1. Protect work of other trades, whether to be painted or not, against damage the painting and finishing Work. Leave all such work undamaged. Correct all damages by cleaning, repairing or replacing, and repainting, as acceptable to the ENGINEER.
2. Do not begin painting Work in any area until the ENGINEER approves protection techniques proposed by the CONTRACTOR.
3. Provide fire extinguishers and spot caution signs warning against smoking and open flame when working with flammable materials.
4. Provide "Wet Paint" signs as required to protect newly painted finishes.
5. CONTRACTOR to supply a powered ventilation system to eliminate fumes from work area.

E. Clean surfaces to be painted before applying paint or surface treatments.

1. Remove oil and grease with clean cloths and cleaning solvents prior to mechanical cleaning. Schedule the cleaning and painting so that dust and other contaminants from the cleaning process will not fall in wet, newly painted surfaces.
2. Prior to painting in any area, the area and surface to be painted shall be cleaned and dust shall be removed. After painting operations have begun in a given area, broom cleaning shall not be allowed; additional cleaning in the same area shall then be accomplished only with commercial HEPA vacuum cleaning equipment.
3. Provide the on-site services of a representative of the manufacturer to inspect surfaces after cleaning. The representative shall certify that surfaces are properly clean and dry and are ready for intended paint application.

F. Materials

1. Mix and prepare painting materials in strict accordance with the written instructions of the manufacturer.
2. Do not mix together different coating materials, unless otherwise permitted by the instructions of the manufacturer.
3. Store materials not in actual use in tightly covered containers. Maintain containers used for storage, mixing, and application of paint in a clean condition and free of foreign materials and residue.
4. Stir all materials before application to produce a mixture of uniform density and as required during the application of the materials to maintain a uniform consistency.

5. Do not stir any film which may form on the surface into the material. Remove the film and, if necessary, strain the material before using.

3.03 APPLICATION

A. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to the formation of a durable paint film.

B. Apply paints only when the temperature of surfaces to be painted and the surrounding air temperatures are between 50 °F and 90 °F unless otherwise permitted by the printed instructions of the paint manufacturer.

C. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 80 percent; or to damp or wet surfaces.

D. Painting may be continued during inclement weather only if the areas and surfaces to be painted are enclosed and heated within the temperature limits specified by the paint manufacturer during application and drying periods.

E. Provide illumination and ventilation in all areas where painting operations are in progress.

F. Apply paint by brush, roller, air spray or airless spray in accordance with the written recommendations and directions of the manufacturer. Use brushes best suited for the type of material being applied. Use rollers of carpet, velvet back, or high pile sheep's wool as recommended by the paint manufacturer for material and texture required. Use air spray or airless spray equipment recommended by the paint manufacturer for specific coating system specified. Submit a list of application methods proposed, listing paint systems and locations.

G. The number of coats and paint film thickness required is the same regardless of the application method.

H. Paint all exposed surfaces where shown, specified, and required, except where the natural finish of the material is specifically noted as a surface not to be painted. The term "exposed" as used herein shall mean all surfaces not covered with concrete, plaster, fireproofing, or similar material.

I. Apply additional coats when undercoats, stains, or other conditions can still be seen through the final coat of paint, until the paint film is of uniform finish, color, and appearance.

J. Insure that all surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a film thickness equivalent to that of flat surfaces.

K. Apply each material at not less than the recommended spreading rate of the manufacturer and provide total dry film thickness as specified.

L. Apply extra coats if required to obtain specified total dry film thickness.

M. Operating Parts and Labels:

1. Moving parts of operating equipment, such as valve operators and motor shafts, shall not be painted.
2. Do not paint over any code-required labels, such as UL and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.
3. Remove all paint, coating, or splatter inadvertently placed on these surfaces.

N. Install piping markers and safety signs only after all painting and finish Work has been completed. Apply pipe markers in accordance with the written instructions of the manufacturer.

3.04 SCHEDULE

A. Apply the first-coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

B. Allow sufficient time between successive coatings to permit proper drying in accordance with written recommendations of the manufacturer. Do not recoat until paint has dried to

where it feels firm, does not deform or feel sticky under moderate thumb pressure, and the application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

3.05 FIELD QUALITY CONTROL

A. The CONTRACTOR shall provide all equipment necessary to maintain the proper humidity level and temperature within the Work area in accordance with the written instructions of the paint manufacturer. The CONTRACTOR shall submit, to the ENGINEER in writing, a plan to properly address any and all humidity and temperature problems prior to the start of Work in accordance with recommendations of the manufacturer. The plan shall be for information only and not submitted for approval.

B. After completion of each coat of paint, CONTRACTOR shall notify ENGINEER. After inspection, checking of film thickness and approval by ENGINEER, proceed with the succeeding coat. CONTRACTOR shall supply a Gardner dry-film thickness gage and check the film thickness in the presence and at locations directed by the ENGINEER. Additional coats shall be applied, if required, to produce the specified film thickness.

3.06 CLEAN-UP

A. During the progress of the Work, remove from the site all discarded paint materials, rubbish, cans and rags at the end of each work day.

B. Upon completion of painting Work, clean window glass and all other paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

C. Remove all temporary protective wrappings provided for protection after completion of painting operations.

3.07 MAINTENANCE MATERIAL

A. Furnish the OWNER with one (1) unopened original container gallon of each finish color paint utilized for the Work. Clearly indicate, on each container, the color, finish, and application area.

END OF SECTION

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SECTION 09980

COATINGS FOR CONCRETE AND MASONRY

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope:

1. CONTRACTOR shall furnish all supervision, labor, materials, equipment, and incidentals as shown, specified, and required to provide all coating Work. This Specification shall apply to all non-ferrous surfaces such as concrete, concrete masonry unit (CMU) block, etc.
2. The term "sealant" as used herein means all coating systems materials, which includes pretreatments, primers, sealers and other applied materials whether used as prime, intermediate, or finish coats.
3. The Work includes patching of all holes and cracks, repair of all spalling areas, surface cleansing and preparation, priming and painting, or sealing as specified under this Section.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 09900, Painting.

1.03 QUALITY ASSURANCE

A. Applicator Qualifications:

1. Submit the name and experience record of the coatings applicator. Include a list of utility or industrial installations coated, responsible officials, architects, or engineers concerned with the project.
2. Applicators whose submissions indicate that they have not had the experience required to perform the Work shall not be approved.

B. All concrete sealer products shall be supplied by a single manufacturer unless otherwise approved. All concrete paint shall be supplied by a single manufacturer unless otherwise approved. (Concrete sealer and concrete paint manufacturer need not be the same.)

C. Reference Standards: Comply with applicable provisions and recommendations of the following except where otherwise shown or specified:

1. OSHA, Safety Color Code for Marking Physical Hazards.
2. SSPC, Surface Preparation Guide and Paint Application Specifications.
3. American Society for Testing and Materials (ASTM).
4. American Water Works Association (AWWA).

1.04 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
1. Copies of manufacturer's technical information, including label analysis and application instructions for each material proposed for use.
2. Copies of CONTRACTOR'S proposed protection procedure in each area of the Work.

3. List each material and cross-reference to the specific coating and finish system and application. Identify by manufacturer's catalog number and general classification.
4. Copies of manufacturer's complete color charts for each coating system.
5. Maintenance Manual: Upon completion of the work, furnish copies of a detailed maintenance manual including the following information.

    a. Product name and number.
    b. Name, address and telephone number of manufacturer and local distributor.
    c. Detailed procedures for routine maintenance and cleaning.
    d. Detailed procedures for light repairs such as dents, scratches and staining.

1.05 COORDINATION

A. Review installation procedures under other Sections and coordinate the Work.
B. Notify other contractors in advance of the field coating to provide sufficient time for installation of items included in their contracts.
C. Coordinate the coating of areas that are inaccessible once equipment has been installed.
D. Provide finish coats that are compatible with the priming coatings used. Review other Sections of these Specifications in which primers are to be provided to ensure compatibility of the total coatings systems for the various substrates. CONTRACTOR shall be responsible for the compatibility of all shop primed and field painted and/or coated items in this Contract. Furnish information on the characteristics of the finish materials proposed to use, to ensure that compatible prime coats are used. Provide barrier coats over incompatible primers or remove and reprime as required. Notify the ENGINEER in writing of anticipated problems using the coating systems as specified with substrates primed by others

PART 2 - PRODUCTS

2.01 MATERIAL QUALITY

A. General: All products shall be epoxy type coatings.
B. Provide manufacturer's best grade of the various types of coatings suitable for use in the conditions specified as regularly manufactured by acceptable materials manufacturers. Materials not displaying the manufacturer's identification as a standard, best-grade product shall not be acceptable.
C. Provide primers produced by the same manufacturer as the finish coats. Use only thinners recommended by the manufacturer and use only to recommended limits.
D. Provide sealant of durable and washable quality. Use materials which will withstand normal washing as required to remove grease, oil, chemicals, etc., without showing discoloration, loss of gloss, staining, or other damage.
E. At a minimum, all concrete walls, floors, and concrete masonry unit (CMU) block shall be sealed and painted with the following products, as manufactured by Sherwin Williams:

    1. For the areas in direct contact with potable water (storage areas):

        a. DURA-PLATE UHS Primer
        b. TANK CLAD HS Epoxy
        c. STEEL-SEAM FT910 Epoxy Patching and Surfacing Compound (as required)

2. For all applicable components within the water storage areas, but not directly in contact with the potable water:

   a. MACROPOXY 920 PRE-PRIME Penetrating Epoxy Pre-Primer
   b. MACROPOXY 646PW Potable Water Epoxy
   c. STEEL-SEAM FT910 Epoxy Patching and Surfacing Compound (as required)

3. For all applicable components in all other areas:

   a. MACROPOXY 646 Fast Cure Epoxy
   b. MACROPOXY 920 Pre-Prime Penetrating Epoxy Pre-Primer (as required)
   c. STEEL-SEAM FT910 Epoxy Patching and Surfacing Compound (as required)

4. For all concrete flooring:

   a. ARMORSEAL FLOOR-PLEX 7100 Primer
   b. ARMORSEAL REXTHANE I Floor Coating
   c. Anti-Slip Additive: H&C SharkGrip, or approved equal

**** The minimum and maximum dry film thickness (DFT) of the coating shall be specified by the manufacturer. DFT shall be in compliance with SSPC requirements.**

F. Additional manufacturers offering paints that may be equal to the paints noted above, and upon approval, may be incorporated into the Work, include:

1. Du Pont
2. Pratt & Lambert
3. Tnemec Company
4. Or Approved Equal.

2.02 SUBSTITUTIONS

A. No substitutions shall be considered that decrease the film thickness, the number of coats, the surface preparation, or the generic type of coating specified.

2.03 COLORS AND FINISHES

A. All colors finishes shall be pure, nonfading, applicable types to suit the substrates and service indicated.
B. All colors and finish type shall be as chosen by the OWNER from the standard color charts of the paint manufacturer.

PART 3 - EXECUTION

3.01 INSPECTION

A. CONTRACTOR and his applicator shall examine the areas and conditions under which coating 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 have been corrected.
B. Do not apply coatings over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to the formation of a durable bond.

3.02 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials: Deliver all materials to the job site in original, new and unopened packages and containers bearing manufacturer's name and label, and the following information:

1. Name or title of material.
2. Manufacturer's stock number and date of manufacture.
3. Manufacturer's name.
4. Thinning instructions where recommended.
5. Application instructions.

B. Storage of Materials:

1. Store only acceptable project materials on project site.
2. Store in a suitable clean, dry, accessible location.
3. Water-based materials must be kept from freezing.
4. Comply with health and fire regulations including the Occupational Safety and Health Act.

C. Handling of Materials:

1. Handle materials carefully to prevent inclusion of foreign materials.
2. Do not open containers or mix components until necessary preparatory Work has been completed and application Work will start immediately.

3.03 JOB CONDITIONS

A. Existing Conditions:

1. Before a coating is started in any area, the area shall be cleaned and dust shall be removed in accordance with this Section.
2. Broom cleaning will not be allowed; cleaning shall be done only with commercial vacuum cleaning equipment.

B. Environmental Requirements:

1. Apply water-based coatings only when the temperature of surfaces to be painted and the surrounding air temperatures are between 40°F and 90°F unless otherwise permitted by the paint manufacturer's printed instructions.
2. Apply other coatings only when the temperature of surfaces to be painted and the surrounding air temperatures are between 65°F and 95°F, unless otherwise permitted by the paint manufacturer's printed instructions.
3. Do not apply coating when the relative humidity exceeds 85 percent; or to damp or wet surfaces.
4. Work may be continued during inclement weather only if the areas and surfaces to be painted are enclosed and heated within the temperature limits specified by the paint manufacturer during application and drying periods.
5. Provide illumination and ventilation in all areas where coating operations are in progress.

C. Protection:

1. Cover or otherwise protect finished Work of other trades and surfaces.

2. Employ procedures to prevent contamination of the water processes. Submit proposals for protection work to ENGINEER for review.
3. Do not begin work in any area until ENGINEER approves protection techniques proposed by CONTRACTOR.
4. Provide fire extinguishes and spot caution signs warning against smoking and open flame when working with flammable materials.

3.04 SURFACE PREPARATION

A. General:

1. Perform all preparation and cleaning procedures as specified herein and in strict accordance with the coating manufacturer's instructions for each particular substrate and atmospheric condition.
2. When the Contractor is require to remove existing paint systems, the Contractor shall submit for approval by the Engineer, a detailed plan of equipment and materials proposed for this work, which shall be in conformance with the manufactures recommendations.
3. The Contractor shall be solely responsible for the proper removal and disposal of all removed paint systems, to include all materials used for removal. Removal, transportation, and disposal of said materials shall be in conformance with all Federal, State, and local regulations governing this work. It shall be the Contractors sole responsibility to be aware of the applicable regulations, and to make sure all work is performed in accordance. The Contractor will be solely responsible for any and all costs associated with the improper removal and disposal of existing paint systems.
4. Provide surface applied protection to all hardware, fixtures, and similar items in place prior to surface preparation and coating operations. Remove, if necessary, for the complete coating of adjacent surfaces. Following completion of coating of each space or area, reinstall the removed items by workmen skilled in the trades involved.

B. Cleaning

1. Care shall be taken to clean the concrete surfaces without eroding the surfaces beyond what is necessary to clean and degrease. All concrete surfaces should be abraded to remove all contaminants.
2. Remove oil and/or grease with cleansing/degreasing solvents prior to acid etching.
3. All cleaning and surface preparation solutions shall be fully compatible with the proposed coating systems.

C. Drying

1. Allow the concrete to thoroughly dry before coating. The CONTRACTOR may choose to use methods of heating or fanning the area to increase the speed of the drying process as approved by the coating manufacturer.
2. Use ASTM D 4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method. Test the concrete using this method. Do not apply sealants until there is no moisture detected in the concrete.
3. Do not apply sealants until approved by the ENGINEER.

3.05 MATERIALS PREPARATION

A. General:

1. Mix and prepare coating materials in strict accordance with the manufacturer's directions.
2. Do not mix together coating materials produced by different manufacturers, unless otherwise permitted by the manufacturer's instructions.
3. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing, and application of sealant in a clean condition, free of foreign materials and residue.
4. Stir all materials before application to produce a mixture of uniform density, and as required during the application of the materials. Do not stir any film that may form on the surface into the material. Remove the film and, if necessary, strain the material before using.

3.06 GENERAL APPLICATION

A. General:

1. Apply coatings by brush, roller, air spray, or airless spray in accordance with the manufacturer's written recommendations. Use brushes best suited for the type of material being applied. Use rollers of carpet, velvet back, or high pile sheep's wool as recommended by the sealant manufacturer for material and texture required. Use air spray or airless spray equipment recommended by the sealant manufacturer for specific coating system specified. Submit a list of application methods proposed, listing paint systems and locations.
2. The number of coats and sealant film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has completely dried.

B. Minimum Coating Thickness:

1. Apply each material at not less than the manufacturer's recommended spreading rate, and provide total dry film thickness (DFT) as required by the manufacturer.
2. Apply extra coats if required to obtain specified total dry film thickness.
3. Apply additional coats when the undercoats, stains, or other conditions show through the final coat of paint, until the paint film is of uniform color, finish, and appearance as approved by the ENGINEER.
4. Insure that all surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a film thickness equivalent to that of the flat surfaces.

C. Scheduling Coating Applications:

1. Apply the first-coat material to surfaces that have been cleaned, pretreated, or otherwise prepared for coating as soon as practicable after preparation and before subsequent surface deterioration.
2. Allow sufficient time between successive coatings to permit proper drying in accordance with manufacturers recommendations. Do not recoat until coating has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and the application of another coat does not cause lifting or loss of adhesion of the undercoat.

D. Prime Coats: Recoat primed and sealed areas where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects caused by insufficient coating.

E. Brush Application:

1. Brush-out and work all brush coats onto the surfaces in an even film. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

F. Mechanical Applicators:

1. Use mechanical methods for sealant application when permitted by governing ordinances, manufacturer, and approved by ENGINEER. If permitted, limit to only those surfaces impracticable for brush applications.

3.07 INTERIOR CONCRETE

A. Surface Preparation

1. All holes and/or penetrations remaining or made during the other Work shall be patched and repaired by the CONTRACTOR. Concrete shall be fully cured, clean and dry prior to any coating.
2. Any areas where aggregate is exposed or deep pits or air holes existing, shall be filled with a cement grout and surface trowelled to a uniform surface texture.

3.08 FIELD QUALITY CONTROL

A. CONTRACTOR shall provide all equipment necessary to maintain the proper humidity level in the work area in accordance with manufacturers representatives. CONTRACTOR shall submit to ENGINEER a plan to properly address any and all humidity problems prior to the start of work in accordance with manufacturer's recommendations. Plan shall be for ENGINEERS information and not submitted for approval.

B. After completion of each coat of sealant, CONTRACTOR shall notify ENGINEER. After inspection, checking of film thickness and approval by ENGINEER, proceed with the succeeding coat. CONTRACTOR shall supply a Gardner dry-film thickness gage and check the film thickness in the presence and at locations directed by the ENGINEER. Additional coats shall be applied, if required, to produce the specified film thickness.

3.09 PROTECTION

A. Protect Work of other trades against damage by the coating work. Leave all such work undamaged.

B. Correct all damages by cleaning, repairing or replacing, as acceptable to the ENGINEER.

C. Restrict access to the area following the Work as required by manufacturer's directions for drying time to protect newly sealed floor.

D. CONTRACTOR to supply a powered ventilation system to eliminate fumes from work area.

3.10 CLEAN-UP

A. During the progress of the Work, remove from the site all discarded materials, rubbish, cans and rags at the end of each work day.

B. At the completion of work of other trades, touchup and restore all damaged or defaced painted surfaces as determined by ENGINEER.

3.11 MAINTENANCE MATERIAL

A. Furnish the OWNER with one (1) unopened original container gallon of each concrete sealer utilized and each paint color utilized for the Work. Clearly indicate, on each container, color, finish, and application area.

END OF SECTION

SECTION 11900

WATER TREATMENT PROCESS EQUIPMENT

PART 1 – GENERAL

1.01 WORK INCLUDED

A. Two (2) internally baffled chlorine contact tanks.
B. Complete filter system consisting of three (3) manganese dioxide (greensand plus) filters, filter piping, valves, and controls.
C. Chemical feed system for feeding sodium hypochlorite, as specified and shown on the contract drawings.
D. Booster Pump System to provide system potable water demand and the associated VFDs and controls.
E. Control panels for the existing well pumps.
F. Hydropneumatic storage tanks.

1.02 QUALITY ASSURANCE

A. The equipment and services specified under this section have been based on the manufacturers listed. The CONTRACTOR shall base their Bid around this equipment for the purpose of providing the Base Bid and in determining the lowest Bidder.
B. For the purposes of items dependent upon the start-up date of the main process equipment system, the term "start-up" and the beginning of all requirements that begin upon the start-up of the main process equipment, shall be defined as follows: Start-up shall be considered a point in time that all of the equipment under this specification is properly installed and working for its intended purpose. The CONTRACTOR and Equipment Supplier shall contact the ENGINEER and the OWNER at a point in time that they consider the process and equipment to meet the above criteria. At this time, the ENGINEER will make a final determination and document in writing the official start-up date or any items that need to be addressed by the CONTRACTOR and Equipment Supplier prior to issuing an official date for start-up.
C. Upon completion of installation of the equipment, the CONTRACTOR and/or Equipment Supplier shall certify to the ENGINEER in writing that the equipment has been properly installed as per the manufacturer's recommendations and is ready for operation by the OWNER, and all warranties are in effect.

1.03 SUBMITTALS AND SHOP DRAWINGS

A. Submit shop drawings and product data for all equipment covered in this specification in accordance with all applicable sections of the Contract Documents, to include the following (where applicable):
    1. Complete assembly and installation drawings.
    2. Descriptive information on materials and equipment furnished.
    3. Complete drawings and wiring diagrams for all control systems.
    4. Performance data on all equipment.
    5. Total weight of the equipment, including weight of single largest item.
    6. Motor drive data.
    7. Control data and wiring diagrams.

1.04 DESIGN CRITERIA

A. The water treatment system shall be designed to treat raw water at a flow rate of 21.5 gpm and produce finished water in compliance with US Environmental Protection Agency Water Quality Standards:

a. Finished Water Iron Concentration: less than 0.3 mg/L*
b. Finished Water Manganese Concentration: less than 0.3 mg/L*

* Finished water concentrations of Iron and Manganese shall be less than 0.5 mg/L, combined

PART 2 – PRODUCTS

2.01 CHEMICAL FEED SYSTEM

A. Chemical feed system shall be a Stenner 1" Proportional Injection System, Model 45MPHP2, or approved equal, complete with the following components:
1. A turn-down filter
2. Water meter w/ dry-contact pulse output
3. Stenner Pump Control Module (PCM1)
4. Chemical feed pump
5. Chemical feed flow indication tube
6. Injection quill
7. HDPE backing/mounting plate
8. Additional piping and fittings to connect the components together

B. A spare chemical feed pump shall be furnished to the Owner for direct replacement in the event of a fault or failure.

C. Chemical metering pumps shall be of the positive displacement, peristaltic (roller) pump type.

D. Output shall be continuously rated at operating temperature, and adjustable while pumps are in operation.

E. Each pump shall have a maximum capacity of 0.06 GPH at a maximum back pressure of 80 PSI.

F. Pump Controls:

1. The control panel shall be integrated into the pump unit.
2. Control functions to include external 4-20 mA input and stop.
3. A single relay output shall be provided to allow for interfacing the pump with external equipment.
4. The pump to have an LCD display to view control options, operating conditions and alarms.

G. A 7.5-gallon chemical day tank shall also be furnished for storage of sodium hypochlorite. The day tank shall be a Stenner Model STS7GC, or approved equal.

2.02 CHLORINE CONTACT TANKS

A. Chlorine contact tanks shall be installed immediately downstream of the sodium hypochlorite injection point, prior to the manganese dioxide media filters. Chlorine contact tanks shall be Flexcon Industries BAF-120 tanks, or approved equal, meeting the flowing specification:
1. Rated capacity of at least 119 gallons.
2. Rated baffling factor of 0.6, or greater.
3. Maximum working pressure of 100 psi, or greater.
4. Drain port located near the bottom of the tank.

2.03 MANGANESE DIOXIDE MEDIA FILTERS

A. Manganese Dioxide Media Filters shall be Custom Care Model C53-MG-18-15, or approved equal, meeting the following specifications:
1. Tank size of 18" diameter and 65" in height.
2. Inlet pipe size: 1.5" diameter

3. Drain pipe size: 1" diameter
4. Filter media volume capacity: 5.0 cubic feet
5. Filter media cross-sectional area: 3.67 square feet
6. Required backwash flow rate: 20 gpm

B. Filters shall be equipped with automated control valves designed for use with the filter housings, with 1.5" inlet/outlet pipe connections.

C. The control valves shall also be capable of controlling the direction of water flow, to automatically backwash on a set schedule.

D. Control valves shall also be capable of outputting a signal to a motorized alternating valve (MAV) to control the flow of raw water and finished water for normal operation and backwash cycles.

2.04 BOOSTER PUMPS AND CONTROLS

A. The booster pumps are intended to maintain a constant discharge pressure of 60 psi at varying flowrates up to 48 gpm with two pumps running.

B. The booster pumps shall be Goulds® 5SV-03, or equal, and shall be sized to meet the following design criteria:
1. Suction head: 54 to 98 feet
2. Discharge head: 138 feet
3. TDH: 40 to 85 feet
4. Max. Flow: 24 gpm per pump

C. The booster pump controllers shall be Goulds® Aquavar IPC, or equal, and shall be sized to be compatible with the booster pumps.
1. Input voltage: 120/240-volt, 1-phase
2. Output voltage/phase: per pump

D. The booster pump control system shall be capable of operating the booster pumps based on input from pressure transducers installed at the discharge ends of the booster pumps.

2.05 HYDROPNEUMATIC STORAGE TANKS

A. Hydropneumatic storage tanks shall be Wessels Model FXA-500, or approved equal, meeting the flowing specifications:
1. Nominal tank volume of 132 gallons, or greater
2. 2" NPT inlet/outlet connection
3. Integrated external pressure gauge
4. Bladder integrity monitor
5. Carbon steel tank shell with epoxy-based paint coating on internal and external surfaces
6. Heavy duty butyl bladder liner, NSF-61 rated

2.06 WELL PUMP CONTROL PANELS

A. The well pumps are intended to pump water from the water wells, through the treatment train, and into the 100,000-gallon storage tank via a dedicated 2-inch fill line.

B. The well pumps shall be controlled by a tank level pressure transducer installed on the 2-inch fill line inside the well house.

C. Materials
1. The well pump control panel shall be a single-phase duplex alternating control panel capable of operation based on a tank level pressure transducer. The control panel shall meet the following requirements:
a. NEMA 4X rated enclosure
b. Minimum one output for alarm beacon
c. Minimum one control signal output
d. Analog input for tank level pressure transducer. Tank levels above the well house finished floor are expected to be from 42.5 feet (tank floor) to 103 feet (tank overflow).
e. Hand-off-auto switch for each pump

f. Automatic pump alternator

D. Installation

1. The duplex pump control panel shall be installed according to manufacturer's recommendations. The control panel shall be configured to control the operation of the two well pumps, based on input from the tank level pressure transducer installed on the 2-inch fill line inside the well house.
2. The pressure transducer setpoints shall be calibrated at installation to reflect the actual tank levels while one (1) well pump is running. The pressure transducer reading and the actual tank level shall be recorded while the well pump is running and the tank is half-full and while the well pump is running and the tank is full.
3. Static pressures shall also be noted with no pumps running and correlated to actual tank levels when the tank is half-full and full.

PART 3 – EXECUTION

3.01 INSTALLATION

A. The CONTRACTOR shall require the Manufacturer to furnish the services of qualified factory-trained servicemen to assist in initial installation of the equipment including a minimum of one (1) trip to the project site. The manufacturer shall then provide start-up service after the equipment has been installed to confirm proper installation and operation of the complete system. Start-up shall be a minimum of one (1) trip to the project site.

A. Install each item in accordance with Manufacturer's recommendations and in accordance with the Contract Documents.

B. Conform to all applicable provisions of the NEMA standards, NEC and local, State and Federal codes when installing the equipment and interconnecting wiring.

C. Operator training of the operations personnel shall be provided including one day/one trip after start-up is complete. A follow-up training session (one day/one trip) will also be provided within three months of start-up.

END OF SECTION

SECTION 15063

PVC PRESSURE PIPE, FITTINGS, AND ACCESSORIES
4IN. THROUGH 48IN. FOR WATER DISTRIBUTION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Specified

1. CONTRACTOR shall furnish all labor, materials, equipment and incidentals as shown, specified and required to install and place in satisfactory service polyvinyl chloride (PVC) pressure piping, fittings and associated appurtenances.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02221, Excavation, Backfill, and Trenching For Utility Systems
B. Section 15110, Valves Hydrants and Appurtenances
C. Section 15140, Testing and Disinfection

1.03 QUALITY ASSURANCE

A. Qualifications of the Manufacturer

1. Manufacturer shall have a minimum of five (5) years' experience producing polyvinyl chloride (PVC) pipe, fittings, and accessories, and shall show evidence of at least ten (10) installations in satisfactory operation.
2. Piping manufacturer shall maintain a continuous quality control program. All PVC plastic molding materials used to manufacture pipe and fittings under this Section shall be tested for conformance to the requirements of ASTM D1784.
3. Parts Interchangeability: It is the intent of these specifications that all materials furnished herein shall be compatible with similar materials of other manufacturers.
4. The CONTRACTOR shall obtain each type of material from a single manufacturer.
5. The OWNER reserves the right to reject the material of a manufacturer if that material fails to meet the requirements or performance criteria of these specifications.

1.04 REFERENCE STANDARDS

A. AWWA C900-07, AWWA Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. Through 12 in., For Water Distribution
B. AWWA C905-10, AWWA Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 14 in. Through 48 in., For Water Transmission and Distribution
C. AWWA C909-02, AWWA Standard for Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 in. Through 24 in., For Water Distribution
D. ASTM D 1598, Test for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure.
E. ASTM D 1599, Test for Short-Time Rupture Strength of Plastic Pipe, Tubing and Fittings.
F. ASTM D 2122, Determining Dimensions of Thermoplastic Pipe and Fittings.
G. ASTM D2152 Standard Test Method for Adequacy of Fusion of Extruded Poly(Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion.
H. ASTM D 2241, Polyvinyl Chloride (PVC) Plastic Pipe, SDR-PR.
I. ASTM D 2412, Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.

J. ANSI/ASTM D1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
K. ASTM D 2837, Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.
L. ASTM D 3139, Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
M. ASTM F 477, Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
N. NSF 61, Drinking Water System Components – Health Effects.
O. NSF 372, Drinking Water Components – Lead Content.
P. PPI TR-3, Policies and Procedures for Developing Recommended Hydrostatic Design Stresses For Thermoplastic Pipe Materials.
Q. AWWA M23, Manual of Water Supply Practices, PVC Pipe Design and Installation
R. AWWA Standard C105, Polyethylene Encasement for Ductile-Iron Pipe Systems

1.05 SUBMITTALS

A. The CONTRACTOR shall submit shop drawings to the ENGINEER for approval prior to placing final orders for materials required for waterline construction.
B. Shop drawings shall consist of the descriptive literature of the manufacturer with sufficient detail to ascertain that the proposed material meets all requirements of the Contract Documents and is suitable for incorporation into the Work.
C. Shop drawing submittals shall be required for the following and any other materials permanently incorporated into the Work:

1. Pipe
2. Fittings
3. Concrete for anchor (thrust) blocking and encasement sections
4. Joint restraining devices
5. Tracer Wire

D. The CONTRACTOR shall provide certification of the manufacturer that the materials proposed to be incorporated into the Work conform to the Specifications herein.
E. Furnish delivery tickets indicating the pipe manufacturer, pipe type and class, and identifying that the pipe was new and from a manufacturer that has been submitted and approved.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. During delivery and handling, all materials shall be braced and protected from any distortion or damage; any such distortion or damage shall be basis for rejection of the materials.
B. Equipment used for unloading shall be covered with wood or rubber to avoid damage to the exterior of the pipe, fittings and accessories. Do not drop or roll materials off trucks. All PVC pipe and fittings shall be handled with padded slings or other appropriate equipment. The use of cables, hooks or chains will not be permitted.
C. The materials shall be inspected before and after unloading. Materials that are found to be cracked, gouged, chipped, dented or otherwise damaged will not be accepted.
D. Interiors of pipe, fittings and accessories shall be kept free from dirt and foreign matter.
E. Store pipe and fittings on heavy wood blocking or platforms so they are not in contact with the ground. Do not store pipe or fittings in sunlight.
F. Pipe, fittings, and specials shall be unloaded opposite to or as close to the place where they are to be used as is practical to avoid unnecessary handling.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General

1. All materials must be suitable for use in potable water systems.
2. All PVC pipe, fittings and accessories shall be designed for a working pressure and field hydrostatic test pressure as specified herein, or as directed by the Engineer.
3. All PVC pipe, fittings, and accessories must be new materials in first-class condition. Used or recycled materials shall not be allowed, regardless of condition.

2.02 POLYVINYL CHLORIDE (PVC) PIPE – UNDERGROUND INSTALLATION

A. POLYVINYL CHLORIDE (PVC) PRESSURE PIPE

1. All PVC Water pipe shall be made of compounds conforming to ASTM D1784 with a cell classification of 12454, in accordance with the dimensional, chemical, and physical requirements of AWWA C900–07 (4"-12") or C905-10 (14"-48").
2. All joints shall meet the requirements of ASTM 3139.
3. All gaskets shall meet the requirements of ASTM F477.
4. The pipe shall be furnished in laying lengths of 20'.
5. All PVC Water pipe shall be of pressure class (psi) 235 @ 73.4°F, DR 18.
6. PVCO Water pipe conforming to AWWA C909 shall be an acceptable alternate to PVC Water pipe conforming to C900.

B. FITTINGS

1. All pipe main fittings shall be fabricated of ductile iron and shall be of mechanical joint design complying with AWWA C153 and shall be Class 350 (4"-12") of Class 250 (14"-48").
2. The fittings shall be cement mortar lined and seal coated inside and out with an approved bituminous coating 1 mil thick in accordance with AWWA C104; coating shall be NSF 61 compliant.
3. All fasteners used on fittings shall be fluorocarbon coated, such as StandCote SC-1 Fasteners as manufactured by Standco Industries, Inc., or approved equal.
4. All exposed surfaces of fittings, valves, flanges, bolts, nuts, tie-rods, turn buckles, etc., in contact with the earth and backfill materials shall be coated with a minimum of 30 mils of bitumastic coating and encased in polyethylene wrapping in accordance with the requirements of AWWA Standard C105, "Polyethylene Encasement for Ductile-Iron Pipe Systems". The polyethylene wrap shall be taped to provide a snug fit along the pipe. Any punctures, tears, or other damage shall be patched with polyethylene wrap and taped.

C. JOINT RESTRAINTS

1. Mechanical joint restraint shall be incorporated into the design of the follower gland. The restraint mechanism shall consist of a plurality of individually-actuated gripping surfaces to maximize restraint capability. Glands shall be manufactured of ductile iron conforming to ASTM A536-80.
2. The gland shall be such that it can replace the standardized mechanical joint gland and can be used with the standardized mechanical joint bell conforming to

ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53 of latest revision. Twist off nuts, sized same as tee-head bolts, shall be used to insure proper actuating of restraining devices.

3. The restraining glands shall have a pressure rating equal to that of the pipe on which it is used. The restraining glands shall have been tested to UNI-B-13-92, be listed by Underwriters Laboratories, and be approved by the Factory Mutual.
4. Joint Restraints for C900 PVC Pipe shall be EBAA Iron Inc. Series 2000PV for mechanical joints and Series 1600 for PVC pipe bells, or approved equal.

D. THRUST BLOCKING

1. All plugs, caps, tees, valves and bends of 22½° or more shall be anchored to prevent movement by providing suitable reaction blocking as detailed on the Contract Drawings. Concrete used for such blocking shall have a minimum 28-day compressive strength equal to 3000 psi.
2. Prior to placing concrete, the fitting shall be completely wrapped with a 6-mil polyethylene membrane to prevent concrete bond to pipe or fittings.
3. All thrust blocking constructed of cast-in-place concrete shall be constructed using ready-mix concrete. The use of "sakrete" bags (or equal) will not be allowed.

E. SERVICE SADDLE

1. Service saddles for Polyvinyl Chloride (PVC) pipe shall be of the brass body with double stainless steel bands.
2. Bodies shall be brass alloy conforming to ASTM B62 (85-5-5-5) and a threaded outlet conforming to AWWA C800.
3. Stainless steel bands shall be welded to UNC threaded stainless steel bolts and shall be fully passivated for corrosion resistance.
4. Nuts shall be brass alloy or stainless steel as per ASTM B62 and/or ASTM B-584.
5. Gasket shall be EPDM rubber in accordance with ASTM D2000.
6. Manufacturer: Ford Meter Box 202BS Series, or approved equal.

F. TRACER WIRE

1. The CONTRACTOR shall install tracer wire with all PVC pipe direct bury (open cut) installations, such that the pipe can be accurately located after installation is complete. Tracer wire shall be 12 AWG steel core soft drawn high strength tracer wire with a minimum 380# average tensile break load, 30 mil high molecular weight-high density polyethylene jacket complying with ASTM-D-1248, 30 volt rating, as by Copperhead Industries, LLC, or approved equal.
2. The CONTRACTOR shall install **12 AWG steel core hard drawn extra high strength** tracer wire when installing PVC pipe by method of **horizontal directional drilling (HDD) or boring**, with a minimum 1150# average tensile break load, 45 mil high molecular weight-high density polyethylene jacket complying with ASTM-D-1248, 30 volt rating, as by Copperhead Industries, LLC, or approved equal.
3. The CONTRACTOR shall install corrosion proof wire connectors that are properly sized for the tracing wire at all splice locations in the tracer wire. Wire connectors shall be rated for direct burry applications and shall make use of a non-hardening, silicone based sealant to prevent moisture from entering the splice. Wire connectors shall be Snake Bite or Locking Snake Bite as manufactured by Copperhead Industries, LLC, DBR-6 Direct Burry Splice Kit as manufactured by 3M Division, or approved equal. Making tracer wire connections by twisting wires together and taping the wires together is not an acceptable method of making tracer wire connections.

4. The CONTRACTOR shall install above ground utility markers as shown on the Contract Drawings. The utility markers shall be of a durable polypropylene construction that is UV stabilized, designed to withstand extreme temperatures (-30°F to 120°F), and designed to rebound from vehicular impacts at high speeds. Above ground utility markers shall be fitted with an identification decal that meets the textual requirements of the Contract Documents. The utility marker shall provide 360° visibility. Above ground utility markers shall be provided with a direct bury end. Utility marker shall also serve as a tracer wire testing station. The utility marker shall be fitted with internal testing terminals and a cap to provide protection. Above ground utility markers shall be fitted with a shunt to provide continuity through the tracer wire terminal and brass terminal posts. Above ground utility markers shall be "TriView Test Station" as manufactured by Rhino Marking and Protection Systems, or an approved equal.
5. The CONTRACTOR shall install at grade tracer boxes as indicated on the Contract Drawings. At grade tracer boxes shall have a cast iron cap and embedded magnet for easy detection by means of a standard metal detector. At grade tracer boxes shall be appropriately designed for roadway or driveway installations where required. At grade tracer boxes shall be fitted with an insulated direct connection to allow locating equipment to be hooked up to the tracer wire without requiring the cap to be removed. The connection point shall be brass. At grade tracer box covers shall have locking capability. At grade tracer boxes shall be "Snake Pit Lite Duty XL Boxes" or "Snake Pit Roadway Boxes" as manufactured by Copperhead Industries, LLC and as indicated on the Contract Drawings, or an approved equal.
6. **The color of all tracer wire, connectors, utility markers, and at grade tracer boxes shall be BLUE for Potable Water Installations and GREEN for Sanitary Sewer Installations, meeting APWA standards.**

G. DETECTABLE MARKING TAPE

1. Shall consist of 5 mil overall thickness, 2 inch wide, solid aluminum foil core blue detectable marking tape. Lettering on tape shall be a minimum of 1" and read" CAUTION BURIED WATERLINE BELOW".
2. Manufacturer: CH Hanson or equal.

PART 3 - EXECUTION

3.01 GENERAL

A. The CONTRACTOR shall coordinate all Work in this Contract with the work of other contractors, utility companies, and local highway authorities.
B. The CONTRACTOR shall construct all waterlines as indicated on the Contract Drawings and specified herein in a neat and workmanlike manner, in accordance with these Specifications, the recommendations of the manufacturer, and as generally accepted by the industry.
C. All materials incorporated into the Work shall be transported, handled, stored, and installed in the Work in such a manner as to insure against breakage, cracking or other damage. No such defective material shall be incorporated into the Work.
D. Prior to installing pipe, every precaution shall be taken to ensure that no foreign material enters the pipe.

3.02 EXCAVATION, TRENCHING, PIPE BEDDING, AND BACKFILL FOR POLYVINYL CHLORIDE (PVC) PIPE

A. Trenching, excavation, and backfill shall comply with Section 02221 of these Specifications. The water line should be installed to follow line and grade shown on the Contract Drawings

providing a minimum depth of cover of 4.5 - feet over the top of the pipe bell unless otherwise indicated on the Contract Drawings.

B. The trench bottom shall be graded flat to allow uniform support for the entire length of the pipe. Six (6) inches of No 1A stone bedding shall be installed such that uniform support is provided for the entire length of pipe. After the pipe is carefully placed and the pipe-layer has assured himself that the pipe is uniformly supported, the trench shall be carefully backfilled by hand to the springline, with No.1A Stone. Care shall be taken to insure that the material is worked under the haunches of the pipe by hand. The trench shall then be carefully backfilled with the excavator bucket or by front-end loader to a depth of 12-inches of cover over the top of the pipe with No.1A stone. Tracer wire shall then be installed directly over the pipe on the top of the No.1A stone, and the remainder of the trench shall be backfilled in accordance with Section 02221 of these specifications.

C. Proper implements, tools and facilities, satisfactory to the ENGINEER, shall be provided and used by the CONTRACTOR for the safe and convenient prosecution of the Work, including hoists, ropes, or other means to lower the material into the trench. Under no circumstances shall pipe, valves, specials, etc., be dropped or dumped into the trench.

3.03 POLYVINYL CHLORIDE (PVC) PIPE – UNDERGROUND INSTALLATION

A. The water line shall be installed in accordance with applicable sections of AWWA Manual M23, AWWA C605, and these Specifications.

B. Every precaution shall be taken to prevent foreign material from entering the pipe at any time.

1. Excess dust, dirt, or oil on the inside of the pipe shall be removed by an approved means prior to installing the pipe.
2. If the pipe laying crew cannot get the pipe into the trench without getting dirt into it, the ends shall be covered with a heavy tightly woven canvas bag, which shall be left in place until the connection is to be made to the adjacent pipe.
3. At times when pipe laying is not in progress, the open ends of pipe shall be closed with a watertight plug or other approved means.
4. If water is in the trench when Work is to resume, the seals shall remain in place until the trench is pumped completely dry (these provisions shall apply during the noon hour, as well as overnight).

C. Pipe shall be laid with the bell end facing in the direction of laying, unless otherwise directed by the ENGINEER.

D. Installation shall be made in accordance with the recommendations of the pipe manufacturer, these specifications, and as directed by the ENGINEER. The CONTRACTOR shall provide the ENGINEER with a copy of the manufacturer's instructions for making joints and installing pipe. In assembling the pipe, the CONTRACTOR shall not deflect the pipe joints horizontally or vertically, more than 1 degrees for mainline pipe. Fittings shall be used to accomplish any change in alignment that exceeds the standard.

E. Pipe cutting shall be done in a neat and workmanlike manner taking care not to damage the pipe. Cuts shall be smooth and at right angles to the axis of the pipe. Bevel ends as per manufacturer's recommendations.

F. Joints shall be assembled under conditions that ensure clean mating and sealing surfaces, in accordance with the manufactures recommendations. Factory-installed gaskets should not be removed for cleaning. The joint shall be free of dirt, sand, grit, grease, or any foreign material. When assembling gasketed joints, an approved lubricant shall be applied as specified by the pipe manufacturer. If joints are to be assembled in cold weather conditions, factory-installed gaskets may be removed and taken to a heated truck cab or shelter to restore the gasket's flexibility prior to joint assembly. Not all factory-installed gaskets are field removable.

G. Pipelines shall be located on the line and grade as indicated on the Contract Drawings. The

Contractor shall be required to lay-out one days worth of pipe installation, at least a day in advance of the proposed installation, such that the proposed line and grade can be reviewed in the field with the ENGINEER for its accuracy, and such that any potential re-alignments can be worked out due to conflicts determined in the field, not previously indentified during the design phase. No deviation from the required line or grade shall be made without the authorization of the ENGINEER.

H. The CONTRACTOR shall install 12 AWG steel core soft drawn high strength tracer wire with all PVC pipe installations, such that the pipe can be accurately located after installation is complete. The tracer wire shall be installed approximately 12-inches directly over the pipe, on the top of the No.1 stone fill. The tracer shall not be placed in the bottom of the trench, off to one side of the pipe or the other. In areas where PVC piping is being installed within casing pipe, or is being encased in concrete, the tracer wire shall be attached directly onto the top of the pipe. The tracer wire shall be appropriately spliced when required, to provide for continued current throughout the pipe sections. The tracer wire shall be brought to the surface at all in-line valve locations, up through the inside or outside of the valve box, or where further directed by the ENGINEER. Prior to receiving any payment for the pipe installation, the CONTRACTOR must prove that the tracer wire is working correctly by means of locating sections of the completed installation using locating equipment (provided by the CONTRACTOR), equipped with the ability to provide a depth reading. The CONTRACTOR shall take note that it is the explicit intent of the OWENR, the ENGINEER, and the Contract Documents, that tracer wire be installed, such that the piping can be located in the future. The CONTRACTOR shall be responsible to perform all work necessary and required, not necessarily explicitly expressed in the Contract Documents, in order to accomplish the functional and design intent of the tracer wire installation. Should the tracer wire break during the installation processes it shall be the CONTRACTORS responsibility and expense to correct the situation, such that the installation is completed as stated above.

I. The Contractor shall place approximately 12-18-inches of backfill material over the bedding stone and then install Detectable Marking Tape directly over the pipe.

3.04 PVC PIPE – INSTALLATION BY BORING

A. The new waterline shall be installed in casing pipe where shown on the plans. The waterline shall be PVC pipe. The encasement shall be installed without excavation; the casing pipe shall be placed by boring or jacking it into place.

B. The casing pipe shall be placed at the locations shown on the drawings in such a manner to allow for the waterline to be installed to the line and grade depicted on the drawings. The casing pipe shall be so constructed as to prevent leakage of any substance from the casing throughout its length except at ends. Casing shall be installed as to prevent the formation of a waterway under the roadway, with an even bearing throughout its length and shall slope to one end. Contractor shall open test pits as required to verify utility depths prior to beginning bore.

C. The Contractor shall make the approach trench or the bore pit large enough to accommodate the jacks, blocking, and at least one section of casing or carrier pipe. The Contractor shall be responsible to provide adequate shoring for the bore pit in accordance with all recommended standards, to include but not be limited to OSHA and the New York State DOT.

D. Bored or jacked installations shall have a bored-hole diameter essentially the same as the outside diameter of the pipe plus the thickness of the protective coating. If voids should develop or if the bored-hole diameter is greater than the outside diameter of the pipe (including coating) by more than 1 inch, remedial measures as approved by the Engineer shall be taken.

E. Do not disturb the ground surface above the pipe while jacking the casing. The excavation ahead of the casing shall be approximately the same diameter as the casing outside diameter. Do not carry the excavation far enough ahead of the casing to cause caving of the earth. Should any caving occur, the void shall be filled with grout in an approved manner. A steel

cutting edge may be utilized on the front section of the casing to properly form and cut the opening.

F. The Contractor shall lay rails and sills to keep the casing at the desired established line and grade. Maximum allowable vertical error for the casing pipe shall be 0.2 ft. above or below the design grade. Maximum allowable error horizontally shall be 4 in. off alignment. Errors in excess of this shall be suitably corrected.

G. The Contractor shall use two jacks with a minimum of 50 Ton capacity each to perform the jacking. He shall construct a backstop or cribbing substantially enough to support the pressure of the jacks at the back end of the bore pit.

H. The steel casing pipe shall be welded together in conformance with AWA (American Welding Association) specifications for welding steel casing together. The length of the casing shall be as shown on the Plans, but in general should extend a minimum of 10-feet past the edge of pavement. Where encasement pipe is called out on the Plans, the encasing pipe shall be ANSI Standard Grade, all new pipe, meeting ASTM A-53. The minimum wall thickness shall be 0.375 inches.

I. The carrier pipe, or waterline pipe, shall be installed inside of the casing pipe using polyethylene casing spacers, installed per the manufactures recommendations, and as approved by the ENGINEER. The ends of the encasing pipe shall be sealed with full conical shaped synthetic rubber end seals. Tracer wire shall be attached to the top of the carrier pipe prior to installation of casing spacers, and installation of the carrier pipe within the casing pipe.

J. The use of water or other liquids to facilitate placing the casing and removing the spoil is prohibited.

K. Should the Contractor encounter an obstruction during the placement of the casing, he shall remove the obstruction without disturbing the surface and continue. In the event that the obstruction cannot be reasonably removed, the Contractor shall abandon the casing, fill it with cement grout, and relocate the crossing as approved by the Engineer. The price bid shall include cost involved in removing obstructions.

3.05 JOINT RESTRAINTS

A. All joint restraints proposed shall be compatible with the type of pipe and fittings being utilized.

B. When joint restraining is being utilized in lieu of thrust blocking, the Contractor shall be required to install a complete restraining system, in accordance with the Manufacturers recommendations, the contract plans and specifications, and as directed by the ENGINEER.

C. The Contractor shall refer to the restraining schedule on the detail sheets, included as part of the plans. The restraining schedule has been developed for the laying conditions specific to this project, and should not be altered unless otherwise authorized by the ENGINEER.

3.06 THRUST BLOCKING

A. All thrust blocking shall be placed so that fittings, nuts, bolts, and joints are accessible for repairs.

B. Blocking shall be placed against firm, undisturbed earth.

C. Area of bearing on the pipe and the ground shall be as indicated on the Contract Drawings.

D. All cast-in-place thrust blocking shall be constructed using ready-mix concrete only. The use of "sakrete" bags, or equal, will not be permitted.

3.07 CONCRETE ENCASEMENT

A. The watermain shall be encased in 3000 psi ready-mix concrete where shown on the plans, or as further directed by the ENGINEER.

B. All piping and fittings within the proposed encasement area shall be wrapped with 6 mil polyethylene (or approved equal), to prevent bonding to the concrete.

C. Tracer wire shall be attached directly to the top of the PVC piping prior to placement of the polyethylene wrapping and concrete.

3.08 CONNECTIONS TO EXISTING MAINS

A. It shall be the Contractors responsibility to verify the location, size, and type of piping of the existing main in which the interconnection is to be made to, to verify the size and type of materials which will be required to make the interconnection. The Contractor shall also verify the alignment which will be required to make the interconnection.

B. Configurations of the existing water mains, as shown on the Plans, are shown using the best information available. However, the actual field condition may differ substantially from those shown. Therefore, special care shall be taken to determine, in advance of the pipe laying operation, the configuration of the existing water mains and other underground utilities at all locations where interconnections with the existing water mains are to be made.

C. If the location of the existing utility piping requires changes in the connection details, the CONTRACTOR shall submit an alternative connection detail for the approval of the ENGINEER as a part of the work plan.

D. The CONTRACTOR shall connect to the existing mains at only one (1) feed point until all testing, disinfection, and flushing are completed and Health Department approval to use the new lines is secured.

E. In the event that the water must be turned off to allow for the proposed interconnection, the Contractor shall be required to issue notification to all those affected by the disruption no later than 48 hours in advance of the proposed shut-down. The Contractor will not be allowed to perform the work if proper notification is not made.

3.09 EXISTING UTILITIES

A. The CONTRACTOR shall satisfy himself as to the locations of all existing structures and underground utilities as well as the value and location of the Work, the general conditions, particularly those bearing upon transportation, disposal, handling and storage of materials, availability of labor, water, electric power, and roads, physical conditions at the site, the confirmation and condition of the ground, the character, quality and quantity of surface and subsurface materials to be encountered, and all other matters which can in any way affect the Work or the cost thereof, under this Contract.

B. Any failure of the CONTRACTOR to acquaint himself with all available information concerning these conditions will not relieve him from responsibility of estimating properly the difficulty or cost of doing Work.

C. The CONTRACTOR shall be solely responsible for the location of all underground facilities located within the path of the piping. The plans indicate approximate locations of known facilities, but in no way shall the locations depicted on the plans be considered accurate. They have been shown solely for the purpose of making the CONTRACTOR (and Bidder) aware of their existence. The CONTRACTOR shall also recognize that additional underground facilities may exist which have not been indicated on the drawings. It shall be the CONTRACTOR'S sole responsibility to take all actions necessary to determine the location of all underground facilities, to include visual confirmation if required. The CONTRACTOR shall be solely responsible to repair any facilities damaged as a result of their operations, or that of any of its representatives (i.e. subcontractors). Neither the OWNER or ENGINEER, or any of their representatives, will be responsible for this work, for compensation for any work performed to obtain accurate locations, or for any costs associated with the repair of any damaged facilities.

3.10 SAMPLING TAPS

A. To facilitate the testing and subsequent chlorination and bacteriological sampling, sampling taps shall be installed. These shall be required at all connections to existing

water lines, as indicated on the Contract Drawings or as otherwise directed in the field by the ENGINEER.

B. The sampling tap shall consist of a corporation stop installed in the main, with a pipe running from the corporation to a point two (2) feet above the surface. For ease of operation a curb stop may then be installed with a short piece of pipe following the curb stop. All materials shall be as specified in these Technical Specifications, and as indicated on the Contract Drawings.

C. At the completion of all testing, the sampling taps shall be properly abandoned. To do so, shut off the corporation stop, remove the riser pipe, replace the plastic cap on the corporation stop and backfill.

3.11 TESTING & DISENFECTION

A. Refer to Section 15140, Testing and Disinfection, of these Specifications for testing and disinfection requirements.

END OF SECTION

SECTION 15065

POLYETHYLENE (PE) PRESSURE PIPE AND TUBING
½ IN. THROUGH 3 IN.

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Work specified shall include all supervision, coordination, labor, materials, tools, equipment, services and incidentals necessary and required to furnish and install new polyethylene (PE) pressure pipe and tubing, ½ in. through 3 in., as shown, specified, and required.

B. The information included in this section shall be considered as a general guidance only. In completion of all work included under this section, or in association with this section, the CONTRACTOR shall adhere to the specifications and recommendations of the pipe manufacturer, the Plastic Pipe Institute (PPI), AWWA M55 manual, and ANSI/AWWA C901.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02221, Excavation, Backfill, and Trenching for Utility Systems
B. Section 15062, Ductile Iron Pipe, Fittings, and Accessories
C. Section 15064, High Density Polyethylene (HDPE) Pipe 4 In. Through 63 In.
D. Section 15901, Service Lateral Kit
E. Section 15110, Valves and Appurtenances
F. Section 15140, Testing of Pressure Piping

1.03 QUALITY ASSURANCE

A. Qualifications of the Manufacturer

1. Manufacturer shall have a minimum of five (5) years experience producing PE pipe, tubing, fittings and appurtenances, and shall show evidence of at least five (5) installations in satisfactory operation.
2. Parts Interchangeability: It is the intent of these Specifications that all materials furnished herein shall be compatible with similar materials of other manufacturers.

B. Reference Standards

1. ASTM D1598, Test Method for Time-to-Failure of Plastic Pipe
2. ASTM D1599, Test Method for Short-Time Hydraulic Failure of Plastic Pipe, Tubing, and Fitting
3. ASTM D2239, Specification for PE Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
4. ASTM D2737, Specification for PE Plastic Tubing
5. ASTM D2837, Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials
6. ASTM D3035, Specification for PE Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
7. ASTM D3350, Specification for PE Plastic Pipe and Fittings Materials
8. F412, Standard Terminology Relating to Plastic Piping Systems
9. ISO R161-1960, Pipe of Plastic Materials for the Transport of Fluids, Part 1 Metric Series
10. NSF Standard 14, Plastics Piping Components and Related Materials
11. NSF Standard 61, Drinking Water System Components – Health Effects
12. NSF Standard 372, Drinking Water System Components – Lead Content
13. PPI TR-3, Policies and Procedures for Developing Hydrostatic Design Bases (HDB), Pressure Design Bases (PDB), Strength Design Bases (SDB), and Minimum Required Strengths (MRS) Ratings for Thermoplastic Piping Materials for Pipe

14. PPI TR-4, PPI listing of Hydrostatic Design Bases (HDB), Strength Design Bases (SDB), Pressure Design Bases (PDB) and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials for Pipe

1.04 SUBMITTALS

A. The CONTRACTOR shall submit shop drawings to the ENGINEER for approval prior to placing final orders for materials required for pipeline construction.

B. Shop drawings shall consist of the descriptive literature of the manufacturer with sufficient detail to ascertain that the proposed material meets all requirements of the Contract Documents and is suitable for incorporation into the Work.

C. Shop drawing submittals shall be required for the following and any other materials permanently incorporated into the Work:

1. Pipe;
2. Fittings;
3. Corporation and Curb Valves and Boxes (if applicable);
4. Service Saddles (if applicable);
5. Unions and Couplings;
6. Pipe Stiffeners;
7. Joint restraining devices;
8. Locating Wire;
9. Fusion Equipment;
10. Qualifications of personal who will be performing fusion work.

D. The CONTRACTOR shall provide certification of the manufacturer that the materials proposed to be incorporated into the Work conform to the Specifications herein.

E. Furnish delivery tickets indicating the pipe manufacturer, pipe type and class, and identifying that the pipe was new and from a manufacturer that has been submitted and approved.

F. The Manufacturer shall supply an Installation Manual to the ENGINEER which outlines guidelines for handling, joining, installing, embedding and testing of polyethylene pipeline. These guidelines shall be used as reference material for the ENGINEER in his determination of the required procedures.

G. The company name, address, telephone number of the directional drilling contractor, including the name, title, and email address of the responsible party who will be contracted to perform Work on the Contract. Provide a list of completed work performed by the directional drilling contractor, including names of contact people. Provide municipal projects only.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. During delivery and handling, all materials shall be braced and protected from any distortion or damage; any such distortion or damage shall be basis for rejection of the materials.

B. Equipment used for unloading shall be covered with wood or rubber to avoid damage to the exterior of the pipe, fittings and accessories. Do not drop or roll materials off trucks. All PE pipe and fittings shall be handled with padded slings or other appropriate equipment. The use of cables, hooks or chains will not be permitted.

C. The materials shall be inspected before and after unloading. Materials that are found to be cracked, gouged, chipped, dented or otherwise damaged will not be accepted.

D. Interiors of pipe, fittings and accessories shall be kept free from dirt and debris.

E. Store pipe and fittings on heavy wood blocking or platforms so they are not in contact with the ground. Do not store pipe or fittings in sunlight.

F. Pipe materials shall be unloaded opposite to or as close to the place where they are to be used as is practical to avoid unnecessary handling.

PART 2 - PRODUCTS

2.01 PIPE MATERIALS

A. Pipe shall be PE 4710 Polyethylene (PE) Pressure Pipe meeting ASTM D3350 cell classification 445574C.
B. Polyethylene (PE) Pressure Pipe and Tubing shall conform to AWWA Specification C901.
C. Pipe shall be SDR 11, rated for a minimum of 160 psi working pressure.
D. All PE piping for potable water service shall comply with NSF 61 and 372.
E. All piping shall be based on outside diameter (O.D) control size according to the following sizing standard schedule.

Application	Size	Size Standard	Diameter Ratio	ID Striping
Potable Water Mainline	¾″, 1″, 2″	Copper Tubing Size (CTS) – ASTM D-2737	DR 11 (PC 160)	BLUE
Potable Water Service	2″, 3″	Iron Pipe Size (IPS) – ASTM 3035	DR 11 (PC 160)	Single Extruded BLUE
LP Sanitary Sewer Mainline	2″, 3″	Iron Pipe Size (IPS) – ASTM 3035	DR 11 (PC 160)	Single Extruded GREEN
LP Sanitary Sewer Service	1.25″, 1.5″	Iron Pipe Size (IPS) – ASTM 3035	DR 11 (PC 160)	Single Extruded GREEN
Casing Pipe (Potable Water)	2″, 3″	Iron Pipe Size (IPS) – ASTM 3035	DR 11 (PC 160)	Single Extruded BLUE
Casing Pipe (Sanitary Sewer)	2″, 3″	Iron Pipe Size (IPS) – ASTM 3035	DR 11 (PC 160)	Single Extruded GREEN

The CONTRACTOR shall take particular note of the outside diameter sizing for all PE piping utilized on this project, such that it is compatible with all other materials (fittings in particular) required for a complete installation. Neither the Engineer nor the Owner shall be responsible for materials required to complete the system, which are not compatible with one another, regardless of the type of material recommended by the Contract Documents. The Contractor shall notify the Engineer immediately in writing of any conflicts due to the type of materials recommended by the Contract Documents. (See section 15064 of these Specifications for PE piping 4″ through 63″)

F. All PE piping shall be manufactured with permanent identification of the piping service provided by co-extruded blue stripes into the outside pipe surface for Potable Water Installations and co-extruded green stripes into the outside pipe surface for Sanitary Sewer Installations. Paint is not acceptable.
G. All PE pipe, tubing, and accessories must be new materials in first-class condition. Used or recycled materials will not be allowed, regardless of condition.

2.02 MARKINGS

A. All items shall be marked or labeled with the following information:

1. Material Designation and Cell Classification.
2. Size and schedule.
3. ASTM specification number.
4. Name and location of supplier.
5. Identification Striping according to Section 2.01-D above.
6. NSF 61 and 372 certification markings for potable water service.

2.03 FITTINGS

A. All Electrofusion fittings shall be designed and manufactured in accordance with ASTM F-1055 for use with pipe conforming to ASTM D2513/3035, F-714 and with Butt fittings conforming to ASTM D3261 as applicable.
B. All Electrofusion fittings shall be produced from a pre-blended virgin resin that has a PPI listing of PE4710 which complies with ASTM D3350.
C. Molded PE4710 Butt fittings shall be manufactured and tested to the requirements of ASTM D2513, and ANSI/AWWA C906 for use with pipe conforming to ASTM D2513/3035, F-714 and with Butt fittings conforming to ASTM D3261 as applicable. Molded Butt fittings shall be molded from a pre-blended virgin resin in accordance with the material specifications listed in ASTM D3350 with a PPI designation of PE4710. All Molded Butt fittings shall be manufactured and tested to the requirements of ASTM D3261 and are compatible for heat fusion with any pipe and or fitting manufactured from a like or similar resin.
D. All PE4710 Electrofusion Tapping Tees shall be designed and manufactured in accordance with ASTM F-1055 for use with pipe conforming to ASTM D2513/3035, F-714 and with Butt fittings conforming to ASTM D3261 as applicable. These fittings shall be supplied with an integral identification resistor which can be recognized by a processor to automatically set the proper fusion parameters. PE4710 Electrofusion Tapping Tees shall be produced from a pre-blended virgin resin that has a PPI listing of PE4710 which complies with ASTM D3350.
E. All transition fittings shall be manufactured to ANSI/AWWA C901, ANSI/AWWA C906, and ANSI/AWWA C909, ASTM D1599, and ASTM D1598.
F. All electrofusion fittings for potable water service shall comply with NSF 61 and 372.
G. All electrofusion fittings shall be supplied with a 24 digit ISO compliant barcode label which facilitates the fusion with various manufactures processors.
H. Manufacturer: Performance Pipe, Charter Plastics, or Approved Equal.

2.04 SERVICE CONNECTIONS

A. Service Connections shall consist of service saddle, corporation valve, ¾" Type "K" copper pipe, curb valve, curb valve box, and meter pit setter as specified on the Contract Drawings and in Section 15063 of these Technical Specifications.
B. Service Connections for potable water service shall comply with NSF 61 and 372.

2.05 STIFFENERS

A. A stiffener shall be installed in all PE piping ≤ 2" when using O.D. controlled compression fittings, and when connecting plain end PE pipe to a mechanical joint pipe, fitting or appurtenance.
B. Stiffeners for potable water service shall comply with NSF 61 and 372.

2.06 LOCATING WIRE

A. The CONTRACTOR shall install tracer wire with all HDPE pipe direct bury(open cut) installations, such that the pipe can be accurately located after installation is complete. Tracer wire shall be12 AWG steel core soft drawn high strength tracer wire with a minimum 380# average tensile break load, 30 mil high molecular weight-high density polyethylene jacket complying with ASTM-D-1248, 30 volt rating, as by Copperhead Industries, LLC, or approved equal.
B. The CONTRACTOR shall install **12 AWG steel core hard drawn extra high strength** tracer wire when installing HDPE pipe by method of **horizontal directional drilling (HDD)**, with a minimum 1150# average tensile break load, 45 mil high molecular weight-high density polyethylene jacket complying with ASTM-D-1248, 30 volt rating, as by Copperhead Industries, LLC, or approved equal.

C. The CONTRACTOR shall install corrosion proof wire connectors that are properly sized for the tracing wire at all splice locations in the tracer wire. Wire connectors shall be rated for direct burry applications and shall make use of a non-hardening, silicone based sealant to prevent moisture from entering the splice. Wire connectors shall be Snake Bite or Locking Snake Bite as manufactured by Copperhead Industries, LLC, DBR-6 Direct Burry Splice Kit as manufactured by 3M Division, or approved equal. Making tracer wire connections by twisting wires together and taping the wires together is not an acceptable method of making tracer wire connections.

D. The CONTRACTOR shall install above ground utility markers as shown on the Contract Drawings. The utility markers shall be of a durable construction that is UV stabilized, designed to withstand extreme temperatures (-30°F to 120°F), and designed to rebound from vehicular impacts at high speeds. Above ground utility markers shall be fitted with an identification decal that meets the textual requirements of the Contract Documents. The utility marker shall provide 360° visibility. Above ground utility markers shall be provided with a direct bury end. Utility marker shall also serve as a tracer wire testing station. The utility marker shall be fitted with internal testing terminals and a cap to provide protection. Above ground utility markers shall be fitted with a shunt to provide continuity through the tracer wire terminal and brass terminal posts. Above ground utility markers shall be "TriView Test Station" as manufactured by Rhino Marking and Protection Systems, or an approved equal.

E. The CONTRACTOR shall install at grade tracer boxes as indicated on the Contract Drawings. At grade tracer boxes shall have a cast iron cap and embedded magnet for easy detection by means of a standard metal detector. At grade tracer boxes shall be appropriately designed for roadway or driveway installations where required. At grade tracer boxes shall be fitted with an insulated direct connection to allow locating equipment to be hooked up to the tracer wire without requiring the cap to be removed. The connection point shall be brass. At grade tracer box covers shall have locking capability. At grade tracer boxes shall be "Snake Pit Lite Duty XL Boxes" or "Snake Pit Roadway Boxes" as manufactured by Copperhead Industries, LLC and as indicated on the Contract Drawings, or an approved equal.

F. The color of all tracer wire, connectors, utility markers, and at grade tracer boxes shall be BLUE for Potable Water Installations and GREEN for Sanitary Sewer Installations, meeting APWA standards.

PART 3 - EXECUTION

3.01 GENERAL

A. In general, all polyethylene piping shall be installed in accordance with the recommendations of the pipe manufacturer, ASTM D2774 – Standard Practice for Underground Installation of Thermoplastic Piping, and the Plastic Pipe Institute (PPI) Handbook of Polyethylene Pipe.

B. The CONTRACTOR shall note that the exact location of all proposed services shall be determined in the field at the time of installation. The CONTRACTOR, along with the ENGINEER (or representative thereof), shall make this determination after conferring with the property owner for which the service is being provided. Service locations shown on the plans have been done so for the purpose of comparing bids, and in no way be considered absolute.

C. All services shall be installed by method of pushing, boring, or directional drilling. Open cutting of roadways will not be permitted unless otherwise authorized by the ENGINEER. In the event that the drilling/boring head becomes lodged underneath the pavement section, the CONTRACTOR will not be allowed to open cut the pavement section to release or retrieve the equipment without written permission from the agency having jurisdiction over the roadway. If the CONTRACTOR is unable to receive said permission, the equipment shall be abandoned in place, at the CONTRACTORS expense.

D. The CONTRACTOR shall install 12 AWG copper locating wire (tracer wire) with all HDPE pipe installations, such that the pipe can be accurately located after installation is complete. For installation of PE services, the tracer wire shall be **attached** directly onto the pipe at intervals of no more than 10 feet, as well as to the casing pipe when applicable. The tracer wire

shall be extended the entire length of the service line (and casing pipe when applicable), from the tapping fitting, to the grinder pump and brought to the ground surface, where it can be easily accessed for locating. Above ground utility markers or at grade tracer boxes, as specified in Section 2.06 of this specification, shall be installed at locations indicated on the Contract Drawings as per the manufacturer's recommendations. When the service line is being installed within a PE casing pipe, the tracer wire for the casing pipe shall be extended to the ground surface as well, but shall not be spliced with the tracer wire for the service line. Tracer wire for service piping shall be spliced with the tracer wire running along the mainline piping. The tracer wire shall be appropriately spliced using connectors per Section 2.06C above. Any bare/exposed wire shall be replaced or properly protected against the possibility of incidental grounding following the installation, to the satisfaction of the ENGINEER. Prior to receiving any payment for a service installation, the CONTRACTOR must prove that the tracer wire is working correctly by means of locating sections of the completed installation using locating equipment, equipped with the ability to provide a depth reading. The CONTRACTOR shall take note that it is the explicit intent of the OWNER, the ENGINEER, and the Contract Documents, that tracer wire be installed, such that the piping can be located in the future. The CONTRACTOR shall be responsible to perform all work necessary and required, not necessarily explicitly expressed in the Contract Documents, in order to accomplish the functional and design intent of the tracer wire installation. Should the tracer wire break during the installation processes of any service, it shall be the CONTRACTORS responsibility and expense, to correct the situation, such that the installation is completed as stated above.

E. The pipe should be installed to provide a minimum depth of cover of 4.5 feet over the top of the pipe, unless otherwise indicated on the Contract Drawings, or otherwise directed by the ENGINEER.

F. Proper implements, tools and facilities, satisfactory to the ENGINEER, shall be provided and used by the CONTRACTOR for the safe and convenient prosecution of the Work, including hoists, ropes, or other means to lower the material into the trench. Under no circumstances shall pipe, valves, specials, etc., be dropped or dumped into the trench.

G. The pipe shall be handled carefully. Any pipe with any gouges larger than 10% of the pipe wall removed from the trench and taken off site.

3.02 JOINING AND CONNECTIONS

A. HDPE outside diameter (OD) controlled piping products shall be connected using heat butt fusion, electrofusion, and mechanical methods such as MJ Adapters, flanges, and compression couplings. Joining and connection methods will vary depending upon requirements for internal or external pressure, leak tightness, restraint against longitudinal movement (thrust load capacity), gasket requirements, construction and installation requirements, and the product.

3.03 SERVICE CONNECTIONS

A. **Service connections shall be made after the mainline pipe has been installed, but prior to the mainline pipe being tested.** All service piping shall be tested in accordance with Section 15140 of these Specifications.

B. Services shall be constructed using a single piece of pipe. Compression or mechanical couplings will not be permitted to connect sections of pipe to be used for any service installation unless prior approval is givenby the ENGINEER.

C. The CONTRACTOR shall be solely responsible to make sure that all service taps are made using fittings which will accommodate the size and dimension of the mainline pipe, and the service piping. Neither the Engineer nor the Owner shall be responsible for materials required to complete the system, which are not compatible with one another, regardless of the type of material recommended by the Contract Documents. The CONTRACTOR shall be solely responsible to take note of the material and size specifications for each type of installation

required, and to verify that the individual components of the proposed system will properly work with each other, and in conformance with the Contract Documents, and the design intent. The Contractor shall notify the Engineer immediately in writing of any conflicts due to the type and size of materials recommended by the Contract Documents.

D. Service taps shall be made at 10 o'clock or 2 o'clock on the circumference of the pipe. Construction shall be as detailed on the Contract Drawings. Stagger taps along the length of the pipe no closer than 24 inches apart.

E. When service piping must be installed down or up slopes, or under ditches, the CONTRACTOR shall be solely responsible to make sure that a minimum of 4.5' of cover is maintained over the pipe. If the OWNER or ENGINEER should determine that any portion of the piping has less than 4.5' of cover, and the CONTRACTOR has not been provide written approval by the ENGINEER to do so, the CONTRACTOR shall be required to replace as much piping as is required, such that the 4.5' of minimum cover is achieved, at the CONTRACTOR'S expense. The CONTRACTOR shall also be required to maintain a maximum depth of cover of 8', unless otherwise authorized by the ENGINEER, as it would become extremely difficult and expensive to make repairs on piping beyond that depth. In the event that the piping has been installed to a depth of greater than 8', the ENGINEER shall advise the CONTRACTOR of what action will be required, if any. Any work required, will be at the CONTRACTOR'S expense.

F. The CONTRACTOR shall not backfill any open sections of new services installed until the ENGINEER has inspected the open sections of the installation, and provided the CONTRACTOR verbal authorization to proceed with backfilling. This procedure shall not negate the CONTRACTOR'S responsibility for safety of any open excavations or holes, and the CONTRACTOR shall be solely responsible to take all precautions and actions necessary and required to properly block-off the opening. It shall be the CONTRACTOR'S responsibility to notify the ENGINEER that the service is ready for inspection. If the CONTRACTOR backfills the installation prior to inspection by the ENGINEER, the CONTRACTOR shall be required to re-excavate the backfilled area(s) at the CONTRACTOR'S expense, so that the inspection by the ENGINEER can be performed. The CONTRACTOR will not receive payment for any service installations which were backfilled prior to inspection by the ENGINEER.

G. Curb boxes shall be installed such that they can be adjusted several inches above or below finished grade, such that the OWNER has the flexibility to adjust the curb box in the future. Unless otherwise directed by the ENGINEER, all curb boxes shall be adjusted such that they are flush with the proposed finished grade directly adjacent to the curb box. The CONTRACTOR shall install a flag or wooden lath next to each valve box so that its location is known at all times during the course of construction. The cost of this work shall be included in the bid.

H. The CONTRACTOR shall be responsible to tie-down (as-built measurements) all components of the service installation, to include the mainline tap, any connection points and provide the information to the ENGINEER for use in assembling record drawings. Whenever possible, measurements shall be made from the front corners of structures, or utility poles. The CONTRACTOR may use alternate forms of recording said components, such as GPS equipment, upon approval by the ENGINEER. The cost of this work shall be included in the unit price bid per each service.

3.04 EXISTING UTILITIES

A. The CONTRACTOR shall satisfy himself as to the locations of all existing structures and underground utilities as well as the value and location of the Work, the general conditions, particularly those bearing upon transportation, disposal, handling and storage of materials, availability of labor, water, electric power, and roads, physical conditions at the site, the confirmation and condition of the ground, the character, quality and quantity of surface and subsurface materials to be encountered, and all other matters which can in any way affect the Work or the cost thereof, under this Contract.

B. Any failure of the CONTRACTOR to acquaint himself with all available information concerning these conditions will not relieve him from responsibility of estimating properly the difficulty or cost of doing Work.

C. The CONTRACTOR shall be solely responsible for the location of all underground facilities located within the path of the piping. The plans indicate approximate locations of known facilities, but in no way shall the locations depicted on the plans be considered accurate. They have been shown solely for the purpose of making the CONTRACTOR (and Bidder) aware of their existence. The CONTRACTOR shall also recognize that additional underground facilities may exist which have not been indicated on the drawings. It shall be the CONTRACTOR'S sole responsibility to take all actions necessary to determine the location of all underground facilities, to include visual confirmation if required. The CONTRACTOR shall be solely responsible to repair any facilities damaged as a result of their operations, or that of any of its representatives (i.e. subcontractors). Neither the OWNER or ENGINEER, or any of their representatives, will be responsible for this work, for compensation for any work performed to obtain accurate locations, or for any costs associated with the repair of any damaged facilities.

3.05 TESTING

A. Refer to Section 15140 of these Specifications for testing (pressure and leakage) requirements.

END OF SECTION

SECTION 15110

VALVES, HYDRANTS AND APPURTENANCES

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Work specified shall include all coordination, supervision, labor, material, equipment, services, and incidentals necessary to furnish and install valves and appurtenances as indicated on the Contract Drawings, specified and required herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02221, Excavation, Backfill, and Trenching for Utility Systems
B. Section 15063, PVC Pipe, Fittings, and Accessories
C. Section 15064, High Density Polyethylene (HDPE) Pipe 4 In. Through 63 In.
D. Section 15065, PE Pressure Pipe and Tubing, 1/2 In. Through 3 In., For Potable Water Systems
E. Section 15140, Testing and Disinfection

1.03 QUALITY ASSURANCE

A. Qualifications of the Manufacturer

1. The manufacturer shall have a minimum of five (5) years of experience producing valves and appurtenances, and shall show evidence of at least five (5) installations (similar to the Work required for this Project) in satisfactory operation.
2. Parts Interchangeability: It is the intent of these specifications that all materials furnished herein shall be compatible with similar materials of other manufacture.

B. Reference Standards

1. American Nation Standards Institute (ANSI)
   a. ANSI B16.1, Cast Iron Pipe Flanges and Flanged Fittings
   b. ANSI B16.4, Cast Iron Fittings
2. American Society for Testing and Materials (ASTM)
   a. ASTM A48, Standard Specification for Gray Iron Castings
   b. ASTM A126, Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings
   c. ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
   d. ASTM A354, Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs and Other Externally Threaded Fasteners
   e. ASTM A436, Standard Specification for Austenitic Gray Iron Castings
   f. ASTM A536, Standard Specification for Ductile Iron Castings
   g. ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings
3. American Water Works Association (AWWA)
   a. AWWA C515, Standard for Metal-Seated Gate Valves for Water Supply Service
   b. AWWA C504, Standard for Rubber-Seated Butterfly Valves
   c. AWWA C508, Standard for Swing Check Valves for Waterworks Service, 2 in.(50 mm) Through 24 in. (600 mm) NPS
   d. AWWA C509, Standard for Resilient Seated Gate Valves for Water Supply Service

e. AWWA C800, Underground Service Line Valves and Fittings

4. American Gear Manufacturers Association (AGMA) Standards
5. National Electrical Manufacturer's Association (NEMA)
6. National Electrical Code (NEC)
7. NSF International (NSF) Standard 61
8. NSF International (NSF) Standard 372.
9. Underwriter's Laboratories (UL)
10. International Organization for Standardization (ISO)
11. Factory Mutual Research Corporation
12. 1996 Safe Drinking Water Act
13. Manufacturing Standardization Society of the Value and Fittings Industry (MSS)

1.04 SUBMITTALS

A. Shop Drawings:

1. Manufacturer's literature, illustrations, specifications, detailed drawings, data and descriptive literature on all valves and appurtenances.
2. Deviations from Drawings and Specifications.
3. Engineering data including dimensions, materials, size and weight.
4. Fabrication, assembly, installation and wiring diagrams.
5. An installation drawing indicating the piping and valve layout with the correct dimensions, manufacturer, and model numbers easily readable on the drawing.

B. Operation and Maintenance Data: Submit complete manuals including:

1. Copies of all Shop Drawings, test reports, maintenance data and schedules, description of operation, and spare parts information.

C. Shop Tests: Submit for approval the following:

1. Hydrostatic tests for each valve when required by the valve specifications included herein.

D. Certificates:

1. Where specified or otherwise required by ENGINEER, submit test certificates.
2. The CONTRACTOR shall submit certificates of compliance with the applicable referenced standards.

E. Delivery Tickets:

1. Furnish delivery tickets indicating the valve manufacturer, valve type and class, identifying that the valve or appurtenance was new and from a manufacturer that has been submitted and approved.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. During delivery and handling, all materials shall be braced and protected from any distortion or damage; any such distortion or damage shall be basis for rejection of the materials.

B. Equipment used for unloading shall be covered with wood or rubber to avoid damage to the exterior of the pipe, fittings and accessories. Do not drop or roll materials off trucks. All valves and appurtenances shall be handled with padded slings or other appropriate equipment. The use of cables, hooks, or chains will not be permitted.

C. The materials shall be inspected before and after unloading. Materials that are found to be cracked, gouged, chipped, dented or otherwise damaged will not be accepted.

D. Interiors of valves and appurtenances shall be kept free from dirt and foreign matter.
E. Store valves and appurtenances on heavy wood blocking or platforms so they are not in contact with the ground.
F. Valves and appurtenances shall be unloaded opposite to or as close to the place where they are to be used as is practical to avoid unnecessary handling.

1.06 WARRANTY

A. In addition to the standard warranty of the manufacturer, the CONTRACTOR shall include the services of a factory trained serviceman to provide repair service for valves for the period of one (1) year commencing with the time the equipment is placed in continuous permanent operation. This service shall include the cost of all replacement parts required during the interval. The CONTRACTOR shall submit a letter stating this guarantee along with the shop drawing submittals.

PART 2 - PRODUCTS

2.01 VALVES

A. GENERAL

1. All materials must be suitable for use in a potable water system.
2. Valves shall have name of the manufacturer and working pressure cast in raised letters on valve body.
3. Manual valve operators shall turn clockwise to close unless otherwise specified. Direction to open valve counter-clockwise (left). Valves shall indicate the direction of operation.
4. Unless otherwise specified, all valves shall have mechanical joint ends conforming to AWWA C111.
5. All bolts, nuts and studs shall, unless otherwise approved, shall conform to ASTM A307, Grade B; or ASTM A354. All bolts, nuts and studs on or required to connect submerged or buried valves shall be Type 304 stainless steel or fluorocarbon coated.
6. Bolts and nuts shall have hexagon heads and nuts.
7. Gasket material and installation shall conform to the recommendations of the manufacturer.
8. Identification: Identify each valve 4-inches and larger with a brass or stainless steel nameplate stamped with the approved designation. Nameplate shall be permanently fastened to valve body at the factory. Stenciled designations are acceptable for buried valves.
9. All valves and appurtenances must be new materials in first-class condition. Used or recycled materials will not be allowed, regardless of condition.
10. All valves, operators, and appurtenances shall be designed to withstand the working and hydrostatic test pressures as specified herein and indicated on the Contract Drawings.

B. GATE VALVES (BURIED)

1. Gate valves shall conform to AWWA Specification C509, and the following supplemental details. Gate valves conforming to AWWA Specification C515 shall be considered an acceptable alternate to gate valves conforming to AWWA C509.

a. Resilient Wedge, with non-rising stem, having parallel seats and ductile or cast iron body;
b. The body, bonnet, and o-ring plate shall be fusion-bond epoxy coated, both interior and exterior on body and bonnet. Epoxy coating shall be NSF 61 approved and applied in accordance with AWWA C550.

c. The wedge shall be totally encapsulated with rubber, with the sealing rubber permanently bonded to the sedge per ASTM D429;
d. Standard Mechanical Joint ends complying with ANSI/AWWA C111;
e. Two inch (2") operating nut (open (left) counter-clockwise);
f. Mainline and hydrant auxiliary valves shall have resilient seat.
g. Manufacturer:

1) Mueller A 2360-20.
2) Kennedy Valve Style 8571 or 7571.
3) Or Approved Equal.

C. VALVE BOXES

1. Valve Boxes shall be of three (3) piece, Buffalo style cast iron construction, screw type with threads integrally cast with the box.

a. Coating: Two (2) coats of asphaltic coating.
b. Extensions: If needed for abnormally deep valve installations, shall be provided by the CONTRACTOR at no additional expense to the OWNER.
c. Lid: The word WATER shall be cast in the lid.
d. Manufacturer:

1) Sigma.
2) East Jordon Iron Works, Inc.,
3) Or Approved Equal.

D. TAPPING SLEEVES

1. Tapping sleeves, if required, shall be Mechanical Joint tapping sleeve, having duck tipped end gaskets, certified to NSF/ANSI 61 and NSF/ANSI 372.
2. Tapping sleeves shall have a maximum working pressure of 250 psig for 4”-12” sizes, and 200 psig for 14”-24” sizes.
3. Outlet flange shall comply with ANSI B16.1, Class 125, and with MSS SP-60.
4. The CONTRACTOR shall verify the type, and OD of the pipe to be tapped, and be certain that the gasket is the correct size, and type.
5. Tapping sleeves shall be as manufactured by Mueller, model H-615, U.S. Pipe, or approved equal.

E. BUTTERFLY VALVES (3”-48”)

1. Butterfly valves shall be manufactured in accordance with the latest revision of AWWA C504 and C516 for Classes 150B and 250B, and shall conform to NSF Standard 61 and NSF Standard 372.
2. Class 150B and 250B valve bodies shall be constructed of ASTM A536 Grade 65-45-12 ductile iron.
3. Flanged end connections shall be flat faces, and shall be in conformance with ANSI B16.1 for Class 125, Class 250 iron flanges, or AWWA C207 Class D. Wafer end connections shall be designed for installation between ANSI B16.1 Class 125 iron flanges or between ISO 7005-2 PN10 or PN16 flanges.
4. When required, mechanical joint end connections shall be in conformance with ANSI/AWWA C111/A21.11.
5. Resilient seats shall be made of Buna-N rubber compound that seals a full 360 degrees against a Type 316 stainless steel spherical disc edge. Seats shall be mechanically retained with a stainless steel retaining ring and screws which shall pass through both the resilient seat and the retaining ring.
6. Valve discs shall be solid without external ribs or vanes, and shall be ASTM A536 Grade 65-45-12 ductile iron. Valve bearings shall be of a self-lubricating

nonmetallic material to effectively isolate the disc-shaft assembly from the valve body. Metal-to-metal thrust bearings in the flow stream are not allowed.

7. Valve shafts shall be of ASTM A276 Type 304 or ASTM A564 Type 630 Stainless Steel.
8. Valve exteriors for above ground service shall be coated with a universal, alkyd primer. Valve exterior for buried service shall be coated with an epoxy coating. Valve interiors shall be coated with an NSF/ANSI 61 epoxy coating approved for potable water.
9. Hydrostatic and seat leakage tests shall be conducted in strict accordance with AWWA Standard C504.
10. Valves shall be equipped with manual actuactor. Manual actuators shall be of the traveling nut, self-locking type, and shall be designed to hold the valve in any intermediate position between fully open, and fully closed, without creeping or fluttering. Actuators shall conform to AWWA C504. For all above ground installations, valves shall be provided with hand-wheel and position indicator.
11. Butterfly valves shall be ValMatic 2400 series, Mueller Lineseal III, or approved equal.

F. SWING CHECK VALVE

1. Swing Check Valves shall be of the flanged type in full compliance with AWWA C-508-93.
2. Swing Check Valves shall have a pressure rating of 250 psig for valves 30" and smaller, and 150 psig for valves 30" and larger.
3. Valve bodies shall be of ASTM A-536 Grade 65-45-12 ductile iron or ASTM A-126 Class B cast iron for valves 30" and larger. Flanges shall be in full compliance with ANSI B16.1 Class 125.
4. Disc shall be precision molded Buna-N (NBR), ASTM D2000-BG with Type 302 Stainless Steel disc accelerator. Disc shall be of one-piece construction with an integral o-ring type sealing surface. The flex portion of the disc shall be warranted for twenty-five years.
6. Testing shall be performed in accordance with AWWA C-508.
7. Swing check valve shall be able to be mounted vertically or horizontally.
8. Swing check valve shall be as manufactured by Val-Matic Valve and Manufacturing Corp., or approved equal.

G. PRESSURE REDUCING VALVES

1. The valve shall be size full port "_____", ANSI Class 150 pressure rating flange standard, globe style valve. The Pressure Reducing Pilot (Normally Open Pilot) spring range shall be "___ to ___" psi / "___ to ___" bar, with set-point preset at Singer Valve to "___" psi / "___" bar. Assembly shall be according to Schematic A-0306C.
2. The valve shall maintain relatively accurate control of the downstream pressure regardless of fluctuation in flow or upstream pressure.
3. Valve(s) shall be a hydraulically operated globe valve. The inner valve assembly shall be top and bottom guided by means bearing bushings. The inner valve assembly shall be the only moving part and shall be securely mounted on a AISI 316 Stainless Steel stem. Lower grades of stainless steel stems will not be acceptable.
4. The stainless steel stem shall be provided with wrench flats on all valves 1 in / 25 mm to 16 in / 400 mm, for ease of assembly and maintenance. Wrench flats will be fully accessible when inner valve is assembled.
5. All pressure containing components shall be constructed of ASTM A536-65 / 45 / 12 ductile iron. The flanges shall be designed to ANSI Class 150 or Class 300 standards. Flange drilling to ANSI shall be standard; however, ISO and other drillings shall be available upon request.

6. Valve(s) shall have a protective fusion bonded epoxy coating internally and externally. The protective fusion bonded epoxy coating shall conform to the ANSI / AWWA C116 / A21.16 (current version) specification. No machining of any external parts after final coating will be acceptable to ensure a continuous coating surface throughout the entire valve.
7. The valve cover shall have a separate stem cap on valves larger than 2 in / 50 mm giving access to the stem for alignment check, spring installation and ease of assembly.
8. On valve(s) 1 in / 25 mm and larger, bonnets shall be accurately located to bodies utilizing locating pins. Locating pins shall eliminate corrosion resulting from the use of uncoated ductile iron to ductile iron surfaces. Valves with lipped spigot covers shall not be acceptable due to risk of rust and difficulty in assembly.
9. Valve(s) 3 in / 80 mm to 8 in / 200 mm shall have the AISI 316 Stainless Steel seat with integral bottom guide, bolted in place, utilizing SpiralockTM thread tapping technology. The AISI 316 Stainless Steel seat ring shall be easily replaceable without special tools. Valves 10 in / 250 mm and larger shall incorporate a two-piece seat and bottom guide design.
10. The valve(s) shall form a drip-tight seal between the stationary stainless steel seat ring and the resilient disc, which has a rectangular cross-section and is retained by clamping on three and one half sides. The resilient disc shall be constructed of Buna-N or EPDM for normal service conditions.
11. All external fasteners shall be AISI 18-8 Stainless Steel with AISI 18-8 Stainless Steel washers. Mild steel studs or bolts will not be acceptable.
12. All repairs and maintenance shall be possible without removing the valve from the line. To facilitate easy removal and replacement of the inner valve assembly and to reduce unnecessary wear on the guide, the stem shall be vertical when the valve is mounted in a horizontal line.
13. Each valve shall be air tested prior to shipment. The standard test shall include leakage test, seat leakage test, and stroke test. Refer to IOM 622B for further details (contact Singer Valve). Where the set-point is provided, Singer Valve will preset the pilot. Further testing is available upon request at published rates within the capabilities of Singer Valve's manufacturing facilities.
14. The valve(s) shall be covered by a minimum three year (3) warranty against defects in materials and workmanship. The stainless steel seat shall be covered by a lifetime replacement warranty.
15. Valve(s) 4 in / 100 mm and smaller shall provide smooth frictionless motion with actuation being achieved by the use of a flat style EPDM / Buna-N diaphragm. They shall be constructed of nylon fabric bonded with synthetic rubber. The diaphragms shall not be used as a seating surface.
16. Valve(s) 6 in / 150 mm and larger shall provide smooth frictionless motion and maximum low flow stability with actuation being achieved by the use of the Singer Rolling Diaphragm technology. The diaphragms shall not be used as a seating surface.
17. Acceptable Manufacturers: Singer Valve, Cla-Val, or approved equal.

H. GATE VALVES (VALVE VAULT)

1. Gate valves shall conform to AWWA Specification C509, and the following supplemental details. Gate valves conforming to AWWA Specification C515 shall be considered an acceptable alternate to gate valves conforming to AWWA C509.
2. Resilient Wedge, with non-rising stem, having parallel seats and ductile or cast iron body;
3. The body, bonnet, and o-ring plate shall be fusion-bond epoxy coated, both interior and exterior on body and bonnet. Epoxy coating shall be NDF 61 approved and applied in accordance with AWWA C550.
4. The wedge shall be totally encapsulated with rubber, with the sealing rubber permanently bonded to the sedge per ASTM D429;

5. Standard Flange Joint ends complying with ANSI/AWWA C111;
6. Hand Wheel (open (left) counter-clockwise); Minimum 12 inch Diameter.
7. Mainline and hydrant auxiliary valves shall have resilient seat.
8. Manufacturer:

    a. Mueller A 2360-06.
    b. Kennedy Valve Style 8561 or 7571.
    c. Or Approved Equal.

I. FASTENERS

1. All fasteners (nuts, bolts, threaded rod, etc.) used on all fittings, valves, restraints, hydrants, and etc. shall have a corrosion resistant fluorocarbon coating, or be stainless steel.

2.02 HYDRANTS

A. Hydrants furnished for the Work shall conform to AWWA C502, latest revision, and the following:

1. Compression type with valve opening equal to 5¼ inches.
2. Cast iron body, fully bronze mounted.
3. Two (2) 2½ inch hose connections with national standard threading (NST thread).
4. One (1) 4½ inch pumper connection with NST thread.
5. The operating stem nut shall be a five-sided (pentagon) 1½" nut to open left (counterclockwise) of one piece bronze construction.
6. The boot (base) shall be mechanical joint with a 6" inlet diameter.
7. Hydrant shall be factory painted red.
8. Traffic model with breakaway flange.
9. Nozzle caps shall be securely fastened to the barrel with chain.
10. A dirt (weather) shield shall be provided to protect the operating mechanism from grit buildup and corrosion due to moisture.
11. Hydrant shall be draining.
12. Manufacturer:

    a. Kennedy Guardian K81A.
    b. American Darling B-84-B-5.
    c. Or Approved Equal.

B. All hydrants shall be furnished with an orange fiberglass hydrant marker, with permanently attached flag, heavy coil spring at the base, and L mounting bracket with 5/8" drilled hole for bolt mounting.

2.03 2" BLOW-OFF HYDRANT

A. Post hydrants shall be non-freezing, self draining type with a minimum 5' bury depth.
B. Hydrant shall be furnished with a 2" horizontal inlet, a non-turning rod, and shall open to the left (counter-clockwise).
C. All of the working parts shall be of bronze-to-bronze design, and shall be serviceable from above grade with no digging.
D. The outlet shall be a 2-1/2" NST nozzle, of bronze.
E. Hydrant shall be lockable to prevent unauthorized use.
F. Hydrant assembly come with operating wrench and valve repair kit.
G. Hydrant shall be manufactured by Kupferle Foundry, or approved equal.

2.04 FITTINGS

A. All pipe main fittings shall be fabricated of ductile iron and shall be of mechanical joint design complying with AWWA C153 and shall be Class 350.

B. The fittings shall be cement mortar lined and seal coated inside and out with an approved bituminous coating 1 mil thick in accordance with AWWA C104; coating shall be NSF 61 compliant.

C. All fasteners used on fittings shall be fluorocarbon coated, such as StandCote SC-1 Fasteners as manufactured by Standco Industries, Inc., or approved equal.

2.05 JOINT RESTRAINT

A. Mechanical Joint Restraints:

1. Restraint devices for nominal pipe sizes 3 inch through 48 inch shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10, ANSI/AWWA C151/A21.51, ANSI/AWWA C150/A21.50, ANSI/AWWA C153/A21.53, and ANSI/AWWA C111/A21.11.
2. The devices shall have a working pressure rating of 350 psi for 3-16 inch and 250 psi for 18-48 inch. Ratings are for water pressure and must include a minimum safety factor of 2 to 1 in all sizes.
3. Gland body, wedges and sedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536.
4. Mechanical joint restraints shall be installed in accordance with AWWA C600.
5. Mechanical Joint Restraints shall be Megalug Series 1100 by EBAA Iron Sales, Inc., or approved equal for use with ductile iron pipe.

B. Restraint Gaskets:

1. In addition to mechanical joint restraints or thrust blocking, joint restraint can be accomplished through the use of locking segments and gaskets placed within the bell of the pipe, such as "Field Lok" gaskets. If the Contractor desires to utilize this method of joint restraint, the Contractor shall submit a shop drawing for the particular type of gasket proposed for review and approval by the Engineer.

C. Thrust Blocking:

1. Thrust blocks and/or anchor blocks are required on all unrestrained pressure pipelines at locations where thrust forces caused by internal pressures act upon the sides or ends of pipelines. Thrust blocks shall be installed on unrestrained pressure pipelines at all tees, wyes, reducers, horizontal bends, ascending vertical bends, and dead-ends, and shall bear directly against fittings and firm, undisturbed soil. Thrust blocks shall be located so that bearing areas on both fittings and soil are centered along the direction of thrust. For tees and wyes, the direction of thrust is along a line directly opposite the side outlet. For bends, the direction of thrust is along a line bisecting the outside angle formed by the adjacent pipe segments. For reducers, the direction of thrust is along the pipeline from the large end to the small end of the reducer. For dead-ends, including in-line valves, the direction of thrust is along the pipeline. Since the act of closing an inline valve creates a dead-end, valves not connected to other fittings also require thrust blocks.
2. Concrete used for construction of thrust blocks shall have a minimum 28-day compressive strength equal to 3000 psi, and shall be ready-mix concrete (**the use of "sakrete" bags shall not be permitted**). Prior to placing concrete, the fitting shall be completely wrapped with a 6- mil polyethylene membrane to prevent concrete bond to pipe or fittings.

2.06 PAINTING

A. Shop Painting
   1. Clean and prime coat ferrous metal surfaces.
   2. All interior wetted ferrous surfaces of valves and appurtenances except finished or bearing surfaces shall be shop-painted with an approved epoxy paint system listed in NSF-61 for potable water and applied in accordance with the recommendations of the paint system manufacturer.
   3. Coat machined, polished and non-ferrous surfaces including gears, bearing surfaces and similar unpainted surfaces with corrosion prevention compound listed in NSF-61 and applied in accordance with the manufacturer's recommendations. Maintain coating during storage and until equipment begins operation.

PART 3 - EXECUTION

3.01 GENERAL

A. The CONTRACTOR shall construct all waterlines and appurtenances as indicated on the Contract Drawings and specified herein in a neat and workmanlike manner, in accordance with these Specifications, the recommendations of the manufacturer, and as generally accepted by the industry.
B. All materials incorporated into the Work shall be transported, handled, stored, and installed in the Work in such a manner as to insure against breakage, cracking or other damage. No such defective material shall be incorporated into the Work.
C. Prior to installing pipe, every precaution shall be taken to ensure that no foreign material enters the pipe.
D. Trenching, excavation, and backfill shall comply with Section 02221 of these Specifications. Valves, hydrants, and associated appurtenances shall be installed to follow line and grade shown on the Contract Drawings, providing a minimum depth of cover of 4.5 – feet, unless otherwise indicated on the Contract Drawings.

3.02 VALVES

A. Install valves and appurtenances as recommended by the manufacturer, as specified by the Contract Documents, and as otherwise directed by the ENGINEER.
B. Valves shall be set on a concrete brick (base) for support, and shall be set in true alignment with the pipes they serve and the stems set plumb.
C. Valves shall be properly restrained as recommended by the manufacturer, the Contract Documents, and as directed by the ENGINEER. A mechanical joint restraining schedule has been detailed on the Contract Drawings, specific for the installation conditions set forth for this project.
D. Valve boxes shall be firmly supported on all sides, backfilled and blocked in an approved manner (as determined by the ENGINEER), centered and plumbed over the valve nut of the gate valve with the box cover flush with the finished grade. The valve box shall be set such that it can be adjusted several inches above or below proposed finished grade. Proposed finished grade shall be existing grade directly adjacent to the valve box, or as detailed on the Contract Drawings, or as directed by the ENGINEER. Prior to receiving payment for any valve installed, the CONTRACTOR shall be required to demonstrate to the ENGINEER that a valve key can be inserted into the valve box, onto the valve nut, in the plumb position. Any valve box which is not plumb shall be re-set to the plumb position, and re-checked as previously stated. The ENGINEER shall reserve the right to check any valve box at any point throughout the length of the CONTRACT for adjustability and plumbness, and the CONTRACTOR shall be required to make all adjustments directed by the ENGINEER, regardless of how many times a particular valve box has been adjusted, or if the CONTRACTOR has received payment for the valve and valve box. Most valve

boxes are disturbed, and knocked out of plumb during restoration, and as such, all valve boxes will be checked after both the initial installation, and after all restoration has been completed. All necessary and required adjustments to valve boxes shall be made at the CONTRCATOR'S expense, even if the same valve box must be adjusted several times.

E. Valve box covers shall be painted blue, and a blue flag or wooden lath shall be placed next to the valve box to mark its location. These markings shall be maintained throughout the duration of the Contract by the CONTRACTOR. The cost for this work shall be included in the unit price bid per each valve and box.

F. The CONTRACTOR shall be required to place No.1A Stone fill all around, under, and to a point at least 12" above all installed valves. The cost for this work shall be included in the unit price bid per valve.

G. The CONTRACTOR shall take note that when valves are being installed in conjunction with PVC, PVCO, or HDPE piping, in which tracer wire is required to be installed with said piping, the tracer wire shall be brought up through all valve boxes, or around the outside of the valve box, to the ground surface, to allow for easy accessibility of the tracer wire; unless otherwise directed by the ENGINEER.

H. Hydrostatic testing of the waterline shall be performed against every valve installed, to verify its ability to hold the pressure without leaking. Any valves which cannot hold the required testing pressure, shall be repaired or replaced at the CONTRACTOR'S expense.

I. The CONTRACTOR shall be required to tie-down all installed valves, to permanent facilities such as utility poles or structures, and provide the information to the ENGINEER for use in preparation of record drawings.

3.03 HYDRANTS

A. Hydrants shall be installed plumb with nozzles 18" to 24" above finished grade.

B. Hydrant assemblies shall be set on concrete blocks for support, and shall be restrained as approved by the ENGINEER. If using mechanical joint restraints, restraints shall be installed as recommended by these Contract Documents, as recommended by the manufacturer of the restraints, and as directed by the ENGINEER. Thrust blocking shall also be an acceptable means of restraining the hydrant assembly, provided that the thrust blocking is constructed of either a minimum 3000 psi ready mix concrete, or solid concrete blocking, placed against firm, undisturbed, soil. When using ready mix concrete, the hydrant assembly shall be wrapped with 6 mil polyethylene membrane to prevent adhesion to the concrete.

C. The CONTRACTOR shall be solely responsible to thoroughly review the plan profiles, and field conditions, prior to ordering any hydrant assembly, to determine if riser sections will be required to allow for proper setting of the hydrant assembly above finished grade. The building-up, or digging down, of soils directly adjacent to the hydrant assembly will not be an acceptable means of making the hydrant assembly meet the required 18" – 24" nozzle above finished grade requirement. The CONTRACTOR will be required to perform all work necessary and required to properly adjust the hydrant assembly should it not meet the requirements of these Contract Documents. The cost for any such work will be the sole responsibility of the CONTRACTOR.

D. The CONTRACTOR shall verify the location of all hydrant assemblies with the ENGINEER at the time of construction, as the Contract Documents may require some of the hydrant assemblies to be located some distance from the mainline piping, due to slopes and ditches.

E. When the Contract Documents require that the hydrant assembly be installed either down or up a slope, away from the mainline piping, the CONTRACTOR shall make sure that a minimum depth of cover of 4.5' is maintained over the piping.

F. A single hydrant assembly includes all piping and fittings located within 6' of the mainline piping, to include all required hydrant extensions (riser sections). In the event that the Contract Documents, or at the direction of the ENGINEER, the hydrant assembly shall be installed a distance greater than 6', the CONTRACTOR shall receive separate payment for the 6" piping required to extend the assembly to the required location.

G. No. 1 stone bedding and backfill shall be placed the entire length of the hydrant assembly, to a point of at least 12" over all piping, valves, and fittings, as shown on the plans, and as directed by the ENGINEER.

H. The CONTRACTOR shall be solely responsible to provide all necessary and required fittings and restraints required to install a hydrant assembly off-of the type of mainline piping proposed

3.04 2" BLOW-OFF HYDRANT

A. Blow-off hydrants shall be installed where shown on the Contract Drawings, or as directed by the ENGINEER.

B. Blow-off hydrants shall be installed in accordance with the Contract Documents, the manufacturers recommendation, and as directed by the ENGINEER.

C. The valve and outlet ports of the blow-off hydrant shall be equipped with a keyed locking mechanism, to prevent access by unauthorized personal.

D. The CONTRACTOR shall be required to install select backfill material around the riser section of the blow-off hydrant to assure that the riser section is suitably supported/stabilized by the surrounding material.

E. The CONTRACTOR shall be solely responsible to make sure the proper fittings and restraints are provided to allow for the connection of the blow-off hydrant to the type of mainline piping proposed.

F. The CONTRACTOR shall provide a sign, permanently attached to the blow-off hydrant, stating "Hydrant not intended for use in case of fire, for water flushing only."

3.05 JOINT RESTRAINT

A. All joints in a pressurized water system shall be restrained as recommended in DIPRA's latest edition (sixth) of *Thrust Restraint for Ductile Iron Pipe*.

B. When joint restraining is being utilized in lieu of thrust blocking, the Contractor shall be required to install a complete restraining system, in accordance with the Manufacturers recommendations, the contract plans and specifications, and as directed by the ENGINEER.

C. All joint restraints proposed shall be compatible with the type of pipe and fittings being utilized.

D. The Contractor shall refer to the restraining schedule on the detail sheets, included as part of the plans. The restraining schedule has been developed for the laying conditions specific to this project, and should not be altered unless otherwise authorized by the ENGINEER.

3.06 THRUST BLOCKING

A. All joints in a pressurized water system shall be restrained as recommended in DIPRA's latest edition (sixth) of *Thrust Restraint for Ductile Iron Pipe*. Thrust blocks shall be installed in accordance with this manual, as indicated on the Contract Drawings, as recommended by the pipe manufacturer, and as may be further directed by the Engineer.

B. All thrust blocking shall be placed so that fittings, nuts, bolts, and joints accessible for repairs.

C. Blocking shall be placed against firm, undisturbed earth.

3.07 CONCRETE ENCASEMENT

A. The watermain piping, fittings, and appurtenances shall be encased in 3000 psi ready-mix concrete where shown on the plans, or as further directed by the ENGINEER.

B. All piping and fittings within the proposed encasement area shall be wrapped with 6 mil polyethylene (or approved equal), to prevent bonding to the concrete.

3.08 EXISTING UTILITIES

A. The CONTRACTOR shall satisfy himself as to the locations of all existing structures and underground utilities as well as the value and location of the Work, the general conditions, particularly those bearing upon transportation, disposal, handling and storage of materials, availability of labor, water, electric power, and roads, physical conditions at the site, the confirmation and condition of the ground, the character, quality and quantity of surface and subsurface materials to be encountered, and all other matters which can in any way affect the Work or the cost thereof, under this Contract.

B. Any failure of the CONTRACTOR to acquaint himself with all available information concerning these conditions will not relieve him from responsibility of estimating properly the difficulty or cost of doing Work.

C. The CONTRACTOR shall be solely responsible for the location of all underground facilities located within the path of the piping. The plans indicate approximate locations of known facilities, but in no way shall the locations depicted on the plans be considered accurate. They have been shown solely for the purpose of making the CONTRACTOR (and Bidder) aware of their existence. The CONTRACTOR shall also recognize that additional underground facilities may exist which have not been indicated on the drawings. It shall be the CONTRACTOR'S sole responsibility to take all actions necessary to determine the location of all underground facilities, to include visual confirmation if required. The CONTRACTOR shall be solely responsible to repair any facilities damaged as a result of their operations, or that of any of its representatives (i.e. subcontractors). Neither the OWNER or ENGINEER, or any of their representatives, will be responsible for this work, for compensation for any work performed to obtain accurate locations, or for any costs associated with the repair of any damaged facilities.

3.09 TESTING & DISENFECTION

A. Refer to Section 15140, Testing and Disinfection, of these Specifications for testing and disinfection requirements.

END OF SECTION

SECTION 15140

TESTING AND DISINFECTION

PART 1 - GENERAL

1.01 Work Specified

A. Testing and disinfection of all pressure piping systems, to include those constructed of ductile iron pipe (DIP), polyvinyl chloride (PVC) pipe, molecularly oriented polyvinyl chloride (PVCO) pipe, and high density polyethylene (HDPE) pipe.

1. The CONTRACTOR shall furnish all supervision, coordination, labor, equipment, test connections, vents, water and materials necessary for carrying out the pressure and leakage tests as specified and required.
2. The Work specified shall include all labor, material, equipment, services and incidentals necessary to fill, clean, chlorinate, flush, and test all pipelines which will carry or hold potable water.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 15062, Ductile Iron Pipe, Fittings and Accessories
B. Section 15064, High Density Polyethylene (HDPE) Pipe, 4 In. Through 63 In.
C. Section 15110, Valves, Hydrants and Appurtenances

1.03 COORDINATION

A Permission shall be obtained from the OWNER of the water system before the use of water from any existing system. The CONTRACTOR shall:

1. Conform to the requirements of the OWNER.
2. Pay all costs connected with the taking or use of water for any testing or retesting.
3. Give notice at least 24 hours before the use of water for any reason.

B. All Work under this Section shall be performed in the presence of the ENGINEER. A representative of the public health authority having jurisdiction must also be present, if required.
C. Chlorination shall be scheduled such that sampling and flushing will be performed during normal business hours.

1.04 REFERENCE STANDARDS

A. AWWA B300, Standard for Hypochlorites
B. AWWA B301, Standard for Liquid Chlorine
C. AWWA C104, Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water
D. AWWA C301, Prestressed Concrete Pressure Pipe, Steel-Cylinder Type for Water and Other Liquids
E. AWWA C502, Standard for Dry-Barrel Fire Hydrants
F. AWWA C504, Standard for Rubber Seated Butterfly Valves
G. AWWA C600, Standard for Installation of Ductile Iron Watermains and Their Construction
H. AWWA C651, Standard for Disinfecting Water Mains
I. AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe, 4-inch Through 12-inch for Water Distribution
J. Standard Methods for the Examination of Water and Wastewater, latest edition 1996 Safe Drinking Water Act
K. AWWA C605-94, Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water

L. AWWA M23, Manual of Water Supply Practices, PVC Pipe Design and Installation
M. ASTM F2164, Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure
N. ANSI/AWWA C906-99, Polyethylene (PE) Pressure Pipe and Fittings, 4 in. through 63 in for Water Distribution.
O. ANSI/AWWA C901-02, Polyethylene (PE) Pressure Pipe and Tubing, ½ in. Through 3 in. for Water Service
P. ASTM F2164, Standard Practice for Field Leak Testing of Polyethylene (PE) Piping Systems Using Hydrostatic Pressure
Q. AWWA Manual M23, PVC Pipe – Design and Installation
R. AWWA Manual M55, PE Pipe – Design and Installation
S. AWWA C652, Disinfection of Water-Storage Facilities

1.05 SUBMITTALS

A. The CONTRACTOR shall submit proposed materials, methods, and operations regarding testing and disinfection to the ENGINEER for review prior to the start of testing.
B. CONTRACTOR must provide a sketch to the ENGINEER of the sampling locations identifying at minimum the following:

1. Street names,
2. North arrow,
3. Sampling locations (station number),
4. House numbers of nearest buildings to sampling locations.
5. Other distinguishable landmarks,
6. Any other information as requested by ENGINEER, OWNER, or County Health Department.

C. Qualifications of laboratory analyzing biological samples.
D. Chain-of-Custody forms for all biological samples taken.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All materials must be suitable for use in a potable water system.

1. Chlorination shall be by the use of a solution of water and liquid chlorine, calcium hypochlorite, or sodium hypochlorite and the solution shall be contained in the pipe or structure as specified.

PART 3 - EXECUTION

3.01 GENERAL

A. Flush, test and disinfect prior to connection to existing watermains as specified below, except as otherwise authorized by the ENGINEER.
B. All tests shall be conducted in the presence of the ENGINEER.
C. Notify the ENGINEER 48 hours in advance of testing.
D. The length of piping and sections included in the tests shall meet the approval of the ENGINEER.
E. The CONTRACTOR shall have sufficient personnel at the site for the entire duration of all tests.
F. When piping is to be insulated or concealed in a structure, tests shall be made before the pipe is covered.
G. Where connections to existing lines are called for, only one such connection will be allowed.

H. When testing absorbent pipe materials such as cement or concrete, the pipeline shall be filled with water at least 24 hours before the test is made.

I. Testing and disinfection results shall be accepted by the Health Department for the installed section of piping, before another connection is made.

J. The CONTRACTOR shall be required to submit to the ENGINEER a plan for flushing, testing and disinfecting during the shop drawing submittal process.

3.02 TESTS ON PRESSURE PIPING FOR POTABLE WATER

A. General (DIP, PVC / PVCO Pipe, and HDPE/PE Pipe)

1. Equipment in or attached to the pipes being tested shall be protected. Any damage to such equipment during the test shall be repaired by the CONTRACTOR at his expense.
2. Provide outlets to flush line, expel air, and to perform specified tests.
3. All fittings, hydrants and appurtenances must be properly braced and harnessed before the pressure is applied. Thrust blocking and mechanical restraining devices which will become a part of the system must also be tested at the test pressure.
4. If the OWNER is also the owner and operator of the water supply used for flushing, testing and disinfection, then the OWNER shall be responsible for water costs during the initial testing and disinfection of the waterline. Should further testing and disinfection be required to pass Health Department Standards, the OWNER reserves the right to charge the CONTRACTOR for additional water use.

B. Initial Flushing (DIP, PVC/PVCO Pipe, and HDPE/PE Pipe)

1. The CONTRACTOR shall fill and flush new main to remove dirt and miscellaneous debris from the inside of the watermain.
2. The CONTRACTOR is responsible for removing all entrapped air during flushing. Lines should be filled slowly with a maximum velocity of 2 fps (feet per second), preferably at 1 fps, while venting all air.

    a. Taps shall be made, if necessary, at the point of highest elevation, and after the completion of the test, the taps shall be tightly plugged, unless otherwise directed.

3. Flushing must have sufficient flow rate to achieve a fluid velocity of 2.5 fps.
4. A minimum 2" tap is required for proper flushing of all watermains having a diameter of 8 inches or less.
5. Refer to AWWA C651, for number of taps required to obtain the minimum 2.5 feet per second flow velocity in pipes larger than 8 inches in diameter.
6. The CONTRACTOR is responsible for providing a water source for flushing. With the permission of the water supplier, existing watermains may be used as a water source, however, the following restrictions apply:

    a. The CONTRACTOR is responsible for installing an approved backflow prevention device to the existing water supply, prior to flushing.
    b. The CONTRACTOR is not allowed to operate any valves or hydrants or operate any components which belong to the water supplier.
    c. Water from flushing procedures must be disposed of properly. Water may be piped or gravity-fed to an existing storm sewer with the permission of the OWNER and ENGINEER if proper erosion control methods to minimize sediment build-up are used. Discharge of water into a roadway is strictly prohibited.

7. The CONTRACTOR shall partially open and close valves and hydrants several times under expected line pressure to flush foreign material out of the valves and hydrants.

3.02A Ductile Iron Pipe

A. Hydrostatic Testing

1. Testing of ductile iron pipe pressure systems shall conform to all AWWA C600-99 specifications, latest edition.
2. The test methods described in this section are specific for water-pressure testing. These methods should not be applied for air-pressure testing.
3. Tests shall be made only after completion of backfill, and at least 36 hours after the last concrete thrust or reaction blocking has been cast with high early strength concrete or at least seven (7) days after the last concrete thrust or reaction blocking has been cast with standard concrete.
4. The test pressure shall not be less than 1.25 times the working pressure at the highest point along the test section.
5. The test pressure shall not exceed pipe or thrust-restraint design pressures.
6. Test pressure shall be held on the piping for a period of at least 2 hours, unless a longer period is requested by the ENGINEER. Pressure should not fluctuate by more than 5 psi during testing.
7. After the pipe has been laid, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 1.5 times the working pressure at the point of the test, or 150 psi, whichever is greater. The system should be allowed to stabilize at the test pressure before conducting the hydrostatic test.
8. Pressure gauge must be in good working condition and must be demonstrated to be accurate to the ENGINEER prior to any testing.
9. Gauge must have proper labeling to allow ENGINEER to accurately distinguish the change in pressure. Gauge must have markings at no greater than 2 psi increments to allow accurate readings.
10. ENGINEER may tap pressure gauge at each reading to ensure needle is measuring pressure accurately.
11. ENGINEER shall record pressure at 15 or 30 minute intervals to help determine if the pressure loss is stabilizing.
12. The CONTRACTOR will inform the ENGINEER when to begin the test.
13. The pipeline shall be slowly filled with water and the specified test pressure, measured at the pump, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the ENGINEER. The pump, pipe connection, gauges, dampers, and all necessary connections and apparatus shall be furnished by the CONTRACTOR.
14. Any exposed pipe, fittings, valves, hydrants, and joints shall be carefully examined during the testing. Any damage or defective pipe, fittings, valves, hydrants, or joints that are discovered following the pressure test shall be repaired or replaced, and the test shall be repeated until satisfactory results are obtained.
15. When hydrants are in the test section, the test shall be made against the main valve in the hydrant.
16. The testing allowance shall be defined as the quantity of makeup water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi of the specified test pressure after the pipe has been filled with water and the air has been expelled. Testing allowance shall not be measured by a drop in pressure in a test section over a period of time.

17. No pipe installation will be accepted unless the leakage is less than the number of gallons per hour, as determined in AWWA Standard C-600-99, as determined by the following formula, and in reference to Table 6A, reprinted herein.

* these formulas are based on a testing allowance of 11.65 gpd/mi/in. of nominal diameter at a pressure of 150 psi

In inch-pound units, $L = (SD(P)^{1/2}) / 133{,}200$

Where:
- L = testing allowance (makeup water), in gallons per hour
- S = length of pipe tested, in feet
- D = nominal diameter of the pipe, in inches
- P = average test pressure during the hydrostatic test, in pounds per square inch (psi) (gauge)

18. Testing allowance values determined by the above formula are presented in Table 6A below:

Table 6A Hydrostatic testing allowance per 1,000 feet of pipeline - gph

Average Test Pressure psi	Nominal Pipe Diameter - in.																	
	3	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**24**	**30**	**36**	**42**	**48**	**54**	**60**	**64**
450	0.48	0.64	0.95	1.27	1.59	1.91	2.23	2.55	2.87	3.18	3.82	4.78	5.73	6.69	7.64	8.60	9.56	10.19
400	0.45	0.60	0.90	1.20	1.50	1.80	2.10	2.40	2.70	3.00	3.60	4.50	5.41	6.31	7.21	8.11	9.01	9.61
350	0.42	0.56	0.84	1.12	1.40	1.69	1.97	2.25	2.53	2.81	3.37	4.21	5.06	5.90	6.74	7.58	8.43	8.99
300	0.39	0.52	0.78	1.04	1.30	1.56	1.82	2.08	2.34	2.60	3.12	3.90	4.68	5.46	6.24	7.02	7.80	8.32
275	0.37	0.50	0.75	1.00	1.24	1.49	1.74	1.99	2.24	2.49	2.99	3.73	4.48	5.23	5.98	6.72	7.47	7.97
250	0.36	0.47	0.71	0.95	1.19	1.42	1.66	1.90	2.14	2.37	2.85	3.56	4.27	4.99	5.70	6.41	7.12	7.60
225	0.34	0.45	0.68	0.90	1.13	1.35	1.58	1.80	2.03	2.25	2.70	3.38	4.05	4.73	5.41	6.03	6.76	7.21
200	0.32	0.43	0.64	0.85	1.06	1.28	1.48	1.70	1.91	2.12	2.55	3.19	3.82	4.46	5.09	5.73	6.37	6.80
175	0.30	0.40	0.59	0.80	0.99	1.19	1.39	1.59	1.79	1.98	2.38	2.98	3.58	4.17	4.77	5.36	5.96	6.36
150	0.28	0.37	0.55	0.74	0.92	1.10	1.29	1.47	1.66	1.84	2.20	2.76	3.31	3.86	4.41	4.97	5.52	5.88
125	0.25	0.34	0.50	0.67	0.84	1.01	1.18	1.34	1.51	1.68	2.01	2.52	3.02	3.53	4.03	4.53	5.04	5.37
100	0.23	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50	1.80	2.25	2.70	3.15	3.60	4.05	4.50	4.80

* If the pipeline under test contains sections of various diameters, the testing allowance will be the sum of the testing allowance for each size.

19. When testing against closed metal-seated valves, an additional testing allowance per closed valve of 0.0078 gal/h/in. of nominal valve size shall be allowed.
20. If the testing allowance is greater than that described above, the CONTRACTOR shall explore for the cause of the excessive leakage and after repairs have been made, the line shall be retested. This procedure shall be repeated until the testing allowance is less than the maximum allowable.
21. After each test, the CONTRACTOR must demonstrate that the test apparatus, including the pressure gauge, is fully functional and accurate. Inaccurate gauges or non-satisfactory equipment will be grounds for test failure, regardless of test results. CONTRACTOR will re-supply proper equipment and retest, at his expense.
22. The rate of leakage shall be determined at 15 minute intervals by means of volumetric measurement of the makeup water added to maintain the test pressure.

    a. At the completion of the test the pressure shall be released at the furthermost point from the point of application.

23. The CONTRACTOR shall provide a meter certified within the last year or a source-water tank/barrel of small enough cross section so that measurable changes in water

depth can be accurately recorded. If the change in water depth cannot be properly measured, the ENGINEER may require the test to be run more than 2 hours until an accurate depth change can be recorded and the ENGINEER is satisfied with the results.

3.02B Polyvinyl Chloride (PVC) / Molecularly Oriented Polyvinyl Chloride (PVCO) Pipe

A. Hydrostatic Testing

1. **The following procedure is based on the assumption that the pressure and leakage tests will be performed at the same time.**
2. Testing of PVC/PVCO pipe pressure systems shall conform to all AWWA C605-94 specifications, latest edition.
3. The test methods described in this section are specific for water-pressure testing. These methods should not be applied for air-pressure testing.
4. Tests shall be made only after completion of backfill, and at least 36 hours after the last concrete thrust or reaction blocking has been cast with high early strength concrete or at least seven (7) days after the last concrete thrust or reaction blocking has been cast with standard concrete.
5. The test pressure shall not be less than 1.25 times the working pressure at the highest point along the test section.
6. The test pressure shall not exceed pipe or thrust-restraint design pressures.
7. Test pressure shall be held on the piping for a period of at least 2 hours, unless a longer period is requested by the ENGINEER. Pressure should not fluctuate by more than 5 psi during testing.
8. After the pipe has been laid, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 1.5 times the working pressure at the point of the test, or 150 psi, whichever is greater. The system should be allowed to stabilize at the test pressure before conducting the hydrostatic test.
9. Pressure gauge must be in good working condition and must be demonstrated to be accurate to the ENGINEER prior to any testing.
10. Gauge must have proper labeling to allow ENGINEER to accurately distinguish the change in pressure. Gauge must have markings at no greater than 2 psi increments to allow accurate readings.
11. ENGINEER may tap pressure gauge at each reading to ensure needle is measuring pressure accurately.
12. ENGINEER shall record pressure at 15 or 30 minute intervals to help determine if the pressure loss is stabilizing.
13. The CONTRACTOR will inform the ENGINEER when to begin the test.
14. The pipeline shall be slowly filled with water and the specified test pressure, measured at the pump, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the ENGINEER. The pump, pipe connection, gauges, dampers, and all necessary connections and apparatus shall be furnished by the CONTRACTOR.
15. Any exposed pipe, fittings, valves, hydrants, and joints shall be carefully examined during the testing. Any damage or defective pipe, fittings, valves, hydrants, or joints that are discovered following the pressure test shall be repaired or replaced, and the test shall be repeated until satisfactory results are obtained.
16. When hydrants are in the test section, the test shall be made against the main valve in the hydrant.
17. The testing allowance shall be defined as the quantity of makeup water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi of the specified test pressure after the pipe has been filled with water and the air has been expelled. Testing allowance shall not be measured by a drop in pressure in a test section over a period of time.

18. No pipe installation will be accepted unless the leakage is less than the number of gallons per hour, as determined in AWWA Standard C-605-94, as determined by the following formula, and in reference to Table 3, reprinted herein.

* these formulas are based on an allowable leakage of 10.5 gpd/mi/in. of nominal diameter at a pressure of 150 psi

$$L = (ND(P)^{1/2}) / 7{,}400$$

Where:
- L = allowable leakage, in gallons per hour
- N = number of joints in the length of pipeline tested
- D = nominal diameter of the pipe, in inches
- P = average test pressure during the leakage test, in pounds per square inch (psi) (gauge)

Table 3: Allowable leakage per 50 joints of PVC pipe - gph

Avg. Test Pressure psi	Nominal Pipe Diameter, in.											
	4	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**24**	**30**	**36**
300	0.47	0.70	0.94	1.17	1.40	1.64	1.87	2.11	2.34	2.81	3.51	4.21
275	0.45	0.67	0.90	1.12	1.34	1.57	1.79	2.02	2.24	2.69	3.36	4.03
250	0.43	0.64	0.85	1.07	1.28	1.50	1.71	1.92	2.14	2.56	3.21	3.85
225	0.41	0.61	0.81	1.01	1.22	1.42	1.62	1.82	2.03	2.43	3.04	3.65
200	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72	1.91	2.29	2.87	3.44
175	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	2.15	2.68	3.22
150	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99	2.48	2.98
125	0.30	0.45	0.60	0.76	0.91	1.06	1.21	1.36	1.51	1.81	2.27	2.72
100	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.62	2.03	2.43
75	0.23	0.35	0.47	0.59	0.70	0.82	0.94	1.05	1.17	1.40	1.76	2.11
50	0.19	0.29	0.38	0.48	0.57	0.67	0.76	0.86	0.96	1.15	1.43	1.72

* If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

19. Leakage values determined by the above formula are presented in Table 3 below:
20. When testing against closed metal-seated valves, and additional leakage per closed valve of 0.078 gph/in. of nominal valve size shall be allowed.
21. If the testing allowance is greater than that described above, the CONTRACTOR shall explore for the cause of the excessive leakage and after repairs have been made, the line shall be retested. This procedure shall be repeated until the testing allowance is less than the maximum allowable.
22. After each test, the CONTRACTOR must demonstrate that the test apparatus, including the pressure gauge, is fully functional and accurate. Inaccurate gauges or non-satisfactory equipment will be grounds for test failure, regardless of test results. CONTRACTOR will re-supply proper equipment and retest, at his expense.
23. The rate of leakage shall be determined at 15 minute intervals by means of volumetric measurement of the makeup water added to maintain the test pressure.

    a. At the completion of the test the pressure shall be released at the furthermost point from the point of application.

24. The CONTRACTOR shall provide a meter certified within the last year or a source-water tank/barrel of small enough cross section so that measurable changes in water depth can be accurately recorded. If the change in water depth cannot be properly measured, the ENGINEER may require the test to be run more than 2 hours until an

accurate depth change can be recorded and the ENGINEER is satisfied with the results.

3.02C Polyethylene (PE) / High Density Polyethylene (HDPE) Pipe

A. Hydrostatic Testing

1. Testing of polyethylene (PE/HDPE) pressure pipe systems shall conform to all AWWA M55 specifications, the Plastic Pipe Institute (PPI) specifications, and all specifications of the pipe manufacturer.
2. The test methods described in this section are specific for water-pressure testing. Pneumatic (compressed gas) leak testing of PE/HDPE pipe systems will be strictly prohibited.
3. Tests shall be made only after completion of backfill, and at least 36 hours after the last concrete thrust or reaction blocking has been cast with high early strength concrete or at least seven (7) days after the last concrete thrust or reaction blocking has been cast with standard concrete.
4. The test pressure shall not be less than 1.25 times the working pressure at the highest point along the test section.
5. The test pressure shall not exceed pipe or thrust-restraint design pressures, and the application service temperature.
6. After the pipe has been laid, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 1.5 times the working pressure at the point of the test, or 150 psi, whichever is greater.
7. PE/HDPE pipe has a reduced strength at elevated temperatures. Test pressure must be reduced when the test section is at elevated temperature either from service conditions or from environmental conditions such as being warmed by the sun. Multiply the test pressure by the Table 1 (below) multiplier to determine the allowable elevated temperature test pressure.

Table 1 - Elevated Temperature Multiplier

Test Section Temperature ^{o}F	≤ 80	≤ 90	≤ 100	≤ 110	≤ 120	≤ 130	≤ 140
Multiplier	1.00	0.90	0.80	0.75	0.65	0.60	0.50

* Use the $80^{o}F$ multiplier for $80^{o}F$ and lower temperatures.

8. PE/HDPE pipe requires an initial expansion period. Gradually pressurize the test section to the test pressure, and maintain test pressure for 3 hours. During this initial expansion period, polyethylene pipe will expand slightly. Additional test liquid will be required to maintain pressure. It is not necessary to monitor the amount of water added during the initial expansion period.
9. When testing PE/HDPE pipe at pressures above system design, pressure up to 1.5 times the system design pressure, the maximum test duration is eight (8) hours including time to pressurize, time for initial expansion, time at test pressure, and time to depressurize the test section. If the test is not completed due to leakage, equipment failure, or for any other reason, depressurize the test section completely, and allow it to relax for at least eight (8) hours before pressurizing the test section again. Testing at excessive pressure or for excessive time may damage the piping system.
10. Pressure gauge must be in good working condition and must be demonstrated to be accurate to the ENGINEER prior to any testing.
11. Gauge must have proper labeling to allow ENGINEER to accurately distinguish the change in pressure. Gauge must have markings at no greater than 2 psi increments to allow accurate readings.

12. ENGINEER may tap pressure gauge at each reading to ensure needle is measuring pressure accurately.
13. ENGINEER shall record pressure at 15 or 30 minute intervals to help determine if the pressure loss is stabilizing.
14. The CONTRACTOR will inform the ENGINEER when to begin the test.
15. The pipeline shall be slowly filled with water and the specified test pressure, measured at the pump, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the ENGINEER. The pump, pipe connection, gauges, dampers, and all necessary connections and apparatus shall be furnished by the CONTRACTOR.
16. Any exposed pipe, fittings, valves, hydrants, and joints shall be carefully examined during the testing. Any damage or defective pipe, fittings, valves, hydrants, or joints that are discovered following the pressure test shall be repaired or replaced, and the test shall be repeated until satisfactory results are obtained.
17. When hydrants are in the test section, the test shall be made against the main valve in the hydrant.
18. Immediately following the initial expansion period, monitor the amount of make-up water required to maintain the test pressure for two (2) hours. If the amount of make-up water needed to maintain the test pressure does not exceed the amount in Table 2 below, no leakage is indicated.

Table 2 - Make-Up Water Allowance for Test Phase - Test pressure is 1.5 times system design pressure

Nominal Pipe Size (in.)	Make-up Water Allowance - U.S. Gal/100ft of pipe		
	1-Hour Test	2-Hour Test	3-Hour Test
1.25	0.06	0.10	0.16
1.5	0.07	0.10	0.17
2	0.07	0.11	0.19
3	0.10	0.15	0.25
4	0.13	0.25	0.40
5.375	0.19	0.38	0.58
5	0.21	0.41	0.62
6	0.30	0.60	0.90
7.125	0.40	0.70	1.00
8	0.50	1.00	1.50
10	0.80	1.30	2.10
12	1.10	2.30	3.40
13.375	1.20	2.50	3.70
14	1.40	2.80	4.20
16	1.70	3.30	5.00
18	2.00	4.30	6.50
20	2.80	5.50	8.00
22	3.50	7.00	10.50
24	4.50	8.90	13.30
26	5.00	10.00	15.00
28	5.50	11.10	16.80
30	6.30	12.70	19.20
32	7.00	14.30	21.50
34	8.00	16.20	24.30
36	9.00	18.00	27.00
42	12.00	23.10	35.30
48	15.00	27.00	43.00
54	22.00	31.40	51.70

19. Test pressure shall be held on the piping for a period of at least 2 hours, unless a longer period is requested by the ENGINEER. Pressure should not fluctuate by more than 5 psi during testing.
20. If the testing allowance is greater than that described above, the CONTRACTOR shall explore for the cause of the excessive leakage and after repairs have been made, the line shall be retested. This procedure shall be repeated until the testing allowance is less than the maximum allowable.
21. After each test, the CONTRACTOR must demonstrate that the test apparatus, including the pressure gauge, is fully functional and accurate. Inaccurate gauges or non-satisfactory equipment will be grounds for test failure, regardless of test results. CONTRACTOR will re-supply proper equipment and retest, at his expense.
22. The rate of leakage shall be determined at 15 minute intervals by means of volumetric measurement of the makeup water added to maintain the test pressure.

    a. At the completion of the test the pressure shall be released at the furthermost point from the point of application.

23. The CONTRACTOR shall provide a meter certified within the last year or a source-water tank/barrel of small enough cross section so that measurable changes in water depth can be accurately recorded. If the change in water depth cannot be properly measured, the ENGINEER may require the test to be run more than 2 hours until an accurate depth change can be recorded and the ENGINEER is satisfied with the results.

3.03 DISINFECTION (DIP, PVC/PVCO Pipe, PE/HDPE Pipe)

A. Before disinfection, the line shall be cleaned and flushed with clean water as defined in the Initial Flushing Section. CONTRACTOR shall provide outlets as required.
B. The chlorine solution shall be admitted to pipelines through corporation stops placed in the horizontal axis of the pipe, to structures by means of tubing extending directly into the structure or other approved methods.
C. The chlorination method used shall be in conformance with ANSI/AWWA C-651, by the continuous feed method.
D. Alternate methods of disinfection, if proposed by the CONTRACTOR, shall be by an AWWA approved method and shall be subject to the approval of the ENGINEER. Method 5.1 of AWWA C-651, the tablet method, shall not be permitted.
E. The proposed piping shall be tested in all respects, prior to connecting the second end of the pipe to the existing system, or prior to connecting service connections to the new watermain.
F. All valves to existing mains must be closed during the chlorination process. While the chlorinated water is being added, all appurtenances on the main shall be operated so as to completely disinfect the new work. The operation shall be repeated as necessary to provide complete disinfection.
G. Chlorinated water from hydrants and taps must be properly collected and disposed of by the CONTRACTOR. Discharge of chlorinated water into the existing storm sewer or a natural water body shall not be allowed.
H. The chlorine treated water shall be retained in the pipe or structure at least 24 hours, unless otherwise directed, in which a chlorine residual of not less than 10 mg/l must be maintained. During the retention period all valves and hydrants within the treated sections shall be operated.
I. **When disinfecting PE/HDPE pipe, disinfecting solutions must not exceed 12% active chlorine because greater concentration can chemically attack and degrade polyethylene.**
J. When making repairs to or when specified, structures and portions of pipelines shall be chlorinated by a concentrated chlorine solution containing between 200 PPM (mg/l) and 300 PPM (mg/l) of free chlorine. The solution shall be applied with a brush or sprayed on the entire inner surface of the empty pipes or structures. The surfaces disinfected shall remain in contact with the strong chlorine solution for at least 30 minutes.

K. The CONTRACTOR must use an approved test method to determine chlorine levels. Test strips will be allowed for testing chlorine levels if the kit is new, in the original bottle, and has a color coded scale on the side with legible concentrations defined. Sending samples to an approved laboratory is also acceptable.

3.04 FINAL FLUSHING (DIP, PVC/PVCO Pipe, PE/HDPE Pipe)

A. Upon completion of each disinfecting operation, the CONTRACTOR will be required to either empty the contents of the pipe into a tank truck, or to apply a neutralizing chemical to the contents, and discharge appropriately. Dumping into a sewer will only be allowed with approval from the local governing body. **In no instance will chlorinated testing or flushing water be emptied onto the roadways, in ditches, culverts, storm sewers, streams, wetlands, or any other natural water body.**

B. The flushing shall occur until the chlorine concentration at each sampling tap is no higher than 1.0 mg/L.

3.05 BACTERIOLOGICAL TESTING (DIP, PVC/PVCO Pipe, PE/HDPE Pipe)

A. After disinfection and final flushing, a representative of the laboratory hired by the CONTRACTOR shall, in the presence of the ENGINEER, take bacteriological samples from sampling points at approximately 1000-foot intervals and at each end of the test section for testing by an approved laboratory in accordance with the latest Health Department requirements. The laboratory performing the testing shall submit the reports directly to the ENGINEER for review. The ENGINEER will then forward the results to all applicable parties.

B. After clean samples are obtained and a completed works approval is provided by the Health Department, the water main may be placed in service.

C. Should safe results not occur after these two (2) consecutive tests, the CONTRACTOR shall, at his expense, repeat the disinfection procedure until safe results are obtained.

D. All precautions shall be taken to maintain dry and sanitary conditions and to prevent contamination of any piping, at the expense of the CONTRACTOR.

E. If, in the opinion of the ENGINEER, contamination has occurred, the CONTRACTOR shall repeat the disinfection and bacteriological testing at his cost and expense.

F. After reconnecting the proposed piping to the existing piping, the CONTRACTOR shall slowly refill the watermain with water and allow it to pressurize so that the ENGINEER may inspect the connections and/or other piping.

G. The CONTRACTOR shall, at his expense, correct any observed defects to the satisfaction of the ENGINEER and OWNER.

3.06 WATER-STORAGE FACILITIES

A. GENERAL:

1. In general, the tank shall be designed, constructed, and tested in conformance with AWWA D103.
2. The CONTRACTOR shall be solely responsible for providing the water required to test and disinfect the tank. It is recommended that the CONTRACTOR approach the OWNER first about supplying water. All costs associated with the obtainment of water shall be included in the unit price bid for construction of the tank.

B. FIELD TESTING:

1. Upon completion of construction of the tank, the tank shall be cleaned, and tested for liquid tightness by filling the tank to its overflow elevation. Any leaks observed shall be repaired by the tank erector in accordance with the manufacturer's recommendations.

2. The OWNER shall provide the water for initial testing at no cost to the CONTRACTOR. If additional testing is required after the initial test, the OWNER reserves the right to charge the CONTRACTOR for additional water use during subsequent testing.

C. DISINFECTION:

1. The tank shall be disinfected at the time of testing by methods of chlorination in accordance with AWWA C652-02, latest revision.
2. Chlorination methods 1, 2, and 3 shall be acceptable.
3. Sodium Hypochlorite is the preferred form of chlorine to be utilized for disinfection.
4. The tank shall not be disinfected until the tank sealant is fully cured, approximately 10-12 days at 73^{o}F and 50% relative humidity.

3.07 CERTIFICATION

A. An Engineer's certification of completed works must be issued, and accepted/approved by the NYSDOH, prior to placing any section of the proposed water system into service.

END OF SECTION

SECTION 16005

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. The electrical work shall be complete in every detail, unless specified otherwise, and shall include miscellaneous items of material and the labor necessary to complete the work described.

B. These Specifications and Contract Drawings are not intended to cover every detail or variation for the installation or provide for every possible installation contingency. It is expected that the Work will be supervised and performed by qualified persons familiar with electrical construction practices, electrical equipment, and safety within a process facility.

C. The Contract Drawings show the principal engineering design elements, such as general orientation of mechanical and electrical equipment to piping, foundations, and buildings, and are not intended to be used as detailed installation documents.

1.02 SYSTEM DESCRIPTION

A. Drawings Intent and Limitations: Small scale electrical drawings are diagrammatic and indicate only the general character, approximate location, and extent of the work. Electrical drawings do not attempt to show details of building construction which may affect the electrical work. Examine architectural, structural and mechanical drawings to find how electrical work may be affected. Riser, ladder and connection diagrams are schematic and do not necessarily show the required physical arrangements of equipment.

B. Dimensions: Do not scale measurements from electrical drawings. Only dimensions appearing on electrical drawings may be used.

C. Symbols: Unless otherwise indicated, symbols used on electrical drawings are according to ANSI Y32.9.

1.03 QUALITY ASSURANCE

A. Submittals For Approval shall include, at a minimum, manufacturer's literature, specifications, wiring diagrams, installation diagrams, and engineering data necessary to fully describe the electrical materials and/or equipment and to substantiate complete compliance with the Contract Documents.

B. Manufacturer Qualifications: A company regularly engaged in the manufacture of equipment of the type, size, and ratings required, and who issues a complete catalog of data on such products.

C. Contractor Qualifications: A specialist with successful installation experience on projects with similar electrical installation requirements.

D. Installer Qualifications: A journeyman electrician, apprentice, or helper as appropriate to the complexity of the work involved. Work accomplished by an apprentice or helper shall be done under the supervision of a journeyman.

E. Labeling Requirements: Each major component of equipment shall have a label or nameplate attached indicating the manufacturer, model or catalog number, and UL electrical rating.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Damage: Material whose factory finish has been damaged shall be refinished to match original factory finish, or replaced as necessary.

PART 2 - PRODUCTS

(There are no applicable requirements.)

PART 3 - EXECUTION

3.01 INSTALLATION

A. Interface with Other Work: Labor, material, equipment and services that are necessary to construct the complete electrical systems shall be scheduled so as to not obstruct or delay other work necessary on the jobsite. The Contractor shall be responsible for adjustments in the wiring and equipment locations due to structural obstructions or conflicts with work specified elsewhere.

B. Governing Standards: Do electrical work according to either the National Electrical Code (NFPA 70), National Electrical Safety Code (ANSI C2), and the NECA Standard of Installation or local standards, whichever is more stringent.

C. Manufacturer's Instructions: Material and equipment shall be installed according to the manufacturer's instructions. When the manufacturer's instructions are in conflict with these specifications, furnish a copy of the manufacturer's instructions to the Contracting Officer prior to installation and defer installation until the Contracting Officer issues written instructions on which method shall be followed.

D. Removing Existing Wiring: Unless otherwise indicated, remove all devices and conductors back to nearest outlet box, device or panelboard which is indicated to remain in use. In exposed work, remove conduits, boxes and supporting material. In concealed work, leave conduits and boxes in place. Install blank covers on empty boxes left in place.

3.02 FIELD QUALITY CONTROL

A. Testing: The Contractor shall make arrangements for a certified independent testing laboratory, according to the requirements of Section 01410 - Testing Laboratory Services, to perform the required testing, recording, and distributing of the results.

B. Operational Test: When electrical and mechanical installations are complete, the Contractor shall energize electrically connected equipment and demonstrate that the electrical systems function according to design. Prior to performing this test, the Contractor shall verify that mechanical and electrical systems are in condition to be energized without damage to the building and equipment, or injury to personnel. The Contractor shall perform this test prior to final inspection and during final inspection. Malfunctioning units shall be corrected and retested by the Contractor to demonstrate compliance with the specification.

END OF SECTION

SECTION 16010

ELECTRICAL WORK

PART 1 - GENERAL

1.01 DESCRIPTION

A. Furnish and install all electrical work including work incidental thereto as shown on Drawings and specified.

1.02 RULES AND REGULATIONS

A. Work and materials shall conform to and be executed, inspected and tested in accordance with the latest edition of the National Electric Code, and with the governing rules and regulations of federal, state, local governmental agencies.

B. Other codes, which will apply to this installation, include the current editions of:

1. ANSI C2 - National Electrical Safety Code
2. NEMA Standards

C. Where governing codes indicate that Drawings and Specifications do not comply with the minimum requirements of applicable codes, be responsible for either notifying the Owner in writing during the bidding period of the revisions required to meet code requirements, or of providing an installation, which will comply with the code requirements.

1.03 COORDINATION

A. Coordinate equipment, devices and conduit with openings in walls, floors and roofs as shown on Drawings. Be responsible for any changes in openings necessitated by changed in the equipment specified.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All materials, unless otherwise specified, shall be new and be the standard products of the manufacturer. Seconds, rejects, or damaged materials will be rejected.

B. The equipment to be provided under these Specifications shall be essentially the standard commercial grade product of the manufacturer. Where two or more units of the same class of equipment are required, these units shall be products of a single manufacturer.

C. The listing of a manufacturer for certain equipment and systems does not indicate acceptance of a standard or cataloged item of equipment. All equipment and systems shall conform to the Specifications.

2.02 U.L. LISTING

A. All equipment shall bear the Underwriter's Laboratory (UL), or other approved agency, listing label.

B. Wherein an item of equipment is specified to be U.L. Listed, the entire assembly shall be listed by Underwriters Laboratories, Inc.

2.03 ACCESS

A. Provide NEC access for all concealed junction boxes, control devices, duct mounted heat or smoke detectors and other items of equipment requiring maintenance and/or operation. Where access doors are necessary to meet NEC requirements, furnish for installation Milco Type "K" access doors with flush screwdriver operated lock, of size to permit access. Doors shall be of the type suited to the construction into which they are to be installed. Access doors penetrating fire rated walls or ceilings, i.e., shafts, hoistways, fireproofing membranes, to be 1-1/2 hr. "B" labeled.

B. Locate all equipment, which must be serviced, operated or maintained in fully accessible positions. Minor deviations from the drawings may be made to allow for better accessibility at no additional cost to the Owner, but changes shall not be made without approval of the ENGINEER.

C. Minimum clearances in front of or around equipment shall conform to the latest applicable code requirements.

2.04 EQUIPMENT BASES, MATS AND SUPPORTS

A. Provide bases, steel supports, anchor bolts, inserts, etc., for all equipment and apparatus, specified in Division 16.

B. Floor-mounted electrical equipment shall be installed on 4- inch high concrete housekeeping pads. Concrete shall be 3000-pound mix at 28 days minimum. Slump shall not exceed three inches.

2.05 NAMEPLATES AND DEVICE PLATES MARKINGS

A. Device plate for receptacles other than 120-volt, 20-amperes receptacles shall be engraved with 1/8-inch high black letters designating the following:

1. Voltage
2. Panel Name and Circuit number(s)
3. Current rating

B. Laminated plastic bakelite nameplates for equipment specified later in this section shall be 3/4 inch by 2 inches or larger in dimension, fastened with counter sunk, oval head, chrome-plated machine screws. Lettering shall be 1/4 inch high, engraved white on black plate and shall designate the equipment served or the specific equipment designation as shown on Drawings. Smaller nameplate lettering may be used where adequate nameplate mounting space is not available, but in no case shall the lettering be smaller than 1/8 inch.

2.06 CONDUITS FITTINGS AND SUPPORTS

A. Liquid-tight flexible metal conduit shall consist of a core of flexible galvanized sheet tubing over which is extruded a liquid-tight jacket of polyvinyl chloride (PVC). Liquid- tight flexible conduits shall be provided with a continuous copper-bonding conductor wound spirally between the convolutions.

B. Fitting and couplings for rigid or intermediate metal conduit shall be threaded.

C. Bushings for rigid or intermediate metal conduit 1-1/4 inch and larger shall be steel of the threaded grounding insulated type.

D. Fittings for liquid-tight flexible conduit shall be in accordance with UL 360, incorporating a threaded grounding cone, steel or plastic compression ring and a gland for tightening. Fittings shall be made of steel only, with insulted throats.

E. Die-cast zinc-alloy fittings shall not be used on any type of raceway.

F. Conduit Sleeves:

1. All electrical system conduits and raceways passing through concrete slabs, except slabs on grade, shall have sleeves.

G. Exterior Wall Sleeves:

1. Each sleeve shall have an integral circumferential water stop collar located in the approximate center of the concrete construction involved. Collars on steel sleeves shall extend at least 3 inches into the concrete, perpendicular to and all around the sleeve. Sleeves shall extend at least 6 inches on each side of the construction involved.
2. Seals shall be of the modular mechanical type consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the conduit and the sleeve complete with zinc phosphate-plated carbon steel bolts, nuts and pressure plates. The seal shall be OZ CAFS series.

H. Interior Wall, Floor and Partition Sleeves:

1. Each sleeve shall be at least two (2) conduit sizes larger than the conduit passing through the sleeve. Terminate the sleeve flush with walls, floors or partitions. In finished areas, where conduits are exposed, extend sleeve 1/4 inch above finished floor, except in rooms having floor drains, and extend sleeves 3/4 inch above floor.
2. The space around the conduit in the sleeve shall be packed with a non-combustible materials, such as Chase Technology, CTC Pr855 Fire Stop, whose minimum fire rating equals the rating of the wall, floor, or partition through which the sleeve penetrates.

I. Conduit Supports:

1. Support conduits from the building structure. Horizontal runs of conduit shall be supported a maximum of 8 feet on center using hangers especially made for electric conduit. Perforated steel straphangers are not acceptable.
2. Conduits and fitting shall be new, full-length, and manufactured by Allied Tube and Conduit Corp., Triangle Conduit and Cable Co., or Republic.

J. Expansion Fittings:

1. Each conduit that crosses a building expansion joint shall be provided with an expansion fitting. A separate grounding conductor shall be provided including conduits having expansion joints.

K. Fittings:

1. Three-piece steel threaded couplings, Steel City EK- 400 Series shall be used to join two conduits coming together from opposite directions when standard threaded couplings cannot be used.
2. Conduit nipples with running threads and split couplings shall not be used.

L. Conduits shall be installed in accordance with NEC and local utility company requirements.

2.07 OUTLET BOXES

A. Outlet boxes in the following locations shall be of the hot dip galvanized cast iron, threaded hub type, with gasketed weatherproof stainless steel covers:

1. Exterior locations and interior locations where exposed to moisture-laden atmosphere.
2. Exposed conduit runs.
3. Outlet boxes for vapor-proof, explosion-proof and outside bracket fixtures, only as shown on drawings.

B. Box depths greater than 2-1/8 inches shall not be used for obtaining the necessary volume.

C. Outlet boxes for wall switches, telephone, signal receptacles and junctions shall be not less than 4 inches square by 1-1/2 inches deep of the one-piece deep drawn type.

D. Flush floor boxes shall be of the concrete type, fully adjustable after placement of concrete, arranged so that the top may be varied approximately 3/8 inch from the plane of its base. The boxes shall be formed steel with a 54 cubic inch wiring capacity. Cover plates shall be heavy brass, nominally 1/8-inch thick, with permanent ring or flange and rubber gasket. Floor service fittings for attachment to flush floor boxes shall be as required for the specific outlet types and shall match the appearance of the service fitting for fire-rated, poke-through fittings.

2.08 PULL AND JUNCTION BOX

A. Boxes shall have blank covers of the same thickness as the boxes and shall be secured by corrosion-resistant screws or bolts.

B. Boxes exposed to rain or installed in wet locations shall be of the cast vapor-tight type.

C. Boxes connected to concealed conduits shall be provided with access by means of an approved access door.

D. All ferrous boxes shall be hot-dip galvanized.

2.09 LIGHTING, RECEPTACLE AND POWER PANELBOARD

A. General

1. Dead-front panelboards of the shown interrupting duty, incorporating the number, rating and type of circuit breakers or fused switches as shown on Drawings shall be provided in general purpose enclosures for either surface or flush mounting.
2. Panelboards and circuit breakers shall be Square D.

B. Construction

1. Panels shall consist of factory completed dead-front assemblies of sheet steel cabinets, main buses, overcurrent devices and sheet steel trim. 400A panel shall be the manufacturer's standard cabinet, nominally 5-3/4 inches deep by 20 inches wide minimum. All panels shall have forty-two (42) spaces.
2. Inside trim, door and exterior shall be painted with a rust-inhibiting phosphatized coating after pickling and finished in ANSI-61 gray enamel.

C. Circuit Breakers:

1. Circuit breakers for individual or panelboard mounting shall be of the indicating, molded case, bolt-on type consisting of the number of poles, with voltage and ampere ratings as noted on Drawings. Two and three- pole breakers shall be of the common trip type with no handle ties. "G" frame breakers and breakers not UL listed for a 125 or 250 V. D.C. rating in 1,2, and 3 pole configurations are not acceptable for meeting this specification.
2. Breakers shall be of the quick-make and quick-break type toggle mechanism with inverse time trip characteristics and shall trip-free on overload or short circuit. Automatic release shall be secured by a bi-metallic, ambient-compensated, thermal element releasing the mechanism latch. In addition, a magnetic armature shall be

provided to trip the breaker instantaneously for short circuit currents above the overload range.

2.10 WIRING DEVICES

A. Provide, where shown, wiring devices which conform to NEMA performance specifications.

B. Flush Switches: Lighting switches shall be quiet type, toggle, rated for low voltage, or 120 volts AC, back and side wiring, complying with NEMA WD-1 standards, with a mechanism housing of composition completely enclosing the switch. Where more than one switch is indicated at an outlet, they shall be installed under one plate.

C. Receptacles:

1. Receptacles shall be flush type, 15 amps, 125 volt, single pole, three wire, duplex, with phone and data connections, unless indicated as special purpose outlet. Receptacle power contacts shall grip both sides of the plug blades.
2. Ground fault interrupter type receptacles shall be grounding type, specification grade, duplex, 120 volt AC, 15 amperes. They shall be UL listed as Class A, Group I devices shall be in full conformance with NEMA standards publication WD-1-1971.

D. Architect shall select device color prior to placing orders with device manufacturer.

E. Device plates, telephone outlet plates, and blank plates for junction boxes in finished areas shall be 0.04 inches, 302 stainless steel with satin finish.

2.11 MOTOR STARTERS

A. Furnish and install all motor starters, unless otherwise specified in other sections, required for a particular application or indicated by details or control diagrams on drawings. All starters furnished shall be of one manufacturer. Each starter and its component and related parts shall be properly designed and coordinated to suit the characteristics of the motor its controls and the driven equipment. Each starter shall be equipped with twin-break silver-to-silver renewable type contacts to break each ungrounded line to the motor.

B. MANUFACTURES: Square D` Cutler Hammer, Allen Bradley or GE.

C. Single and Three Phase Starters,

1. Starters shall have NEMA 1 general-purpose enclosures, unless otherwise shown on Drawings, with doors or covers. Each enclosure shall be so designed that the entire starter can be readily removed to permit easy mounting and wiring.
2. Electrically operated, electrically held magnetic starters shall be provided for 1/2 horsepower and larger motors and shall be full voltage, single speed, except as required below, across-the-line type with undervoltage release for automatic control and undervoltage protection. Also any motor controlled by an automatic device must be supplied a magnetic starter.

D. Mechanically interlock starter with the unit disconnect device to prevent unintentional opening of the door while energized and unintentional opening of the door while energized and unintentional application of power while the door is open. Padlocking facilities shall be provided to positively lock the disconnect in only the off position, with one, two or three padlocks. It shall be possible to lock the disconnect with the door open or closed. Unit discon nect operating mechanism shall be mounted on the disconnect, and shall indicate "On" and "Off" with door open or closed.

E. Manual single-phase starters, surface or flush mounted, shall be provided for all 120-volt fractional horsepower motors. Starter shall consist of a manual toggle operated trip free switch in series with a thermal motor full load running current. Provide pilot light when shown on Drawings.

2.12 SAFETY SWITCHES

A. Provide, where shown, NEMA type HD, horsepower rated, 250 or 600 volt safety-type, disconnecting switches in NEMA 1 enclosures of the same manufacturer as the starters. Enclosures exposed to wet or damp conditions shall be in NEMA 3R enclosures.

B. Switches shall have a quick-make, quick-break operating handle and mechanism, which shall be an integral part of the enclosure, not the cover. Provide interlocks to prevent opening the cover with the switch in the "ON" position or closing of the switch with the door open.

C. Switches shall be capable of withstanding the available fault or let-through current before the fuse operates, without damage or change in rating.

D. Fusible safety switches shall be of the cartridge-fused type, accepting class J fuses only.

E. Motor rated switches may be used as disconnecting means for fractional horsepower motors.

2.13 GROUNDING

A. The electrical system shall be grounded as indicated on Drawings. All metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, portable equipment and other conductive items in close proximity with electrical circuits shall operate continuously at ground potential and provide a low impedance path for possible ground fault currents.

B. Inaccessible ground connections shall be made with the exothermic welding process using equipment as manufactured by Burndy, Erico Products or Copperweld.

2.14 DISTRIBUTION PANELBOARDS

A. Provide, where shown, distribution panelboards of the dead front type having fusible switches or molded case circuit breaker protective devices as shown on the schedules.

B. Distribution panelboards shall be manufactured by:

1. Square D
2. Engineer Approved Equal

C. Each panelboard shall be permanently marked with its maximum short circuit current rating. Distribution panels shall bear a service entrance label when used as service entrance equipment.

D. Main, branch or feeder circuit overcurrent devices shall be molded case circuit breaker type indicated on drawings and specified herein. Where indicated, "space for future" or "space" shall mean to include all provisions such as buses of at least the same size as the smallest feeder or branch circuit device listed or as otherwise on Drawings.

E. Provide single-phase protection in all secondary overcurrent devices feeding panels or other distribution devices that contain branch circuits for three-phase motors five (5) horsepower and above. This single-phase protection shall, upon failure of any one phase, disconnect power to the aforementioned three-phase motors by either shunt-tripping the secondary overcurrent devices or opening series connected contactors. In addition, the single-phase protection shall be equipped with a time delay function from 0 to 5 seconds, a control power transformer with primary switch and

F. Class J current-limiting fuses, and a secondary of 120 volts. The single-phase protection shall have a stored energy trip device for positive operation of the overcurrent devices and shall be so connected that the breakers will not trip when all power is turned off, a three-phase under voltage condition exists, or when power is restored.

PART 3 - EXECUTION

3.01 COORDINATION WITH THE LOCAL ELECTRICAL UTILITY

A. Coordinate work with the serving electrical utility and meet all of their requirements and schedules so that the electrical service relocation proceeds in a timely and orderly fashion. Obtain locations and details required by the utility.

3.02 FINAL INSPECTION

A. Upon completion of the Work, notify the Architect in writing, that the entire electrical installation has been thoroughly checked and that it is ready for final inspection.

B. On completion of the Work, obtain Certificates of Compliance, and approval or acceptance from all Authorities having jurisdiction over the work, and deliver these certificates to the Architect. The Work shall not be deemed to have reached a state of completion until the certificates have been delivered.

3.03 ELECTRICAL CONNECTIONS

A. Each conduit of a service entrance, feeder or branch circuit shall contain all phase conductors including one neutral conductor and one ground conductor. This applies to all individual and parallel conduit runs. The number of phase conductors shall be as indicated or required.

3.04 INSTALLATION

A. Where equipment supports are on concrete construction, take care not to weaken concrete or penetrate waterproofing.

B. Obtain prior approval for installation method of structural steel required to frame into building structural members for the support of equipment, conduit, etc. Welding will be permitted only when approved.

C. Dimensions of concrete housekeeping pads shall be coordinated with requirements for equipment supplied.

3.05 NAMEPLATES

A. Laminated plastic nameplates shall be provided for all electrical equipment (except device plates), including but not limited to the following:
   1. Distribution panelboards.
   2. Circuit-breaker panelboards.
   3. Safety switches.
   4. Low voltage relay panels.
   5. Signal and Communication Cabinets.
   6. Pushbuttons for motor controls.
   7. Separately mounted motor starters.
   8. Single-pole switches used for motor disconnect switch.

3.06 CONDUITS, FITTINGS, AND SUPPORTS

A. All conduit and raceways shall be installed concealed, except where shown on Drawings to be run exposed.

B. The outside diameter of any conduit buried in concrete shall not exceed one-third of the thickness of the structural slab, wall, or beam in which it is placed. The conduit shall be located entirely within the middle third of the member. Lateral spacing of conduits buried

in concrete slab shall be not less than three diameters, except where the concrete slab has been specially designed to accommodate a closer spacing of conduits.

C. Conduit runs shall be mechanically and electrically continuous from service entrance to all outlets. Unless otherwise specified, each conduit shall enter and be connected to a cabinet, junction box, or outlet box by means of locknuts on the inside and outside and a bushing on the inside.

D. Conduit system shall be installed complete before any conductors are drawn in. Each run of conduit shall be blown through and swabbed before conductors are installed.

E. Where empty conduit is indicated for future installation of wires, the conduit ends shall be capped and a No. 14 AWG galvanized steel fish wire or a plastic line having a tensile strength of not less than 200 pounds shall be provided.

F. The size of each run of conduit shall be the larger of the following:

1. The minimum size, which shall be 1/2 inch.
2. The size noted on Drawings.
3. The size required to accommodate the number, size and type of wires shown, specified, or required.

G. Not more than the equivalent three 90-degree bends will be permitted in any conduit run. Pull boxes shall be furnished and installed where necessary to meet this requirement.

H. Conduits shall be independently supported so that no strain will be transmitted to outlet and pull boxes. Supports shall be rigid enough to prevent distortion of conduit during wire pulling.

I. Conduits shall not come into direct contact with any mechanical system piping or duct.

J. All conduit installed underground on the exterior of the building shall have a minimum of 36 inches of cover.

K. Provide flashing and pitchpockets, making watertight joints where conduits pass through roof or waterproofing membranes.

L. Allow minimum 6 inches clearance at heat sources.

M. Escutcheon plates shall be provided for all exposed conduit passing through walls, floors, and ceilings. Plates shall be nickel-plated, of the split ring type, of size to match the conduit. Where plates are provided for conduits passing through sleeves, which extend above the floor surface, provide deep recessed plates to conceal the sleeves.

N. Conduit and Equipment Supports:

1. Vertical runs of conduits not over 15 feet long shall be supported by hangers placed not over one foot from the elbows on the connecting horizontal runs.
2. Vertical runs of conduit over 15 feet long, but not over 60 feet long and not over 4 inches in size, shall be supported on heavy steel clamps. Clamps shall be bolted tightly around the conduits and shall rest securely on the building structure without blocking.
3. Additional hangers shall be provided at concentrated load points, such as heavy equipment and pull boxes, and for conduit four inches and larger. Unless otherwise specified or indicated on Drawings, the spacing of multiple hangers shall not exceed ten feet. A hanger shall be placed within one foot of each horizontal elbow.
4. Horizontal conduit runs shall be supported on maximum eight foot centers.

O. Closing of Openings:

1. Wherever slots, sleeves, or other openings are provided in floors or walls for the passage of conduits or other forms of raceway, such openings, if unused, or if there is space left in such openings after installation of the conduit and raceways, the space or opening shall be filled.
2. Filling materials for openings in floors or walls shall be fire-resistive, with a rating equal to the material of the floor or wall, itself, and finished so as to prevent passage of water, smoke and fumes.

3. Where conduits passing through openings are exposed in finished rooms, the finish of the filling material shall match and be flush with the adjoining floor, ceiling, or wall finishes.

P. Flexible Conduit

1. May be used in:
   a. Four to six feet long lengths for final connection.
   b. Steel stud walls between outlets and from outlet to rigid raceway leaving wall.

3.07 WIRE AND CABLE

A. Wires and cable shall be rated at 600 volts minimum.
B. Commercially produced wire lubricant may be utilized to ease wire pulling. However, any such lubricant shall be of a type to produce no deteriorating effect on conductor insulation or on the interior of associated raceway and shall be approved by the wire manufacturer.
C. Cable splicing and Terminations:

1. No splices or joints will be permitted in either feeder or branch circuits except at outlets or accessible junction boxes.
2. Connectors shall be insulated by integral or separate covers by means of taping with plastic or rubber and friction tapes to provide insulating value equal to that of the conductors being joined.
3. Insulating materials for splices and connections shall be of the type for the particular use, location, and voltage, and shall be applied and installed in accordance with the manufacturer's recommendations.

D. Make conductor length identical for parallel feeders.
E. General Wiring Methods:

1. Wiring shall be provided complete from point of service connection to all receptacles, lighting fixtures, power outlets, outlets for future extensions and other devices as shown. Slack wire shall be provided for all future connections. Branch circuit conductors shall be No. 12 AWG or larger.
2. Cables shall not be bent either permanently or temporarily during installation to radii less than that recommended by the manufacturer.
3. Conductors not larger than No. 10 AWG located in branch circuit panelboards, signal cabinets, signal control boards, switchboards and motor control centers shall be bundled. Conductors larger than No. 10 AWG located in switchboards, motor control centers and pullboxes shall be cabled in individual circuits. Bundling and cabling shall be done with straps made of self-extinguishing nylon. Each strap shall be constructed with a locking hub or head on one end and a taper on the other.
4. Aluminum conductor, splices, and terminations shall use compression fittings such as the Burndy HyPlug.

3.08 OUTLET BOX

A. Outlet boxes shall be provided with only the conduit openings necessary to accommodate the conduits at the individual locations. Each box shall be large enough to accommodate the required number and sizes of conduits, wires and splices. The necessary volume shall be obtained in each case by using a box of the proper dimensions and not by the use of an extension ring.
B. In switch, or motion sensors outlet boxes where two or more 120-volt circuits are to be switched, suitable barriers to isolate each switch shall be provided.

C. Outlet boxes shall be fastened in position. Outlets in suspended ceilings occurring at locations other than at main ceiling support members shall be provided with auxiliary metal cross members.

D. No outlet box shall be installed that is supported by only the conduit.

E. Wherever possible, adjacent devices shall be grouped under a single cover plate using boxes with partitions between systems.

3.09 LIGHTING, RECEPTACLE AND POWER PANELBOARD

A. Prepare and affix typewritten directory of circuits, in a metal holder with a plastic face, on the door of the cabinet. Directories shall indicate name and location of circuit controlled.

3.10 WIRING DEVICE

A. Coordinate wiring device mounting with architectural drawings.

B. Remote maintained contact emergency stop and reset pushbuttons shall be wired ahead of all other motor control devices and shall interrupt the motor control circuit in both the "Hand" and "Automatic" positions.

C. Receptacles at water coolers shall be located behind the cooler.

3.11 GROUNDING

A. Ground bus in main service entrance equipment shall be connected by an approved method to at least two ground rods, minimum 3/4 in. by 8 ft., buried outside in unpaved earth. Where required to meet the requirements of herein specified tests, extra rods shall be installed. The rods shall be located a minimum of 10 feet from each other or any other electrode and shall beloop interconnected with each other by a minimum No. 3/0 AWG bare copper conductor brazed to each rod below grade. In addition, furnish and install in conduit a minimum 3/0 AWG green insulated copper conductor to the main metallic water service entrance and connect to same by means of approved ground clamps. Where a dielectric main water fitting is installed, connect this ground conductor to the building side of the dielectric water fitting. Do not install a jumper around this fitting. The conduit shall be bonded to the ground conductor at each end. Provide a 3/0 AWG jumper around the water meter with approved ground clamps.

B. Each dry transformer shall have a separate ground conductor sized in accordance with NEC 250-94, run from the secondary ground point to the nearest cold water pipe. This is in addition to the normal equipment ground that is connected back to the primary feeder source ground point.

C. Secondary services shall be grounded at the supply side. Distribution panels connected through transformers and service entrance equipment shall be provided with a neutral disconnecting means, which interconnects with the neutral and ground buses to establish the system common ground point. The neutral disconnecting link or links shall be located so that the neutral bar with all interior secondary neutrals can be isolated from the common ground bus and the feeder or service entrance conductors.

D. All equipment grounding conductors shall be provided with green insulation equivalent to the insulation on the associated phase conductors. The related feeder and branch circuit grounding conductors shall be brazed to the grounding bar or connected with approved pressure connectors. A feeder serving several panelboards shall have a continuous grounding conductor which shall be connected to each related cabinet bar.

E. Provide a separate green insulated equipment grounding conductor for each single or three-phase feeder circuit and each branch circuit with a three-phase protective device or as shown on Drawings. The required grounding conductor shall be installed in the common conduit with the related phase and/or neutral conductors. Where there are parallel feeders installed in more than one raceway, each raceway shall a green insulated equipment ground conductor. Single-phase branch circuits required for 120V lighting and/or receptacles shall

consist of phase and neutral conductors installed in common metallic conduit, which shall serve as the grounding conductor. Flexible metallic conduit equipment connections utilized in conjunction with the above single-phase branch circuits shall be provided with suitable green insulated grounding conductors connected to approved grounding terminals at each end of the flexible conduit.

F. Grounding cable shall not be buried directly in concrete, but a conduit sleeve shall be provided where cable passes through concrete.

G. Where ground conductors are indicated on the drawings and for all feeders, the use of the metallic raceway in place of the ground conductor will not be permitted. Where PVC conduit is used, be responsible for installing a code sized ground conductor, whether shown or not.

H. The complete equipment grounding system shall be subjected to a metered test at service entrance equipment ground bar to ensure that the ground resistance, without chemical treatment or other artificial means, does not exceed three ohms.

3.12 DISTRIBUTION PANELBOARD

A. Surface-mounted panelboards for other than plywood paneling walls shall be supported from floor slab secured "Unistrut" channels.

3.13 LIGHTING FIXTURE

A. Equipment locations and types shall be shown on Drawings and modified by approved shop drawings.

1. Verify fixture locations with architectural plans, reflected ceiling plans and other reference data prior to installation.
2. Check for adequate headroom and non-interference with other equipment, such as ducts, pipes or openings.

B. Upon completion of the installation, lighting equipment must be in first class operating order and free from defects in condition and finish.

1. At time of substantial completion of the project, all lighting fixtures and equipment shall be complete with required lenses or diffusers, reflectors, side panels, louvers, and other necessary components. If lighting fixtures are used for construction lighting, all used lamps shall be replaced with new, unused lamps. If only one set of lamps are provided for the building fixtures, provide, operate, and remove all construction lighting using temporary lighting fixtures.
2. Fixtures and equipment shall be clean and free from dust, plaster or paint spots.
3. Housings shall be rigidly installed, and adjusted to neat flush fit with the ceiling or other finished mounting surface.
4. No light leaks shall be permitted at the ceiling line or from any visible part or joints of the fixtures and shall be achieved without the use of gaskets or tape.

3.14 LIGHTING FIXTURE SUPPORTS

A. Recessed fixtures shall be furnished complete with mounting devices and accessories, and so constructed and mounted to permit access to wiring.

B. Attachment devices shall be made of formed, rolled, or cast metal shapes with the requisite rigidity and strength to maintain continuous alignment of the installed fixtures.

C. Fluorescent fixtures on suspended ceilings shall be supported from the floor construction above by means of a minimum of four separate galvanized chains or wires per fixture, one at each corner of the fixture. Each chain shall be capable of supporting 100 lbs. and each wire shall be a minimum of 12 AWG mild steel. Also provide saddle hangers or tie bars

attached to runners or between cross- bars of ceiling systems. Provide mounting splines or other positive means of maintaining alignment and rigidity. Supporting members shall be surface passivated, and primed or paint-dipped to resist corrosion.

D. Indirect fluorescents below suspended ceilings shall be supported using two white tubes, containing the conductors.

E. Fastening devices shall be of a positive, locking type, and shall not require the use of special tools to apply or to remove. Tie wires shall not be used in place of fastening devices.

F. Verify all ceiling conditions from the Drawings and furnish appropriate mounting hardware for each lighting fixture.

G. Pendant or surface-mounted fixtures shall be provided with required mounting devices and accessories, including hickeys, stud-extensions, ball-aligners, canopies and stems. Suspension means in mechanical areas shall be at least two 1/4" all-thread rods per fixture, attached to the structure above. Coordinate locations of fixtures in mechanical areas. Provide mounting stems on pendent fixtures of the correct length to uniformly maintain the fixture heights as shown on Drawings or established in the field.

3.15 MANUFACTURER'S DIRECTIONS AND SUPERVISION

A. Follow manufacturer's directions for installation, testing and operation of all apparatus and equipment indicated on Drawings or specified.

B. Prior to final acceptance, prepare and submit for review ten (10) copies of operation and maintenance (O and M) instructions in printed form for each item or equipment or system installed in the building. Complete instructions for each system shall be assembled and bound in a brochure.

END OF SECTION

SECTION 16120

CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Furnishing and installing conductors and cables as shown on the drawings and schedules.

1.02 SUBMITTALS

A. General: Submittals shall be according to Section 01340 - Submittal Procedures.
B. Manufacturer's Literature: Submit 8 copies of the manufacturer's technical data for the wires and cables to be used on this project.

1.03 QUALITY ASSURANCE

A. Labeling Requirements: Conductors and cables shall be Underwriters' Laboratories, Inc. (UL) listed and labeled. UL listing and labeling will not be required if it can be shown that conductors and cables meet the requirements of another nationally recognized testing laboratory (NRTL).

PART 2 - PRODUCTS

2.01 MATERIALS

A. General: Conductors, cables, and connectors shall be constructed of the manufacturers standard materials, as listed in published product information; types and sizes shall be as indicated or as required for the installation.

B. Conductors for General Wiring: Unless indicated otherwise, shall be as follows:

1. Single solid copper for sizes No. 8 AWG and smaller.
2. Single stranded copper for sizes No. 6 AWG and larger.
3. Type THW, THWN or XHHW insulation and rated 600 V for use in conduit.
4. Type UF or USE for direct burial.
5. Insulation colored to meet color coding requirements.

C. Type NM, NMC and UF Non-Metallic Sheathed Cables: Shall be as follows:

1. Multiple copper conductors.
2. With color coded, type TW insulated phase and neutral conductors rated 600 V.
3. With full size grounding conductor.
4. With a polyvinylchloride jacket overall.

D. Type N-SD Self-Supporting Secondary and Service Drop Cables: Shall be as follows:

1. Hard-drawn aluminum, insulated phase conductors.
2. High molecular weight polyethylene or cross-linked polyethylene insulated phase conductors, rated 300 V.
3. With full size ACSR neutral/messenger wire.

E. Direct-Buried Signal and Communication Cables: Shall be as follows:

1. Color coded thermoplastic insulated, copper conductors.
2. With extruded polyethylene inner jacket over the conductors.
3. With gopher resistant, 4 mil (min) thick metallic shield over the inner jacket.
4. With extruded high density polyethylene outer jacket overall.

F. Primary Service Cables: Unless indicated otherwise, shall be as follows:

1. Single, stranded, aluminum conductor.
2. With extruded semi-conducting shield over conductor.
3. With high molecular weight polyethylene or cross-linked polyethylene or ethylene propylene insulation over conductor shield.
4. With extruded semi-conducting shield and jacket over insulation.
5. With full size neutral consisting of bare solid copper wires, uniformly spaced and spiraled concentrically overall.

G. Portable Power Cords: Shall be as follows:

1. Multiple, flexible-stranded or extra flexible-stranded copper conductors individually insulated with color-coded rubber and spiraled together.
2. With suitable fillers and separators to produce a round cable.
3. With overall jacket material and voltage rating as follows:

CORD TYPE	JACKET MATERIAL	VOLTAGE RATING
SJ	rubber	300
S	rubber	600
SJO	neoprene	300
SO	neoprene	600

H. Submersible Pump Feeder Cables: Shall be single stranded, copper conductors, with color-coded neoprene insulation rated 600 V, assembled to form a triple conductor cable sized according to the pump manufacturer's recommendations and cabled together as follows:

1. Conductors No. 10 AWG and smaller, assembled parallel to each other in a flat configuration with an extruded neoprene jacket overall.
2. Conductors No. 8 AWG and larger, twisted together with or without jacket.

I. Conductors for Suspended, Liquid-Level Electrodes: Shall be No. 18 AWG (minimum) stranded copper conductor with vinyl insulation. Electrode and conductor shall be supplied by the same manufacturer.

J. Fixture Wires: Shall be single, stranded, No. 18 AWG copper conductor with silicone rubber insulation rated 600 V and with a glass braid jacket overall. Fixture wires shall be type SF-2 (rated 200 degrees C) or type SFF-2 (rated 150 degrees C).

K. Conductor Color Coding: Insulation shall be solid color compound for No. 8 AWG and smaller; larger conductors shall be painted or taped for 2 inches (min.). Color coding shall be as follows:

	120/208 V	120/240 V		277/480 V
		1-Ø	3-Ø	
Phase A	Black	Black	Black	Brown
Phase B	Red	Red	Orange	Orange
Phase C	Blue	--	Blue	Yellow
Neutral	White	White	White	Grey
Ground	Green	Green	Green	Green

L. Connectors and Lugs: Shall be solderless, pressure type of high conductivity and high strength metals or alloys with current and voltage ratings not less than the conductors to which they are connected, shall be approved for use with the wire material, and with characteristics to suit application as follows:

1. Screw-On Splice Connector: Shall be a steel spring, helically wound into a cone shape with integral thermoplastic insulating cover.
2. Crimp-On Splice Connector: Shall be tubular metal sleeve designed to accept one conductor in each end for crimp attachment, with wire-stop indentation at the center of the sleeve. Connector shall have a fixed, vinyl insulating sleeve over the metal sleeve, extending beyond the metal ends and flared to fit over conductor insulation.
3. Split-Bolt Splice Lug: Shall consist of a threaded bolt longitudinally slotted to accommodate the conductors, with hex nut to clamp the conductors against the head end of the slot.
4. Two-Bolt Splice Lug: Shall consist of a saddle and cinch plate design to clamp over conductors by the use of two bolts.
5. Compression Sleeve Splice Lug: Shall consist of hollow tubular sleeve designed for pressure-indent attachment of one conductor at each end, with wire stop at midpoint and suitable for copper to aluminum splice.
6. Forked Tongue Terminal Connectors: Shall have one end flat and slotted to form a two prong fork and the other end tubular, designed for pressure-indent attachment to a conductor. Connector shall have fixed plastic insulating sleeve over the tubular end extending beyond the outside end of the tube and flared to fit over the conductor insulation.
7. Disconnect Terminal Connector: Shall have one end flat with side edges curled toward the centerline designed to make a tight, push-on connection with a flat male tang. Other end tubular, designed to accept one conductor for crimp attachment. Connector shall have a fixed plastic insulating sleeve over the tubular end extending beyond the outside end of the tube and flared to fit over conductor insulation.
8. Screw Clamp Terminal Lug: Shall have one end barreled to receive a stranded conductor and shall have a threaded clamping element designed to screw in perpendicular to the axis of the barrel. Clamping element may be a slotted screw, hex socket screw or hex bolt. Other end shall be a flat-tongue with hole to permit bolting to a flat surface. Lugs for conductors larger than 250 kcmil shall have two clamping elements in the barrel and two holes in the tongue. Lug for terminating two conductors at the same terminal point shall be double barreled.
9. Compression Terminal Lug: Shall have one end tubular for pressure-indent connection of one conductor and other end flat-tongued with hole to permit bolting to a flat surface. Lugs for conductors larger than 250 kcmil shall have two holes in the tongue.

M. Insulating Materials: Shall be of the type approved for the particular use, location, and voltage and shall be noncorrosive to the conductors being spliced.

1. Plastic Tape: Shall be flame-retardant vinyl plastic not less than 3/4-inch wide and 7 mils thick, with a minimum stretchability of 50% at -15 degrees C and shall remain soft, pliable and adhesive throughout a working temperature range of -15 to 100 degrees C.
2. Rubber Tapes: Shall be self-fusing, corona-resistant and shall be compatible with butyl rubber, ethylene propylene rubber, polyethylene and cross-linked polyethylene insulations. Tapes shall have a minimum dielectric strength of 800 V per mil and shall remain soft, pliable and adhesive throughout a working temperature range of 0 to 90 degrees C.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Install conductors, cables, and connectors as indicated or as necessary, complying with the manufacturer's written instructions, applicable requirements of codes and standards, and according to recognized industry practices.
B. Conductor Protection: Unless otherwise indicated, install circuits consisting of one or more single conductors in conduit.
C. Wiring Required: Install and connect conductors from the Utility Company's point of delivery to equipment requiring electrical connections and to outlets for future connections as specified or shown on the drawings.
D. Cable Bends: Do not bend cables to radii less than 10 times the cable's overall diameter.
E. Bundling: In panelboards, train conductors No. 10 and smaller neatly from terminal points to the sides of the box, then bundle and tie them together with nylon locking straps. For conductors No. 8 and larger bundle and tie each circuit separately.
F. Voltage Drop Reduction for Long Home Runs: Install No. 10 wire between the circuit breaker and the first outlet in any 20 ampere branch circuit where the distance between panelboard and outlet exceeds 75 feet.
G. Pulling Lines and Lubricants: Use either rope or flat steel lines to pull conductors into conduits. Attach the conductor to the pulling line with either a woven basket grip or a pulling eye connected directly to the conductor. Verify that any lubricant used for pulling conductors will not damage conductor insulation. Pull all conductors together.
H. Splices and Terminations (Up to 600 V): Shall be:

1. Screw-On Splice Connectors: Install for splicing two or more conductors No. 8 and smaller.
2. Crimp-On Splice Connectors: Install where butt splice is required on conductors No. 8 and smaller.
3. Split-Bolt Splice Lugs: Install for splicing or tapping two conductors size No. 6 through No. 1/0.
4. Two-Bolt Splice Lugs: Install for splicing or tapping two conductors No. 2/0 and larger.
5. Compression Sleeve Splice Lugs: Install where butt splice is required and for splicing copper to aluminum conductors No. 6 and larger.
6. Forked Tongue Terminal Connectors: Install wherever stranded conductors No. 8 and smaller are to be connected to devices equipped with terminal screws.
7. Disconnect Terminal Connectors: Install wherever stranded conductors No. 8 and smaller are to be connected to devices equipped with flat, male terminal tangs.

8. Screw Clamp Terminal Lugs: Install wherever stranded conductors No. 6 and larger are to be connected to a flat surface. Install lugs with two stud holes and two clamping elements for conductors larger than 250 kcmil. Install double barreled lugs where two conductors are to be connected to the same terminal point.
9. Compression Terminal Lugs: Install wherever stranded conductors are to be connected to a flat surface. Install lugs with two stud holes for conductors larger than 250 kcmil.
10. Compression Tools: Follow manufacturer's instructions and use tools and dies recommended by the manufacturer when installing indent or compression connectors and lugs.
11. Matching Sizes: Install connectors and lugs designed to accommodate the conductors to which they are attached. Connector and lug openings shall be at least as large as conductor cross section (without insulation).
12. Tight Contacts: Screw down threaded clamping elements and equipment terminal screws and bolts to assure a tight, stable, low-resistance contact at all splices and terminations.
13. Insulation: Insulate splices with preformed plastic covers designed to fit the lug being insulated or with rubber or plastic tape. Apply enough tape so that splice insulation is not less than conductor insulation.
14. Accessibility: Make splices only in accessible locations.

END OF SECTION

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SECTION 16405

ELECTRIC UTILITY SERVICE

PART 1 - GENERAL

1.01 SCOPE

A. The CONTRACTOR shall provide all coordination, labor, materials, equipment, services, and incidentals necessary and/or required to furnish and install a new electric service.
B. The CONTRACTOR shall furnish all equipment and perform all work in accordance with requirements and specifications of the local electric utility company.
C. The CONTRACTOR shall pay all local electric utility company one time fees associated with the new service not paid directly by the OWNER.
D. The CONTRACTOR shall be responsible for furnishing all information required by the local electric utility company. This shall include, but not be limited to, all easement application information, service application information, work order information, and inspection documentation.
E. The ENGINEER, for information purposes only, shall be copied on all correspondence between the CONTRACTOR and the local electric utility company.

1.02 WORK BY OTHERS

A. The Local Electric Utility Company shall:

1. Furnish, to the CONTRACTOR, all required applications associated with the execution of the Work.
2. Provide the electric service to the site.
3. Designate the point-of-attachment.
4. Provide the revenue meter and, if required, metering transformers complete with interconnecting wiring.
5. Advise the CONTRACTOR of installation requirements and inspect the installation for compliance.

PART 2 - PRODUCTS

2.01 Specified in other Sections.

PART 3 - EXECUTION

3.01 CONTRACTOR

A. Furnish underground conduit(s), wide sweep elbows, and risers from the local utility company designated point-of-attachment to the service entrance disconnect. Refer to the Contract Drawings for quantity of conduits, routing, conduit material, bedding or encasement information, etc.
B. Temporarily cap both ends of each service conduit until ready for use.
C. Cap both ends of spare service conduits with appropriate covers designated for this function (not duct tape). Furnish a heavy- duty nylon pull string in each spare service conduit.
D. Supply and install the new service conductors between the local electric utility company designated point-of-attachment and the service entrance disconnect. (The local electric utility company shall terminate the CONTRACTOR furnished service conductors at the designated point-of-attachment.) The CONTRACTOR shall properly terminate all service conductors at the service entrance disconnect.

E. Shall supply, install, and properly ground RGS conduit between the service entrance metering transformers and the local utility company revenue meter as indicated on the Contract Drawings.

END OF SECTION

SECTION 16500

LIGHTING

PART 1 - GENERAL

1.01 SCOPE

A. This Section covers minimum requirements for lighting furnished either the CONTRACTOR.
B. Unless noted otherwise, the CONTRACTOR shall furnish and assemble all fixtures, lamps, ballasts, control devices, materials, and interconnection necessary and required to provide a complete and functional lighting system.

1.02 SUBMITTAL

A. For Approval

1. Submit Manufacturer's data (i.e. catalog cut sheets) for each type of fixture and/or device.

PART 2 - PRODUCT

2.01 GENERAL

A. Unless noted otherwise, each fixture shall be brand new and shall be UL listed and bear a label stating so.
B. All fixtures shall be formed from material of required thickness to prevent twisting and/or warping.
C. Identical fixtures shall be provided with identical diffusers and identical lamps.
D. Refer to the Contract Drawings and/or other sections of this Specification for additional lighting information.
E. Unless noted otherwise on the Contract Drawings or other sections of this Specification, only 120VAC shall be utilized for lighting applications.

2.02 FLUORESCENT FIXTURES

A. Open Industrial Channel:

1. Two (2) lamp or four (4) lamp. Refer to the Contract Drawings.
2. Solid Top (no uplight)
3. Phosphate treated, white painted, die-formed steel
4. Specular reflector
5. Lithonia AFST–2–32 (for 2 lamp applications) or AFST–4–32 (for 4 lamp applications), or Equal.

B. Four Foot Enclosed

1. Two (2) lamps.
2. Reinforced molded polyester fiberglass housing.
3. One piece molded acrylic diffuser.
4. Retained non-metallic latches.
5. Neoprene gasket between housing and diffuser.
6. UL listed for wet locations.
7. Lithonia DMW-2-32, USI Columbia LUN240-WL, or Equal.

C. Compact

1. Coated aluminum housing.
2. Acrylic refractor.
3. Enclosed and gasketed. Suitable for wet locations.
4. Refractor guards.
5. Stainless steel exterior hardware.
6. O-Z Gedney CM; GE Mini●Gard MGA; or Equal.

2.03 HIGH INTESITY DISCHARGE FIXTURES

A. Wall-Pak

1. 518 LEDs, 36 Watts.
2. 50,000 hours life; 80% Energy Savings over HID.
3. Precision die cast aluminum housing, with bronze finish.
4. Borosilicate Prismatic Lens Refractor
5. Model WP-36W-ETS by Energy Tech Solutions, LLC, or Equal.

B. Low Bay

1. General Electric Minimite, Holophane Petrolux II, or Equal.
2. Industrial grade.
3. Borosilicate prismatic glass refractor/diffuser.
4. Aluminum housing with corrosion resistant paint.
5. Suitable for damp locations.
6. Include prewired autoregulating integral ballasts.

C. Floodlights

1. Corrosion-resistant fiberglass reinforced polyester housing.
2. Suitable for exterior (wet) service.
3. General Electric HLU/VLU Powerflood, or Equal.

D. High Bay

1. Include prewired autoregulating integral ballast and housing.
2. Suitable for damp locations.
3. Enclosed reflector.
4. Certain fixtures, indicated on Contract Drawings, to include time delayed automatically switched quartz lamp (instant-on lamp).
5. General Electric Filterglow or Equal.

2.04 BALLASTS

A. General

1. Rated for voltage required by application.
2. Minimum temperature rating for interior locations: +25ºF.
3. Minimum temperature rating for exterior locations: - 15ºF.
4. Identical fixtures shall be provided with identical ballasts.

B. Fluorescent

1. Rapid start
2. Solid state electronic

3. 0.90 power factor minimum
4. Class A sound rating or better
5. THD less than 10 percent
6. Automatic reset
7. Thermal protection
8. Utilize two-lamp ballasts in open industrial type fixtures; three lamp and four lamp ballasts shall not be used.

C. High Intensity Discharge

1. Capable of operation with an open or short circuit condition without significant loss of life.
2. Entirely encapsulated
3. THD less than 20 percent
4. Auto-regulating type for metal halide lamps.

D. Emergency

1. High temperature maintenance free battery type.
2. Battery charger
3. Electronic control circuitry
4. One (1) compact metal housing
5. Visible status indication light
6. Test switch
7. Capable of operating two 48-inch 32W T-8 fluorescent lamps
8. Capable of 90 minutes of continuous illumination.

2.05 LAMPS

A. Fluorescent (F)

1. 48 inch, 32 watt, T-8 Octran
2. Compact (CF) wattage as indicated on the Contract Drawings
3. Rapid start
4. Triphosphor
5. Operate at 4100^{o} Kelvin

B. Metal Halide (MH) or High Pressure Sodium (HPS)

1. 70, 100, 175, 400, or 1000 watt as indicated on the Contract Drawings
2. Coated
3. Base and bulb to suit fixture

2.06 EMERGENCY LIGHTING

A. Provided either by emergency ballasts in certain fluorescent fixtures or by self-contained emergency battery units.

2.07 EXIT SIGNS

A. Light emitting diode type.
B. Outage of one LED will not affect the integrity of the total sign.
C. Normal operation from the building power supply.
D. Emergency operation for 90 minutes from a self-contained battery.
E. When indicated, include a NEMA 4X Corrosion resistant enclosure.
F. Lithonia Signature LED, Chloride Infinity LED, or equal.

2.08 PHOTOELECTRIC SENSORS

A. Shall be used to turn individual exterior lights on at dusk.
B. Shall have an adjustment for the amount of footcandles that turn the unit on and off.
C. Lights to remain on if the photocell fails.
D. Typically included with wallpacks and/or floodlights used on the exterior of buildings.

2.09 WALL SWITCHES

A. 120/277VAC
B. Toggle handle, totally enclosed case.
C. 20 Ampere
D. Industrial specification grade.
E. Side wired.
F. Provide a ground screw.
G. Ivory color (except where wall finish is wood or dark color, then use brown color)
H. Providing matching 2-pole 3-way and/or 2-pole 4-way switches as indicated on the Contract Drawings or as required for the application.
I. Leviton or Equal.

2.10 EMERGENCY BATTERY UNITS (EBU)

A. Self-contained emergency lighting units.
B. Maintenance free 6V nickel-cadmium battery with 90 minutes of full capacity.
C. Battery charger with sufficient capacity to recharge a fully discharged battery back to full charge within 12 hours.
D. Two (2) sealed beam lamps. Combined lamp output of 25 watts minimum.
E. NEMA 4X fiberglass reinforced polyester enclosure.
F. Indication of AC power on, unit recharging, and fault condition.
G. Include a test button (transfer unit from external AC power to integral battery supply).
H. Lithonia, Hubbell, Chloride, or equal.

2.11 COVER PLATES

A. Recessed boxes: plastic wallplate to match color of switch.
B. Surface mounted boxes: beveled stamped sheet steel.
C. Weatherproof surface mounted boxes: beveled cast iron (similar to box material) cover with gasket.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Minimum average foot-candle illumination levels, as measured at 3 feet above floor level with a 0.70 maintenance factor, shall be:

Emergency egress	5 foot-candles
Stairways and walkways	20 foot-candles
Main process areas	40 foot-candles
Electrical rooms	50 foot-candles
Office areas	75 foot-candles
Exterior process areas	10 foot-candles
Exterior non-process areas	2 foot-candles

B. Light fixtures, lamps, ballasts, and exit signs shall meet the standards, if applicable, to qualify for local electric utility company rebates.

C. If applicable, the Contractor shall file necessary forms for a local electric utility company rebate program. The refund check shall be sent by the local electric utility company directly to the Owner.

D. Furnish and install all supports, hardware, wiring, and accessories necessary and required.

E. All conduit for exterior fixtures shall be run on the interior of the building.

F. Fixtures shall be ceiling mounted wherever possible. Wall mounted lighting fixtures shall be allowed only where mechanical interference prevents ceiling mounted units or where indicated on the Contract Drawings.

G. Fixtures shall be supported independently of HVAC ductwork, ductwork supports, or other mechanical equipment.

H. Fixture mounting heights and locations indicated on the Contract Drawings are approximate and are subject to revision in the field when necessary to clear conflicts and/or obstructions.

I. The Contract Drawings indicate an approximate arrangement to provide uniform light distribution. If interference causes the arrangement to change, the fixture installer shall be responsible for a uniform light distribution.

J. Immediately prior to acceptance by the Owner, the fixture installer shall clean all fixtures, reflectors, and diffusers by the manufacturer's recommended practice.

K. Four-foot fluorescent fixtures shall be supported by at least two fixed support points. Chain shall not be used to support fixtures.

L. Light fixtures shall be supported independently of the cable and/or conduit entering the fixture.

M. Install ballasts for all fixtures that require ballasts.

N. Replace any ballast that exceeds the normal sound level.

O. Four-lamp fluorescent fixtures shall utilize two ballasts.

P. Install new lamps in all fixtures.

Q. Install all controls for lighting system per the equipment manufacturer's recommendations.

END OF SECTION

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