

TECHNICAL SPECIFICATIONS

SLOCUM PARK – PHASE IV IMPROVEMENTS  
CITY OF HAVELOCK



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P.O. Box 368  
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Havelock, NC 28532

Job No.: 2017027  
Drawing No. W-3722



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SECTION 02210 – CLEARING, EXCAVATION AND TRENCHING

PART 1 - GENERAL

RELATED DOCUMENTS:

The general provisions of the Contract, including the General and Special Conditions and Division-1 Specification sections apply to work of this section.

DESCRIPTION OF WORK:

This section covers excavation work and shall include the necessary clearing, grubbing and preparation of the site; removal and disposal of all debris; excavation and trenching as required; the handling, storage, transportation and disposal of all excavated material; all necessary sheeting, shoring and protection work; preparation of subgrades; pumping and dewatering as necessary or required; protection of adjacent property; backfilling; pipe embedment; construction of fills and embankments; surfacing and grading; and other appurtenant work.

RELATED WORK SPECIFIED ELSEWHERE:

Storm Sewer and Sanitary Sewer Systems: Division-2

Pipe and Pipe Fittings: Division-15

QUALITY ASSURANCE:

Codes and Standards: Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction and the OSHA. Field and laboratory testing should be performed in accordance with applicable standards, except where more stringent requirements are shown or specified:

ASTM D 422	“Particle Size Analysis of Soil”
ASTM D 1556	“Density and Unit weight of soil in place Sand-Cone Method”
ASTM D 698	“Laboratory Compaction Characteristics of Soil Using Standard Effort”
ASTM D 2216	“Laboratory Determination of Water (Moisture) Content of Soil And Rock”

ASTM D 2487	“Classification of Soils for Engineering Purposes (Unified Soil Classification System)”
ASTM D 2922	“Density of Soil and Soil-Aggregate In Place by Nuclear Method”
ASTM D 2937	“Density of Soil In Place by the Drive-Cylinder Method”
ASTM D 3017	“Water Content of Soil and Rock In Place by Nuclear Method”
ASTM D 4318	“Liquid Limit, Plastic Limit, and Plasticity Index of Soils”
ASTM D 4718	“Correction of Unit Weight and Water Content for Soils Containing Oversize Particles”
ASTM D 4959	“Determination of Water (Moisture) Content by Direct Heating Method”
ASTM D 5519	“Particle Size Analysis of Natural and Man-Made Riprap Materials”

Testing and Inspection Service:

The OWNER shall select a testing laboratory to perform soil testing and inspection service for quality control testing during earthwork operations. The cost of testing and inspection shall be paid for out of the testing allowance. Testing agency shall be selected by and work for the OWNER but be paid by the CONTRACTOR.

Testing laboratory shall test compaction of backfill placed in accordance with ASTM D 1556, D 2937, or D 2922 and 3017, based upon moisture-density relationships determined for each soil type by ASTM D 698.

All compaction tests performed in the field shall be based upon “field check points” or “one-point Proctor” data for similar laboratory compaction curves, and shall be molded dry of the optimum moisture content of an individual material.

Compaction testing utilizing ASTM D 2922 and D 3017 will provide correlation tests utilizing D 1556. The frequency of correlation tests will be determined by the OWNER.

Compaction Tests will be performed at the following locations and frequencies, unless otherwise directed by the OWNER.

Paved and Building Slab Areas: One test per lift for every 2500 sq.ft. of fill material placed, but no less than two tests per lift.

Trench Backfill: One test per lift for every 100 ft. or less, but no fewer than two tests per lift.

Foundation Wall Backfill: One test per lift for every 75 ft. or less, but no fewer than two tests per lift.

Foundation (Footing) Subgrade: Evaluation of foundation subgrades for adequate bearing capacities by performing Dynamic Hand Cone Penetrometer tests. Tests shall be provided at sufficient number of locations and extended to sufficient depths to confirm subsurface findings of design subsurface investigation as approved by OWNER. Subsequent or intermediate testing of other foundation subgrades may be based on a visual comparison with tested subgrade when approved by the OWNER.

SUBMITTALS:

Test Reports-Excavating: Submit following reports directly to OWNER from the testing services, with copy to CONTRACTOR:

Test reports on borrow material

Verification of each footing subgrade

Field density test reports

One optimum moisture-maximum density curve for each type of soil encountered

Report of actual unconfined compressive strength and/or results of bearing test of each strata tested

JOB CONDITIONS:

Classification of Excavated Materials: No classification of excavated materials will be made. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the Contract Work, regardless of the type, character, composition or condition thereof.

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

Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position, when acceptable to Engineer.

Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Engineer.

Undercut Excavation: When excavation has reached required natural or undisturbed subgrade elevations, notify Engineer who will make an inspection of conditions. If unsuitable natural or undisturbed bearing materials are encountered at required subgrade elevations, carry excavations deeper and replace excavated material as directed by Engineer.

All subgrades of all structures must be inspected by soils testing lab prior to placement of stone.

Removal of unsuitable material and its replacement as directed will be paid on basis of contract price established in the Bid Schedule. Backfill placed during this project which has been compacted to less than specified compaction and requires removal and replacement, will not be considered as undercut.

Existing Utilities: Locate existing underground utilities in areas of Work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations.

Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility OWNER immediately for directions. Cooperate with OWNER and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility OWNER.

Do not interrupt existing utilities serving facilities occupied and used by OWNER or others, during occupied hours, except when permitted in writing by OWNER and then only after acceptable temporary utility services have been provided.

Provide minimum of 48-hour notice to OWNER, and receive written notice to proceed before interrupting any utility.

Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility OWNER for shut-off of services if lines are active.

Use of Explosives: The use of explosives is not permitted.

Protection of Persons and Property: Barricade open excavations occurring as part of this Work and post with warning lights.

Operate warning lights as recommended by authorities having jurisdiction.

Protect structures, utilities, sidewalks, pavements and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.



Perform excavation within drip-line of large trees to remain by hand, and protect the root system from damage or dryout to the greatest extent possible. Maintain moist condition for root system and cover exposed roots with burlap. Paint root cuts of 1" diameter and larger with emulsified asphalt tree paint.

## PART 2 - PRODUCTS

### DEFINITIONS:

Satisfactory soil materials are defined as those complying with ASTM D 2487 soil classification groups GW, GP, GM, GC, SM, SW and SP.

Provisionally satisfactory soil materials are defined as those complying with ASTM D 2487 soil classification group SC. Provisionally satisfactory soil materials are moisture sensitive soils which are expected to require moisture conditioning, particularly in wetter times of the year, in order to be considered satisfactory. If proper densities cannot be achieved by moisture conditioning prior to backfill, the soils shall be deemed unsatisfactory and replaced with satisfactory materials at no additional cost to the OWNER.

Unsatisfactory soil materials are defined as those complying with ASTM D 2487 soil classification groups ML, MH, CL, CH, SC, OL, OH and PT.

### GENERAL MATERIALS:

Clean Sand: Washed or natural sand with less than 10 percent by weight passing the No. 200 sieve.

Engineering Fabric: For use in soil stabilization, provide synthetic fabric as specified in NCDOT Standard Specifications for Roads and Structures Section 1056 Type 2.

Filter Cloth: For use under granular fill, provide spun synthetic fiber; 20 oz/sy; burst strength of 500 psi, vertical water flow of 265 gpm/sy.

Granular Fill (Granular Embedment and Stabilization Material): Granular fill or embedment material shall be crushed rock or gravel, shall be free from dust, clay or trash, and shall be #67 or #57 stone as defined in ASTM C 33 except that larger stone may be used for stabilization if approved by the ENGINEER.

Aggregate Base Course Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, natural or crushed sand as specified in NC DOT Standard Specifications for Roads and Structures, Section 1010, Type A.

Fill Material (Backfill): All material deposited in trenches shall be satisfactory soils free from rocks or stones larger than 2 inches, brush, stumps, logs, roots, debris and organic or other objectionable materials, and shall be wetted or dried as required and thoroughly mixed to ensure uniform moisture content.

Select Backfill: Job excavation or borrow material consisting of coarse sands and fine sands with not more than 15% by weight passing the no. 200 sieve. This does not include clays, silts, organic soils or any materials not acceptable as fill material. Select backfill must receive prior approval from the ENGINEER before use. (ASTM D2321 Class II)

#### PIPE EMBEDMENT:

Embedment materials both below and above the bottom of the pipe, classes of embedment to be used and placement and compaction of embedment materials shall conform to the requirements shown on the drawings and to the following supplementary requirements.

Embedment materials shall contain no cinders or other material which may cause pipe corrosion.

Class B Bedding shall be used for all ABS and PVC Truss pipelines.

Class B Bedding shall include granular embedment compacted from 4" below the pipe to the springline, and compacted embedment at least 12" above the pipe as shown on the attached drawing.

Class C Bedding shall be used for all reinforced and nonreinforced concrete pipelines.

Class C bedding shall include granular fill compacted from 4" below the pipe to 1/6 of the outside diameter of the pipe and satisfactory backfill embedment compacted to at least 12" above the top of the pipe as shown on the drawings.

Class D Bedding shall be used for all PVC gravity sewer pipe.

Class D bedding shall include granular embedment from 4" below the pipe to the top of the pipe and at least 12" of compacted select backfill embedment above that as shown on the drawings.

Class E Bedding shall be used for all PVC pressure pipe.

Class E embedment shall include select backfill embedment compacted from 4" below the pipe to at least 12" above the pipe as shown on the drawings.

Class F Bedding shall be used for all ductile iron pipe. (AWWA C150/C151 Type 2)

Class F embedment shall include satisfactory compacted backfill material compacted from the bottom of the pipe (and bell holes) to at least 12" above the pipe as shown on the drawings.

Class G Bedding shall be used for ductile iron pipe. (AWWA C150/151 Type 3)

Class G Bedding shall be the same as Class F Bedding with compacted clean sand or granular fill from 4" below the pipe to 1/6" of the outside diameter of the pipe as shown on the drawings.

### PART 3 - EXECUTION

#### GENERAL REQUIREMENTS:

Excavation shall provide adequate working space and clearances for the Work to be performed therein and for installation and removal of concrete forms. In no case shall excavation faces be undercut for extended footings.

Subgrade surfaces shall be clean and free of loose material of any kind when concrete is placed thereon.

Backfilling and construction of fills and embankments during freezing weather shall not be done except by permission of the ENGINEER. No backfill, fill or embankment materials shall be installed on frozen surfaces, nor shall frozen materials, snow or ice be placed in any backfill, fill or embankment.

#### SITE PREPARATION, CLEARING AND GRUBBING:

All sites to be occupied by permanent construction or embankments shall be cleared of all logs, trees, roots, brush, tree trimmings and other objectionable materials and debris. All stumps shall be grubbed. Subgrades for fills and embankments shall be cleaned and stripped of all surface vegetation, sod, and organic topsoil. All waste materials shall be removed from the site and disposed of by and at the expense of the CONTRACTOR.

Clear and grub the entire width of the permanent right of way. All other clearing shall be performed as necessary for access, stringing of pipeline materials, and construction of the pipeline and appurtenant structures.

Burning on Site: Burning is not permitted on the site.

#### PRESERVATION OF TREES:

No trees shall be removed outside of excavated or filled areas, unless their removal is authorized by the OWNER. Trees left standing shall be adequately protected from permanent damage by construction operations.

UNAUTHORIZED EXCAVATION:

Except where otherwise authorized, shown or specified, all materials excavated below the bottom of concrete walls, footings, slabs on grade and foundations shall be replaced by, and at the expense of, the CONTRACTOR, with concrete placed at the same time and monolithic with the concrete above.

DEWATERING:

Dewatering equipment shall be provided to remove and dispose of all surface and ground water entering excavations, trenches or other parts of the work. Water removed by dewatering operations shall be disposed of in accordance with the N.C. Sedimentation Pollution Control Act. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation or other cause will result.

All excavations for concrete structures or trenches which extend down to or below ground water shall be dewatered by lowering and keeping the ground water level beneath such excavations, 12 inches or more below the bottom of the excavation for trenches, and 24 inches or more for structures. Well pointing will be required for dewatering pipe trenches ahead of trenching and pipe laying, so that excavations are free from ground water.

Surface water shall be diverted or otherwise prevented from entering excavated areas or trenches to the greatest extent practicable without causing damage to adjacent property.

The CONTRACTOR shall be responsible for the condition of any pipe or conduit which he may use for drainage purposes, and all such pipe or conduit shall be left clean and free of sediment.

Temporary sediment basins shall be installed as necessary for dewatering operations, to prevent discharge directly into surface waters.

The CONTRACTOR shall be responsible for installation and proper abandonment of all temporary dewatering wells. The wells shall be installed and abandoned in accordance with applicable well abandonment regulations. Where applicable, the work shall be by a certified well driller familiar with the proper procedures, notification, and documentation for installation and closeout of wells.

SHEETING AND SHORING:

Except where banks are cut back on a stable slope, excavation for structures and trenches shall be sheeted, braced and shored as necessary to prevent caving or sliding.

Trench sheeting shall not be pulled before backfilling unless the pipe strength is sufficient to carry trench loads based on trench width to the back of sheeting, nor shall sheeting be pulled after backfilling. Where trench sheeting is left in place, such sheeting shall not be braced against the

pipe, but shall be supported in a manner which will preclude concentrated loads or horizontal thrusts on the pipe. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment has been completed.

Steel sheet piling shall be furnished, installed and left in place at the locations indicated on the drawings and elsewhere as required to limit the extent of excavations for the deeper structures and necessary backfill under adjacent shallower structures, and to protect adjacent structures and facilities from damage due to excavation and subsequent construction. No additional payment above the Contract amount will be made for such sheet piling as indicated or required.

#### STABILIZATION:

Subgrades for concrete structures and trench bottoms shall be firm, dense and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact under the feet of the workmen.

Subgrades for concrete structures or trench bottoms which are otherwise solid, but which become mucky on top due to construction operations, shall be reinforced with crushed rock or gravel. The stabilizing material shall be spread and compacted to a depth of not more than 4 inches; if the required depth exceeds 4 inches, the material shall be furnished and installed as specified for granular fills. The finished elevation of stabilizing subgrades shall not be above subgrade elevations indicated on the drawings.

#### EARTH FILLS AND EMBANKMENTS:

To the maximum extent available, excess suitable material obtained from structure and trench excavations shall be used for construction of fills and embankments. Additional material shall be provided by the CONTRACTOR as required or obtained from borrow pits where indicated on the drawings. After preparation of the fill or embankment site, the subgrade shall be leveled and rolled so that surface materials of the subgrade will be compact and well bonded with the first layer of the fill or embankment.

All material deposited in fills and embankments shall be free from rocks or stones, brush, stumps, logs, roots, debris and organic or other objectionable materials, and shall be wetted or dried as required and thoroughly mixed to ensure uniform moisture content. Fills and embankments shall be constructed in horizontal layers not exceeding 8 inches in uncompacted thickness.

Material deposited in piles or windrows by excavating and hauling equipment shall be spread and leveled prior to compaction. Each layer shall be thoroughly compacted to 95 percent of the maximum density at optimum moisture content as determined by ASTM D 698. If the material fails to meet the density specified, compaction methods shall be altered.

Wherever a trench passes through a fill or embankment, the fill or embankment material shall be placed and compacted to an elevation 12 inches above the top of the pipe before the trench is excavated.

### EARTH FILLS AND EMBANKMENTS:

General: Fills and embankments shall be constructed to lines and grades indicated on the drawings. To the maximum extent available, excess suitable material obtained from structure and trench excavation shall be used for the construction of fills and embankments. Additional material shall be provided by the CONTRACTOR as required or obtained from borrow pits where indicated on the drawings.

All material placed in fills and embankments shall be free from rocks or stones larger than 6 inches in their greatest dimension, brush, stumps, logs, roots, debris and organic or other deleterious materials. No rocks or stones shall be placed in the upper 18 inches of any fill or embankment. Rocks or stones within the allowable size limit may be incorporated in the remainder of fills and embankments provided they are distributed so that they do not interfere with proper compaction.

Subgrade Preparation: After clearing, grubbing, demolition and topsoil stripping of the fill or embankment site, the subgrade shall be leveled and rolled so surface materials of the subgrade will be as compact and well bonded with the first layer of the fill or embankment as specified for subsequent layers.

Placement and Compaction: All fill and embankment materials shall be placed in approximately horizontal layers not to exceed 8 inches in uncompacted thickness. Material deposited in piles or windrows by excavating and hauling equipment shall be spread and leveled before compaction.

Roadway fill shall have compaction moisture on the dry side of the material's optimum compaction moisture.

Moisture content of the material shall be within 2% of the material's optimum compaction moisture. The material in each layer shall be wetted or dried as required and thoroughly mixed to ensure uniform moisture content and adequate compaction. Each layer shall be thoroughly compacted to 95 percent of maximum density at optimum moisture content as determined by ASTM D 698. If the material fails to meet the density specified, compaction methods shall be altered.

### EXCAVATION FOR STRUCTURES:

Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10', and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction and for inspection.

In excavation for footings and foundations, take care not to disturb bottom of excavation. Trim bottoms to required lines and grades to leave solid base to receive other work.

Except where exterior surfaces are specified to be dampproofed, monolithic concrete manholes and other concrete structures, or parts thereof, which do not have footings that extend beyond the

outside face of exterior walls, may be placed directly against excavation faces without the use of outer forms, provided that such faces are stable.

Excavations for manholes and similar structures constructed of masonry units shall have such horizontal dimensions that not less than 6 inches clearance is provided for outside plastering.

#### ROADWAY EXCAVATION:

Excavation for the roadways, drives and parking areas shall conform to the lines, grades, cross sections and dimensions indicated on the drawings and shall include the excavation of all unsuitable material from the subgrade. After shaping to line, grade and cross section, the subgrade shall be compacted to a depth of at least 6 inches to 98 percent of maximum density at optimum moisture content as determined by ASTM D 698. This operation shall include any reshaping and wetting or drying required to obtain proper compaction. All soft or otherwise unsuitable material shall be removed and replaced with suitable material.

Provide a proofrolling of the compacted aggregate base course with a heavy roller or loaded dump truck (+25 tons) in the presence of the Engineer's Representative. The proofrolling shall be covered by the wheels of the proofroller operating at a speed between 2-1/2 and 3-1/2 miles per hour.

Any areas that rut or pump excessively shall be scarified, dried, and recompact, or shall be undercut and backfilled with select backfill or coarse aggregate base course as directed by the Engineer.

After undercut and backfill operations are complete, a final proofrolling of the undercut areas will be performed in the presence of the Engineer's Representative.

#### DITCH EXCAVATION:

The excavation shall be done to the lines, grades, typical sections, and details shown on the plans or established by the Engineer. All work covered by this section shall be coordinated with the grading, construction of drainage structures, excavation of borrow and material sources, and other work along the project, and shall be maintained in a satisfactory condition so that adequate drainage is provided at all times. The ditches shall be maintained by the Contractor until the final acceptance of the project. Any roots which protrude into the ditch shall be trimmed flush with the sides of the ditch. Inlet and outlet ditches for pipe lines shall be completed before the pipe is installed unless otherwise permitted by the Engineer.

#### TRENCH EXCAVATION:

Trenches shall be excavated so that pipes can be laid straight at uniform grade, without dips or humps, between the terminal elevations indicated on the drawings.

Minimum Cover: Where pipe grades or elevations are not definitely fixed by the Contract drawings or profiles, trenches shall be excavated to a depth sufficient to provide a minimum depth of backfill cover over the top of the pipe of 36 inches.

Limiting Trench Widths: Trenches shall be excavated to a width which will provide adequate working space and sidewall clearances for proper pipe installation, jointing and embedment. However, the limiting trench widths from the bottom of the trench to an elevation one foot above the top of installed pipe, and the minimum permissible sidewall clearances between the installed pipe and each trench wall shall be as follows:

<u>Nominal Pipe Size</u> (inches)	<u>Minimum Trench Width</u> (inches)	<u>Maximum Trench Width</u> (inches)
Less than 18	Pipe O.D. Plus 18	Pipe O.D. Plus 24
18 through 27	Pipe O.D. Plus 24	Pipe O.D. Plus 30
28 through 42	Pipe O.D. Plus 24	Pipe O.D. Plus 36
43 through 60	Pipe O.D. Plus 30	Pipe O.D. Plus 36

Stipulated minimum sidewall clearances are not minimum average clearances but are minimum clear distances which will be required.

Cutting trench banks on slopes to reduce earth load to prevent sliding and caving shall be done only in areas where the increased trench width will not interfere with surface features or encroach on right-of-way limits. Slopes shall not extend lower than one foot above the top of the pipe.

Unauthorized Trench Widths: Where, for any reason, the width of the lower portion of the trench, as excavated at any point, exceeds the maximum permitted in the foregoing tables, either pipe of adequate strength, special pipe embedment, or arch concrete encasement, as required by loading conditions and with the concurrence of the ENGINEER, shall be furnished and installed by and at the expense of the CONTRACTOR.

Mechanical Excavation: The use of mechanical equipment will not be permitted in locations where its operation would cause damage to trees, buildings, culverts, or other existing property, utilities, or structures above or below ground. In all such locations, hand excavating methods shall be used.

Only rubber-tired equipment will be permitted on paved streets unless specifically allowed by the Owner and Engineer on a case-by-case basis.

Mechanical equipment used for trench excavation shall be of a type, design, and construction, and shall be so operated that the rough trench excavation bottom elevation can be controlled, that uniform trench widths and vertical sidewalls are obtained at least from an elevation one foot above the top of the installed pipe to the bottom of the trench, and that trench alignment is such that pipe when accurately laid to specified alignment will be centered in the trench with adequate clearance between the pipe and sidewalls of the trench. Undercutting the trench sidewall to obtain clearance will not be permitted.



Where soil conditions permit, trenches for pipe 12 inches or less in diameter may be excavated by trenching equipment comparable to a Cleveland JS36. Trenchers shall be capable of being leveled on sloping ground. Trench depths for proper pipe grade according to profiles, elevations, dimensions, etc., on plans must be complied with even if a trencher is utilized.

Concrete and asphalt pavement over trenches excavated for pipelines shall be removed so that the width at any point is not greater than the top edge of the trench. Trench width at the bottom shall not be greater than at the top and no undercutting will be permitted. Pavement cuts shall be made to and between straight or accurately marked curved lines which, unless otherwise required, shall be parallel to the centerline of the trench.

Pavement removed for connections to existing lines or structures shall not be of greater extent than necessary for the installation.

Where the trench parallels the length of concrete walks and the trench location is all or partially under the walk, the entire walk shall be removed and replaced. Where the trench crosses drives, walks, curbs, or other surface construction, the surface construction shall be removed and replaced between existing joints or between saw cuts as specified for pavement.

Excavation Below Pipe Subgrade: Where required, pipe trenches shall be excavated below the underside of the pipe, to provide for the installation of granular embedment.

Bell Holes shall provide adequate clearance for tools and methods used in installing pipe. No part of any bell or coupling shall be in contact with the trench bottom, trench walls or granular embedment when the pipe is jointed.

#### PIPE EMBEDMENT:

Placement and Compaction: Granular embedment material shall be spread and the surface graded to provide a uniform and continuous support beneath the pipe at all points between bell holes or pipe joints. It will be permissible to slightly disturb the finished subgrade surface by withdrawal of pipe slings or other lifting tackle.

After each pipe has been graded, aligned and placed in final position on the bedding material or trench bottom and shoved home, sufficient pipe embedment material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof to hold the pipe in proper position and alignment during subsequent pipe jointing and embedment operations.

Embedment material shall be deposited and compacted uniformly and simultaneously on each side of the pipe to prevent lateral displacement.

Hand placed embedment shall be compacted to the top of the pipe in all areas where compacted backfill is specified.

Whenever crushed rock is used as embedment for 36 inch and larger pipe, the portion above the bottom of the pipe shall be vibrated with a mechanical probe type vibrator during placement to ensure that all spaces beneath the pipe are filled.

TRENCH BACKFILL:

A layer of backfill material not more than 8 inches deep may be placed over concrete arch encasement or concrete reaction blocking after the concrete has reached its initial set, to aid curing. No additional backfill shall be placed over arch encasement or blocking until the concrete has been in place for at least 3 days.

Backfill compacted to 95 percent of maximum density at optimum moisture content as determined by ASTM D 698 will be required for the full depth of the trench above the embedment in the following locations:

Where beneath pavements, surfacings, driveways, curbs, gutters, walks or other surface construction or structures

Where in street, road or highway shoulders

Where beneath fills or embankments

In established lawn areas

In addition to the above, the final one foot below soil subgrade for slabs and paved areas shall not have compaction less than 98 percent of the Standard Proctor Maximum dry density, as determined by ASTM D 698.

In other areas the backfill shall be compacted to 90 percent or equal to existing.

Where the trench for one pipe passes beneath the trench for another pipe, backfill for the lower trench shall be compacted to the level of the bottom of the upper trench.

Job excavation material may be used for compacted backfill when the job excavated material is finely divided and free from debris, organic material, cinders or other corrosive material, and stones larger than 3 inches in greatest dimension. Masses of moist, stiff clay shall not be used. Each layer of material shall have the best practicable moisture content for satisfactory compaction. The material in each layer shall be wetted or dried as required and thoroughly mixed to ensure uniform moisture content and adequate compaction. Backfill materials shall be placed in uniform layers not exceeding 8 inches in uncompacted thickness. Increased layer thickness may be permitted for noncohesive material if the CONTRACTOR demonstrates to the satisfaction of the ENGINEER that the specified compacted density will be obtained.

The method of compaction and the equipment used shall be appropriate for the material to be compacted and shall not transmit damaging shocks to the pipe.

The top portion of backfill beneath established lawn areas shall be finished with not less than 4 inches of topsoil corresponding to, or better than, that underlying adjoining lawn areas.

STRUCTURE BACKFILL:

The quality and moisture content of materials for backfill around and outside of structures shall conform to the requirements for fill materials. Backfill materials shall be deposited in layers not to exceed 8 inches in uncompacted thickness and compacted to at least 95 percent of maximum density, within 2% of the material's optimum moisture content as determined by ASTM D 698. Compaction of structure backfill by rolling will be permitted provided the desired compaction is obtained and damage to the structure is prevented. Compaction of structure backfill by inundation with water will not be permitted.

No backfill shall be deposited or compacted in water. Particular care shall be taken to compact structure backfill which will be beneath pipes, drives, roads, parking areas, walks, curbs, gutters or other surface construction or structures. In addition, wherever a trench is to pass through structure backfill, the structure backfill shall be placed and compacted to an elevation not less than 12 inches above the top of pipe elevation before the trench is excavated. Compacted areas, in each case, shall be adequate to support the item to be constructed or placed thereon.

As indicated in Division-3, no water bearing structure shall be backfilled until the structure has been tested for leakage.

AGGREGATE BASE COURSE PLACEMENT:

After completion of construction and final grading of roadway subgrade, place aggregate base course (ABC) in uniform layers and compact to 98 percent compaction as determined by ASTM D 698.

FINAL GRADING AND PLACEMENT OF TOPSOIL:

After other outside work has been finished, and backfilling and embankments completed and settled, all areas which are to be graded shall be brought to grade at the indicated elevations, slopes and contours. All cuts, fills, embankments and other areas which have been disturbed or damaged by construction operations shall be surfaced with topsoil to a depth of at least 4 inches. Topsoil shall be of a quality at least equal to the existing topsoil in adjacent areas, free from trash, stones and debris, and well suited to support plant growth.

Use of graders or other power equipment will be permitted for final grading and dressing of slopes, provided the result is uniform and equivalent to hand work. All surfaces shall be graded to secure effective drainage. Unless otherwise indicated, a slope of at least one percent shall be provided.

Final grading and surfacing shall be smooth, even and free from clods and stones larger than one inch in greatest dimension, weeds, brush and other debris.

DISPOSAL OF EXCESS EXCAVATED MATERIALS:

Insofar as needed, suitable excavated materials shall be used in fills and embankments.

All unused suitable excess excavated materials together with all debris, stones, logs, stumps, roots and other unsuitable materials shall be removed from the site and disposed of by, and at the expense of, the CONTRACTOR.

SETTLEMENT:

The CONTRACTOR shall be responsible for all settlement of backfill, fills and embankments which may occur within the correction period stipulated in the General Conditions.

The CONTRACTOR shall also save the OWNER and ENGINEER harmless of any and all claims that might arise out of the dewatering operation.

The CONTRACTOR shall make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after notice from the ENGINEER or OWNER.

TESTS:

As stipulated in the quality control section, all tests required for preliminary review of materials shall be made by an acceptable independent testing laboratory at the expense of the CONTRACTOR. Two initial gradation tests shall be made for each type of embedment, fill or backfill material and one additional gradation test shall be made for each additional 500 tons of each material. Moisture-density (Proctor) tests and relative density tests on the materials, and all in-place field density tests, shall be paid for out of the testing allowance.

END OF SECTION 02210

SECTION 02737 - GRAVITY SANITARY SEWER SYSTEM

PART 1 - GENERAL

RELATED DOCUMENTS:

The general provisions of the Contract, including the General and Special Conditions and Division-1 Specification sections apply to work of this section.

DESCRIPTION OF WORK:

The extent of sanitary sewer system work is shown on the drawings.

Types of sanitary sewer facilities include the following:

Outfalls (interceptors)

Collectors

Manholes

Service Laterals

Related Work Specified Elsewhere:

Clearing, Excavation and Trenching: Section 02210

Concrete: Section 03305

QUALITY ASSURANCE:

Codes and Standards: Comply with applicable standards contained herein and with the requirements of Owner of utility.

Testing and Inspection: Contractor shall provide all necessary equipment and materials and shall perform the visual inspections, air testing and infiltration testing of the system in conformance with the requirements of this section.

SUBMITTALS:

Material Certificates:

Provide materials' certificates for pipe and manholes.

Shop Drawings: Submit shop drawings and/or product data for all pipe and fittings, pipe gaskets, transitions, precast manholes, sewer brick, manhole covers, frames, steps and other accessories.

PART 2 - MATERIALS

SERVICES:

Service Pipe: Service pipe shall be PVC except when located at a ditch or creek crossing, at which service pipe will then be ductile iron including riser.

PVC service pipe and fittings shall be SCH 40 PVC-DWV conforming to the latest revisions of ASTM D 2665-85, having a minimum cell class of 12454B or 12454C.

Ductile iron service pipe shall be AWWA C151. Joints shall be bell-and-spigot type using stab-in compression methods. Service pipe shall be lined in accordance with the requirements for DIP sewer main.

Service Connections: Service connections for the type and size of pipe shall be as follows:

PVC pipe 8"-12"	Standard wye made or approved by pipe manufacturer.
Ductile iron pipe 8"-16"	Standard wye made or approved by pipe manufacturer.
Ductile iron pipe 16"-36"	Saddle shall be outlet/tapping type with an ANSI A21.11 standard mechanical joint outlet. Saddle shall be manufactured by American Ductile Iron or approved equal.

Manhole connection shall be through precast hole with rubber sleeve and constructed manhole invert.

Vertical Stacks: Vertical Stacks shall be standard wye or double wye made or approved by service pipe manufacturer. Clean-out plugs shall be supplied by wye manufacturer.

Service Clean-out: Service clean-out shall use a standard wye and clean-out plug as made or approved by the service pipe manufacturer.

## PART 3 - EXECUTION

### GENERAL:

Adherence to Standards and Instructions: All pipe shall be transported, handled, stored, and installed in keeping with applicable AWWA/ASTM standards and manufacturer's instructions for the particular pipe material involved.

Responsibility for Materials: During loading, transportation, unloading and storage, every precaution shall be taken to prevent damage to pipe, fittings, and accessories and to keep them free from dirt and foreign matter at all times. Particular care shall be taken to prevent damage to pipe and fitting linings and coatings. Pipe shall be protected during handling against impact shocks or free fall. Pipe shall be kept clean at all times, and no pipe shall be used in the work that does not conform to the appropriate specifications.

### INSTALLATION:

Trenching, Embedment and Backfill: Refer to Section 02210 or 02220 for Trenching, Embedment and Backfill requirements.

Pipe Laying: Each joint of pipe shall be carefully examined before being laid. Defective pipe shall be clearly marked and placed aside. Defective pipe shall not be installed.

All pipe shall be laid so that markings are on top. All pipe in place shall be inspected before being covered or concealed. Provide proper facilities for lowering pipe into trenches.

Ensure that the pipe bedding is set at true line and grade and is in conformance with the specifications.

Pipe shall be laid true to line and grade as designated on the plans with ends abutting. Each joint shall be tested for exact position by use of grade rod and plummet or laser. Carefully center the pipe so that when laid, they will form a sewer with a uniform invert. Ensure that when joining pipes of different wall thickness the inverts of the pipe joints form a smooth line.

Pipe having its grade or joint disturbed after laying shall be taken up, cleaned and relaid.

Pipe installed by use of laser shall be checked for proper grade with engineering level and grade rod at each manhole prior to continuing pipe laying operations.

The Contractor shall not be allowed to skip any section of the pipe line and move further upgrade, except as special permission is granted by the Engineer, or when the Contractor has more than one complete pipe laying crew working on the project.

All pipe shall be laid so that markings are on top. All pipe in place shall be inspected before being covered or concealed.

Insulated copper tracer wire shall be installed with service lateral piping.

Keep trenches water-free and as dry as practicable during bedding, laying and jointing. Place sufficient backfill along each side of pipe as soon as practicable to brace pipe on line and grade.

Place a plastic stopper or other suitable device in the end of the last joint of pipe at the conclusion of each day's work or at other times when pipe laying is not in progress.

Prevent the entry of water, dirt, tools or other foreign matter into the pipe line.

When tying into existing sanitary sewer system, install temporary mechanical plug in closest downstream manhole. In an effort to keep dirt and debris from entering existing sanitary sewer system, plug shall remain in place from beginning through completion of project.

After pipe laying, inspect the interior pipe surfaces with lights held at each manhole. A full circle of light must be visible when viewed from the opposite ends of the line. Immediately correct any deviation from true line and grade and repair all visible leaks.

Service Lateral Installation: Service lateral locations where shown on the plans are approximate for estimates and bidding. Verify with Owner that service will be properly located for each adjoining residence. The service shall be installed in accordance with the details shown on the plans and shall be the same type of pipe utilized for the sewer main unless otherwise shown.

Ensure that bedding and backfill is installed in conformance with requirements.

All joints shall be made in accordance with manufacturers recommendations. Ensure that the service pipe is installed with at least a 1/8 inch per foot slope. Plug each service securely with a watertight plug.

Where services do not connect directly into a manhole, a service wye or saddle must be installed as applicable.

All services shall have a clean-out installed at the easement or right-of-way line as shown on the plan details, or at a location directed by the Engineer. Clean-out shall consist of a wye fitting, bend, pipe, and cap or plug, all of the same material as the service pipe unless otherwise indicated. Top of clean-out cap or plug shall be installed at finished grade.

Pipe connection to existing manholes shall be made by machine coring such that the finished work will conform as nearly as practicable to the essential applicable requirements specified for new manholes, including all necessary concrete work, cutting and shaping.

Clean all joints and carefully inspect. Perform jointing in accordance with manufacturer's specifications. Insure a watertight seal at all joints.



Connections to Existing Systems: Carefully cut opening in existing structure conforming to pipe size. Relay and repoint loose blocks and bricks. Provide smooth interior surface and invert as specified for new construction.

Dewater as necessary to provide a safe, dry area.

Pipe joints with manholes shall be made with premium watertight materials as specified for new manholes. Install with non-shrink grout.

END OF SECTION 02737



## SECTION 02870 – SITE FURNISHINGS

### PART 1 - GENERAL

#### RELATED DOCUMENTS:

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this section.

The following related items of work are included under other Sections:

Clearing, Excavation and Trenching: Section 02210

Concrete: Section 03305

#### SUMMARY:

The work required under this section consists of furnishing all labor, materials, equipment, services and related items necessary to supply and install Site Furnishings, and all related work, complete, as indicated on the drawings or specified herein.

Major items of work include, but are not limited to, supplying and installing:

Tensile Shade Structure

Seat Boulders

Shower/Rinse Station

#### SUBMITTALS:

##### Manufacturer's Data & Shop Drawings

Submit fabrication data, shop drawings and/or catalogue cuts for each manufactured site furnishing specified.

Submit paint color samples and material sample of fabric.

Shop drawings shall include, but not be limited to, depicting all materials and fastening methods in sizes and relationships as shown. All elevations shall be prepared at not less than 1/2" = 1'-0" and all details at not less than 3" = 1'-0".

Submit shop drawings for all custom site furnishings specified or illustrated on the drawings, for approval prior to fabrication.

For prefabricated gazebos and other shade structures, submit a shop drawing of structural details, including footing detail, sealed by a Structural Engineer licensed in the State of North Carolina.

SUBSTITUTION AND REJECTION:

The Owner reserves the right to reject material or work which does not conform to the Contract Documents. Rejected work shall be removed or corrected at the earliest possible time.

PROTECTION:

The Contractor shall be responsible for work until finally inspected and accepted. After delivery and before and after installation, protect work against theft, injury or damage.

The Contractor shall protect work, equipment and material of all other trades from damage that might be caused by this work or workmen and shall pay for all such damage, should it occur.

PART 2 - PRODUCTS

GENERAL:

All Site Furnishings shall be new and in perfect condition. After award of the Contract, and prior to beginning the work, the Contractor shall submit for approval, two copies of the complete list of materials which he proposes to install. Quantities of materials and equipment need not be included. Deviations from the specifications shall not be allowed.

MATERIALS:

Tensile Shade Structure: 3-Point Sail Shade by UltraShade, available from Bliss Products and Services, Inc.  
6831 S. Sweetwater Road, Lithia Springs, GA 30122,  
or approved equal.

Model: 3-Point Sail Shade, 35ft x 35ft x 35ft, 3 posts

Finish: To be decided. Sample colors shall be provided

Description: Supports shall be tubular steel construction. All exposed parts and fixtures shall have Powder Coat Institute (PCI) 4000 certified powder coated finish with epoxy primer. Shall conform to ASTM 03359-02, ASTM G154-04 2000 hours exposure with no chalking and at least 75% color retention. Scratch resistance indicating no substrate appearance with 1000 gram load.

Fabric shall be heavy duty, professional grade architectural shade fabric, made from UV stabilized HPDE monofilament and tape yarns, conforming to NFPA 701-1999, & ASTM E84 Class A.

Seat Boulders: Seat boulders shall be a minimum of 24” tall, 24” wide, and 36” long; they shall

weigh at least 4,000 pounds. Each seat boulder shall be of a single, monolithic natural stone. Owner shall be allowed to choose stones from a vendor's yard located within 50 miles of the project site.

Seat boulders shall be placed on level, compacted subgrade and surrounded completely by an expansion joint material prior to pouring their surrounding concrete. Contractor shall coordinate placement of seat boulders so that the upper surface is generally level while avoiding ponding of water.

Shower/Rinse Station: The shower/rinse station shall be Model 500 Foot & Shower Tower as manufactured by Most Dependable Fountains, Inc., or approved equal.

Shower/rinse station shall be of one-piece weld construction with minimum 3/16" wall thickness. The push bars for valves shall be 304 stainless steel with a minimum 2" diameter in a "mushroom" style. The associated control valves shall require less than 5 lbs of pressure to operated and shall immediately shut off when the push bar is released.

All water-contacting components shall be NSF-61 certified, and the plumbing shall be equipped with a shut off and drain down for winterization purposes.

The finish shall be an over-baked powder coat, with manufacturer's full range of standard colors available for Owner's selection.

### PART 3 - EXECUTION

#### LAYING OUT THE WORK:

The trade performing the work of this section assumes full and sole responsibility for the accuracy and correctness of all layouts, lines, levels, grades and other aspects of the work under this section. Layout all work in accordance with the requirements, therefore, as indicated in the drawings.

#### INSTALLATION:

Locate all site furnishings where indicated on the drawings and attach as detailed on the drawings and as elaborated upon in the specifications and in conformance with manufacturer's recommendation.

Any item locations not specifically detailed in the Contract Documents shall be located at the direction of the OWNER.

Clean and touch-up paint all abraded, welded and scratched surfaces with matching paint provided by each site furnishing and structure manufacturer.

CLEANING:

Perform cleaning during installation of the work and upon completion of the Work.

Remove from the project site and excess material and equipment at the completion of the Work of this section.

Repair damage resulting from Site Furnishings work.

END OF SECTION 02870

SECTION 02910 - EROSION AND POLLUTION CONTROL

PART 1 - GENERAL

RELATED DOCUMENTS:

The general provisions of the Contract, including the General and Special Conditions and Division-1 Specification sections apply to work of this section.

DESCRIPTION OF WORK:

The extent of the work required under this section is that required to minimize water, air, and noise pollution and soil erosion and siltation.

Temporary erosion control measures which may be necessary include, but are not limited to, temporary berms, dikes, dams, drainage ditches, silt basins, silt ditches, perimeter swales, slope drains, structures, vegetation, mulches, mats, netting, gravel or any other methods or devices that are necessary to control or restrict erosion. Temporary erosion control measures may include work outside the right-of-way or construction limits where such work is necessary as a result of construction such as borrow pit operations, haul roads, plant sites, equipment storage sites, and disposal of waste or debris. The Contractor shall be liable for all damages to public or private property caused by silting or slides originating in waste areas furnished by the Contractor.

Related Work Specified Elsewhere:

Earthwork: Section 02200  
Fertilizing, Seeding and Mulching: Section 02920

QUALITY ASSURANCE:

Codes and Standards:

North Carolina Sedimentation Pollution Control Act of 1973 and the Rules and Regulations promulgated pursuant to the provisions of said act.

"Standard Specifications for Roads and Structures", North Carolina Department of Transportation (DOT).

In the event of conflict between the regulations listed above and the requirements of these specifications, the more restrictive requirement shall apply.

SANCTIONS:

Failure of the Contractor to fulfill any of the requirements of this section may result in the Owner ordering the stopping of construction operations in accordance with SUBARTICLE 13.8 of the General Conditions until such failure has been corrected. Such suspension of operations will not justify an extension of contract time nor additional compensation.

Failure on the part of the Contractor to perform the necessary measures to control erosion, siltations, and pollution will result in the Engineer notifying the Contractor to take such measures. In the event that the Contractor fails to perform such measures within 24 hours after receipt of such notice, the Owner may suspend the work as provided above, or may proceed to have such measures performed with other forces and equipment, or both. The cost of such work performed by other forces will be deducted from monies due the Contractor on his contract.

PART 2 - PRODUCTS

SILT FENCES:

Posts: Steel posts shall be 5' in height and be of the self-fastener angle steel type.

Posts shall be spaced at 10' max. when silt fence is backed with wire mesh, and 7' when no wire mesh is used or as required by the Engineer.

Woven Wire: Woven wire fencing shall conform to ASTM A116 for Class 3 galvanizing. Fabric shall be a minimum of 32" in width and shall have a minimum of 6 line wires with 12" stay spacing. The top and bottom wires shall be 10 gauge while the intermediate wires shall be 12-1/2 gauge. Wire fabric shall be fastened to wood posts with not less than #9 wire staples 1-1/2" long.

Fabric: Provide woven synthetic fiber designed specifically for silt fence conforming to NCDOT specifications.

DRAINAGE STONE:

Class I material NCDOT No. 57.

TEMPORARY SEEDING:

Temporary seeding, when required, shall be performed in accordance with the recommendations contained in "Guide for Sediment Control on Construction Sites in North Carolina", published by the Soil Conservation Service and Section 02920 of these specifications.

END OF SECTION 02910



SECTION 02920 - FERTILIZING, SEEDING AND MULCHING

PART 1 - GENERAL

RELATED DOCUMENTS:

The general provisions of the Contract, including the General and Special Conditions and Division-1 Specification sections apply to work of this section.

DESCRIPTION OF WORK:

Permanent Seeding: Permanent seeding is required for all areas disturbed by construction, except for areas covered by structures, pavements, etc.

Temporary Seeding: Temporary seeding of disturbed areas shall be performed whenever one or more of the following conditions exist.

The Engineer determines temporary seeding is necessary to prevent or stop erosion of disturbed areas.

Work is suspended or delayed on any portion of the project for 30 days and the potential for erosion exists.

Whenever permanent seeding is delayed beyond that required by the Contract Documents.

QUALITY ASSURANCE:

Codes and Standards: In general, follow procedures and guides published by the Soil Conservation Service, United States Department of Agriculture.

PART 2 - PRODUCTS

FERTILIZER:

Provide commercial fertilizer conforming to statutory requirements and all rules and regulations adopted by the North Carolina Board of Agriculture.

LIMESTONE:

Provide agricultural limestone conforming to all statutory requirements and all rules and regulations adopted by the North Carolina Board of Agriculture.

SEED:

Provide seed conforming to all statutory requirements and all rules and regulations adopted by the North Carolina Board of Agriculture.

Provide seed in accordance with requirements shown below. Deliver to site in original containers, labeled to show that the requirements of the N.C. Seed Law are met.

Quality of seed shall conform to the following:

<u>Common Name</u>	<u>Minimum Seed Purity</u> %	<u>Minimum Germination</u> %	<u>Maximum Weed Seed</u> %
<u>Grasses</u>			
Fescue Tall (KY.-31)	98	90	1.00
Common Bermudagrass	99	90	0.1
Centipede	80	90	1.00
Rye	80	90	1.00

Seeding containing prohibited noxious weed seed shall not be accepted. Seed shall be in conformance with state seed law restrictions for restricted noxious weeds.

If seed of the accepted quality cannot be bought, secure prior approval before making changes or exceptions.

MULCH:

Mulch for erosion control shall consist of grain straw or other acceptable material, and shall have been approved by the Engineer before being used. All mulch shall be reasonably free from mature seedbearing stalks, roots, or bulblets of Johnson Grass, Nutgrass, Sandbur, Wild Garlic, Wild Onion, Bermuda Grass, Crotalaria, and Witchweed, and free of excessive amount of restricted noxious weeds as defined by the North Carolina Board of Agriculture at the time of use of the mulch. Also there shall be compliance with all applicable State and Federal domestic plant quarantines. Straw mulch that is matted or lumpy shall be loosened and separated before being used.

Material for holding mulch in place shall be asphalt or other approved binding material applied in accordance with this section.

**JUTE MESH:**

Use jute mesh on seeded areas where slope is steeper than 2 horizontal to one vertical (2:1 slope). Use woven jute yarn weighing approximately 90 lbs. per 100 sq. yds. and having 3/4" openings.

END OF SECTION 02920



## SECTION 02950 - LANDSCAPE PLANTING

### PART I – GENERAL

#### DESCRIPTION OF WORK

Provide all exterior planting as shown on the drawings or inferable therefrom and/or as specified in accordance with the requirements of the Contract Documents.

These specifications include standards necessary for and incidental to the execution and completion of planting, including hauling and spreading of topsoil, and finished grading as indicated on the prepared drawings and specified herein.

Protection of existing features. During construction, protect all existing trees, shrubs, and other specified vegetation, site features and improvements, structures, and utilities specified herein and/or on submitted drawings. Removal or destruction of existing plantings is prohibited unless specifically authorized by the owner.

#### APPLICABLE STANDARDS

*American National Standards for Tree Care Operations, ANSI A300.* American National Standards Institute, 11 West 42<sup>nd</sup> Street, New York, N.Y. 10036.

*American Standard for Nursery Stock, ANSI Z60.1.* American Nursery and Landscape Association, 1250 Eye Street. NW, Suite 500, Washington, D.C. 20005.

*Hortus Third*, The Staff of the L.H. Bailey Hortorium. 1976. MacMillan Publishing Co., New York.

All standards shall include the latest additions and amendments as of the date of advertisement for bids.

#### QUALIFICATIONS

Landscape planting and related work shall be performed by a firm with a minimum of five years experience specializing in this type of work. All contractors and their sub-contractors who will be performing any landscape work included in this section of the specification shall be approved by the Project Consultant.

REQUIREMENTS OF REGULATORY AGENCIES

Certificates of inspection shall accompany the invoice for each shipment of plants as may be required by law for transportation. File certificates with the Project Consultant prior to

acceptance of the material. Inspection by federal or state authorities at place of growth does not preclude rejection of the plants at the site.

SUBMITTALS

Manufacturer's Data: Submit copies of the manufacturer's and/or source data for all materials specified, including soils.

Samples: Submit samples of all topsoil, soil mixes, mulches, and organic materials. Samples shall weigh 1 kg (2 lb) and be packaged in plastic bags. Samples shall be typical of the lot of material to be delivered to the site and provide an accurate indication of color, texture, and organic makeup of the material.

Plant Photographs: Submit color photographs of representative specimens of each plant on the plant list. Photos shall be a minimum 3 x 5 in. taken from angle that depicts the size and condition of the typical plant to be furnished. A scale rod or other measuring device shall be included in the photograph. Label each photograph with the plant name, plant size, and name of the growing nursery.

Nursery Sources: Submit a list of all nurseries that will supply plants, along with a list of the plants they will provide and the location of the nursery.

Soil Test: Submit soil test analysis report for each sample of topsoil and planting mix from a soil testing laboratory approved by the Project Consultant.

Provide a particle size analysis, including the following gradient of mineral content:

<u>USDA Designation</u>	<u>Size in mm</u>
Gravel	+2 mm
Very course sand	1-2 mm
Coarse sand	0.5 -1 mm
Medium sand	0.25-0.5 mm
Fine sand	0.1-0.25 mm
Very fine sand	0.05-0.1 mm
Silt	0.002-0.05 mm
Clay	smaller than 0.002 mm

Provide a chemical analysis, including the following:

pH and buffer pH

Percentage of organic content by oven-dried weight.

Nutrient levels by parts per million, including phosphorus, potassium magnesium, manganese, iron, zinc, and calcium. Nutrient test shall include the testing laboratory recommendations for supplemental additions to the soil based on the requirements of horticultural plants.

Soluble salt by electrical conductivity of a 1:2, soil: water, sample measured in millimho per cm.

Cation exchange capacity (CEC).

Material Testing: Submit the manufacturers particle size analysis, and the pH analysis and provide a description and source location for the content material of all organic materials.

### PLANTING SEASON

Planting shall be done between October 01 and April 30.

Variance: If special conditions exist that warrant a variance in the above planting dates, a written request shall be submitted to the Project Consultant stating the special conditions and the proposed variance. Permission for the variance will be given if warranted in the opinion of the Project Consultant. Any variance in the planting season will not affect the guarantee period.

### UTILITY VERIFICATION

The contractor shall contact the local utility companies for verification of the location of all underground utility lines in the area of the work. The contractor shall be responsible for all damage resulting from neglect or failure to comply with this requirement.

## PART 2 – MATERIALS

### EXISTING TOPSOIL

Existing Topsoil shall be used. It is the Contractor's responsibility to inspect the existing topsoil to ensure that it meets the requirements necessary to promote vigorous and healthy establishment and growth of sod.

### IMPORTED TOPSOIL

Topsoil used shall be a Sandy Loam Topsoil in nature with a maximum of 25% clay. Topsoil will be blended with compost at a ratio of two (2) parts topsoil to one (1) part compost. Compost must have the US Compost Council Seal of Assurance. The topsoil/compost blend will be

screened with a mechanical screener to make it free from hard clods, stiff clays, hardpan, gravel, brush roots, refuse and other deleterious material to make it of uniform quality.

The mechanical screened will screen the topsoil/compost blend as to meet these specifications and the following mechanical analysis mechanical:

<u>Sieve size</u>	<u>Percentage Passing by Dry Weight</u>
7/8 inch (.87)	100
3/4 inch (.75)	85 – 99

Test pH of the screened topsoil/compost blend by method acceptable to current industry standards. If pH is not between 6.0 and 6.8, add approved additive to bring pH within that range. Supply complete information on analysis/test methodologies and results; laboratory certifications, manufacturer's specifications, and agency approvals to Project Consultant prior to placement of the screened topsoil/compost blend. In addition, provide Project Consultant with sample of the screened topsoil/compost blend for approval prior to placement. Landscape contractor shall make modifications and improvement to soil mixes deemed necessary by Project Consultant to meet requirements specified herein before, and to insure proper growing medium for all plant material without cost to Owner.

## PLANTS

Plants shall be true to species and variety specified and nursery-grown in accordance with good horticultural practices under climatic conditions similar to those in the locality of the project for at least two years. They shall have been freshly dug during the most recent favorable harvest season.

All plant names and descriptions shall be as defined in *Hortus Third*.

All plants shall be grown and harvested in accordance with the *American Standard for Nursery Stock*.

Unless approved by the Project Consultant, plants shall have been grown at a latitude not more than 200 miles north or south of the latitude of the project unless the provenance of the plant can be documented to be compatible with the latitude and cold hardiness zone of the planting location.

Unless specifically noted, all plants shall be of specimen quality, exceptionally heavy, symmetrical, and so trained or favored in development and appearance as to be unquestionably and outstandingly superior in form, compactness, and symmetry. They shall be sound, healthy, vigorous, well branched, and densely foliated when in leaf; free of disease and insects, eggs, or larvae; and shall have healthy, well-developed root systems. They shall be free from physical damage or other conditions that would prevent vigorous growth.



Trees with multiple leaders, unless specified, will be rejected. Trees with a damaged or crooked leader, bark abrasions, sunscald, disfiguring knots, insect damage, or cuts of limbs over 3/4 in. in diameter that are not completely closed will be rejected.

Plants shall conform to the measurements specified, except that plants larger than those specified may be used if approved by the Project Consultant. Use of larger plants shall not increase the contract price. If larger plants are approved, the root ball shall be increased in proportion to the size of the plant.

Caliper measurements shall be taken on the trunk 6 in. above the natural ground line for trees up to and including 4 in. in caliper, and 12 in. above the natural ground line for trees over 4 in. in caliper. Height and spread dimensions specified refer to the main body of the plant and not from branch tip to branch tip. Plants shall be measured when branches are in their normal position. If a range of sizes is given, no plant shall be less than the minimum size, and no less than 50 percent of the plants shall be as large as the maximum size specified. Measurements specified are minimum sizes acceptable after pruning, where pruning is required. Plants that meet measurements but do not possess a standard relationship between height and spread, according to the *American Standards for Nursery Stock*, shall be rejected.

Substitutions of plant materials will not be permitted unless authorized in writing by the Project Consultant. If proof is submitted in writing that a plant specified is not obtainable, consideration will be given to the nearest available size or similar variety, with a corresponding adjustment of the contract price.

The plant list on the drawing, is for the contractor's information only, and no guarantee is expressed or implied that quantities therein are correct or that the list is complete. The contractor shall ensure that all plant materials shown on the drawings are included in his or her bid.

All plants shall be labeled by plant name. Labels shall be attached securely to all plants, bundles, and containers of plant materials when delivered. Plant labels shall be durable and legible, with information given in weather-resistant ink or embossed process lettering.

### Selection and Tagging

Plants shall be subject to inspection for conformity to specification requirements and approval by the Project Consultant at their place of growth and upon delivery. Such approval shall not impair the right of inspection and rejection during progress of the work.

A written request for the inspection of plant material at their place of growth shall be submitted to the Project Consultant at least ten calendar days prior to digging. This request shall state the place of growth and the quantity of plants to be inspected. The Project Consultant may refuse inspection at this time if, in his or her judgment, sufficient quantities of plants are not available for inspection.

All plants shall be selected and tagged by the Project Consultant at their place of growth. For distant material, photographs may be submitted for pre-inspection review.

### Anti-Desiccants

Anti-desiccants, if specified, are to be applied to plants in full leaf immediately before digging or as required by the Project Consultant. Anti-desiccants are to be sprayed so that all leaves and branches are covered with a continuous protective film.

### Balled and Burlapped (B&B) Plant Materials

Trees designated B&B shall be properly dug with firm, natural balls of soil retaining as many fibrous roots as possible, in sizes and shapes as specified in the *American Standard for Nursery Stock*. Balls shall be firmly wrapped with nonsynthetic, rottable burlap and secured with nails and heavy, nonsynthetic, rottable twine. The root collar shall be apparent at surface of ball. Trees with loose, broken, processed, or manufactured root balls will not be accepted, except with special written approval before planting.

### Container Plants

Plants grown in containers shall be of appropriate size for the container as specified in the most recent edition of the *American Standard for Nursery Stock* and be free of circling roots on the exterior and interior of the root ball.

Container plants shall have been grown in the container long enough to have established roots throughout the growing medium.

### Bareroot and Collected Plants

Plants designated as bareroot or collected plants shall conform to the *American Standard for Nursery Stock*.

Bareroot material shall not be dug or installed after bud break or before dormancy.

Immediately after harvesting plants, protect from drying and damage until shipped and delivered to the planting site. Rootballs shall be checked regularly and watered sufficiently to maintain root viability.

### Transportation and Storage of Plant Material

Branches shall be tied with rope or twine only, and in such a manner that no damage will occur to the bark or branches.

During transportation of plant material, the contractor shall exercise care to prevent injury and drying out of the trees. Should the roots be dried out, large branches broken, balls of earth broken or loosened, or areas of bark torn, the Project Consultant may reject the injured tree(s) and order them replaced at no additional cost to the owner. All loads of plants shall be covered at all times with tarpaulin or canvas. Loads that are not protected may be rejected.

All bare-root stock sent from the storage facility shall be adequately covered with wet soil, sawdust, woodchips, moss, peat, straw, hay, or other acceptable moisture-holding medium, and shall be covered with a tarpaulin or canvas. Loads that are not protected in the above manner may be rejected.

Plants must be protected at all times from sun or drying winds. Those that cannot be planted immediately on delivery shall be kept in the shade, well protected with soil, wet mulch, or other acceptable material, and kept well watered. Plants shall not remain unplanted any longer than three days after delivery. Plants shall not be bound with wire or rope at any time so as to damage the bark or break branches. Plants shall be lifted and handled with suitable support of the soil ball to avoid damaging it.

#### Mechanized Tree Spade Requirements

Trees may be moved and planted with an approved mechanical tree spade. The tree spade shall move trees limited to the maximum size allowed for a similar B&B root-ball diameter according to the *American Standard for Nursery Stock* or the manufacturer's maximum size recommendation for the tree spade being used, whichever is smaller. The machine shall be approved by the Project Consultant prior to use. Trees shall be planted at the designated locations in the manner shown in the plans and in accordance with applicable sections of the specifications.

#### MATERIALS FOR PLANTING

Mulch: shall be triple shredded hardwood bark mulch (non-dyed). Material shall be mulching grade, uniform in size, and free of foreign matter. Submit sample for approval.

Anti-desiccant: shall be an emulsion specifically manufactured for agricultural use, which provides a protective film over plant surfaces. Anti-desiccants shall be delivered in containers of the manufacturer and shall be mixed according to the manufacturer's directions. Submit manufacturer literature for approval.

#### MATERIALS FOR SOIL AMENDMENT

Horticultural-grade milled pine bark, with 80 percent of the material by volume sized between 0.1 and 15.0 mm.

Pine bark shall be aged sufficiently to break down all woody material. Pine bark shall be screened.

pH shall range between 4 and 7.0.

Submit manufacturer literature for approval.

Organic Matter: Leaf matter and yard waste composted sufficiently to break down all woody fibers, seeds, and leaf structures, and free of toxic and nonorganic matter. Organic matter shall be commercially prepared compost. Submit 0.5 kg (1 lb) sample and suppliers literature for approval.

Course Sand: Course concrete sand, ASTM C-33 Fine Aggregate, with a Fines Modulus Index of 2.75 or greater.

Sands shall be clean, sharp, natural sands free of limestone, shale and slate particles.

Provide the following particle size distribution:

<u>Sieve</u>	<u>Percentage Passing</u>
3/8 in (9.5 mm)	100
No. 4 (4.75 mm)	95-100
No. 8 (2.36 mm)	80-100
No. 16 (1.18 mm)	50-85
No. 30 (0.60 mm)	25-60
No. 50 (0.30 mm)	10-30
No. 100 (0.15 mm)	2-10

Lime: shall be ground, palletized, or pulverized lime manufactured to meet agricultural standards and contain a maximum of 60 percent oxide (i.e. calcium oxide plus magnesium oxide). Submit manufacturer literature for approval.

Sulfur: shall be flowers of sulfur, pelletized or granular sulfur, or iron sulfate. Submit manufacturer literature for approval.

Fertilizer: Agricultural fertilizer of a formula indicated by the soil test. Fertilizers shall be organic, slow-release compositions whenever applicable. Submit manufacturer literature for approval.

END OF SECTION 02950

SECTION 03305 - CONCRETE

PART 1 - GENERAL

RELATED DOCUMENTS:

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

DESCRIPTION OF WORK:

Concrete work includes, but is not specifically limited to, concrete piers, pipe encasement, pipe blocking, manhole inverts, concrete slabs, concrete curbs and gutters, concrete drives, walks and other concrete items required in the project.

RELATED ITEMS SPECIFIED ELSEWHERE:

Clearing, Excavation and Trenching: Section 02210

Gravity Sanitary Sewer System: Section 02737

Site Furnishings: Section 02737

QUALITY ASSURANCE:

Codes and Standards: AC1 301 "Specifications for Structural Concrete for Buildings"; AC1 347 "Recommended Practice for Concrete Formwork", AC1 304 "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete"; comply with applicable provisions except as otherwise indicated.

Workmanship: The CONTRACTOR is responsible for correction of concrete work which does not conform to the specified requirements, including strength, tolerances and finishes. Correct deficient concrete as directed by the ENGINEER.

Concrete Testing Service: Employ a testing laboratory acceptable to the ENGINEER to perform material evaluation tests and to design concrete mixes at CONTRACTOR's expense.

Certificates of material properties and compliance with specified requirements may be submitted in lieu of testing. Certificates of compliance must be signed by the materials producer and the

CONTRACTOR.

Quality Control: If required employ a separate testing laboratory to evaluate concrete delivered to and placed at the site. The cost of such testing shall be paid out of the testing allowance.

Testing laboratory will perform sampling and testing during concrete placement, which may include the following, as directed by the ENGINEER.

Sampling: ASTM C172.

Slump: ASTM C143, one test for each load at point of discharge.

Air Content: ASTM C173, one for each set of compressive strength specimens.

Compressive Strength: ASTM C39, one set for each 50 cu. yds. or fraction thereof of each class of concrete; 2 specimens tested at 7 days, 3 specimens tested at 28 days, and one retained for later testing if required.

When the total quantity of a given class of concrete is less than 50 cu. yds., the strength tests may be waived by the ENGINEER if field experience indicates evidence of satisfactory strength.

Materials and installed work may require testing and retesting as directed by the ENGINEER at any time during the progress of the work. Allow free access to material stockpiles and facilities at all times. Any retesting of rejected materials or testing of installed work for which laboratory specimens have failed shall be performed at the CONTRACTOR's expense. Similarly, the cost of any special tests requested by the ENGINEER which result in the identification of defective work or materials shall be borne by the CONTRACTOR.

Manufacturer's Data: Submit manufacturer's product data with installation instructions for proprietary materials including reinforcement and forming accessories, admixtures, joint materials, hardeners, curing materials and others as requested by the ENGINEER.

PART 2 - PRODUCTS

CONCRETE MATERIALS:

Portland Cement: ASTM C150, Type 1, unless otherwise acceptable to the ENGINEER.

Aggregates: ASTM C33, except local aggregates of proven durability may be used when acceptable to the ENGINEER.

Water: Clean, potable.

Design strength: 4000 psi unless otherwise noted (Not less than 564 lbs. cement per yard); 3000 psi for sidewalks curb and gutter, drives, etc.; 3000 PSI with 3/8" aggregate for masonry fill; 2500 psi for pipe blocking and encasement.

No admixtures containing calcium chloride may be used. Use Pozzoloth by Master Builders, Plastiment or Plasticrete by Silka and Chemstrong A, R, or W by Castle Chemical Company or approved equal.

Air-Entraining Admixture: ASTM C260. Only use admixtures having neutralized vensol resins. Use MB-VR by Master Builders, SIKA AER by Sika Chemical Company, or CASTLE VR by Castle Chemical Company, or approved equal.

Use air-entraining admixture in all concrete, providing not less than 4% nor more than 8% entrained air.

Water-Reducing Admixture: ASTM C494, Type A, D, and E. Only use admixtures which have been tested and accepted in mix designs, unless otherwise acceptable.

#### FORM MATERIALS:

Provide form materials with sufficient stability to withstand pressure of placed concrete without bow or deflection.

Exposed Concrete Surfaces: Acceptable panel-type to provide continuous, straight, smooth, as-cast surfaces. Use largest practical sizes to minimize form joints.

Unexposed Concrete Surfaces: Suitable material to suit project conditions.

#### CURING COMPOUND:

Liquid membrane forming curing compound shall comply with ASTM C300, Type I Class A, minimum 22% solids.

#### REINFORCING MATERIALS:

Reinforcing Bars: ASTM A615, Grade 40

Welded Wire Fabric: ASTM A185.

JOINT MATERIALS:

Self-Expanding Cork Joint Filler: Provide resilient and non- extruding type premolded cork units complying with ASTM D1752, Type III.

Water Stop: PVC meeting Corps of Engineers CRD-C572 with center bulb.

EXPOSED AGGREGATE MATERIALS:

Course aggregate shall be #8 pea gravel for exposed aggregate concrete. Provide multiple samples of course aggregate to be used for Owner's approval and color selection.

Fine aggregate shall be concrete sand of similar color to course aggregate proposed for exposed aggregate concrete. Provide multiple samples of fine aggregate to be used for Owner's approval and color selection.

PART 3 - EXECUTION

FORMING AND PLACING CONCRETE:

Ready-Mixed Concrete: ASTM C94. Furnish delivery tickets for each load showing amount of each material in the batch, time batched, date, job.

Formwork: Construct so that concrete members and structures are of correct size, shape, alignment, elevation and position, complying with ACI 347. Provide 3/4" chamfer on all exposed corners.

Provide openings in formwork to accommodate work of other trades. Accurately place and securely support items built into forms.

Clean and adjust forms prior to concrete placement. Apply form release agents or wet forms, as required. Retighten forms during and after concrete placement if required to eliminate mortar leaks.

Reinforcement: Position, support and secure reinforcement against displacement. Locate and support with metal chairs, runners, bolsters, spacers and hangers, as required. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

Install welded wire fabric in as long lengths as practicable, lapping at least one mesh.

Joints: Provide construction, expansion, weakened-plane (contraction), isolation, and control joints as indicated or required. Locate construction joints so as to not impair the strength and appearance of the structure. Place isolation and control joints in slabs-on-ground to stabilize differential settlement and random cracking.



Provide expansion and weakened-plane (contraction) joints where shown or required. Construct weakened-plane joints for a depth equal to at least 1/4 concrete thickness, either tooled, or with inserts unless otherwise shown. Tool edges of joints where slabs, walks, drives, curbs and gutters, etc. are constructed or replaced.

Place construction joints at the end of pours and at locations where placement operations are stopped for more than 1/2 hour, except where such pours terminate at expansion joints. Construct joints as shown or, if not shown, use standard metal keyway sections.

Provide premolded joint filler for expansion joints abutting curbs, manholes, and other fixed objects. Locate at 20' o.c. for pavement lanes unless otherwise specified.

Installation of Embedded Items: Set and build into the work anchorage devices and other embedded items required for other work that is attached to, or supported by cast-in-place concrete. Use setting diagrams, templates and instructions provided by others for locating and setting.

Concrete Placement: Comply with ACI 304, placing concrete in a continuous operation within planned joints or sections. Do not begin placement until work of other trades affecting concrete is completed.

Consolidate placed concrete using mechanical vibrating equipment with hand rodding and tamping, so that concrete is worked around reinforcement and other embedded items and into all parts of forms.

Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placement and curing.

In cold weather comply with ACI 306.

In hot weather comply with ACI 305.

#### CONCRETE FINISHES:

Exposed-to-view Surfaces: Provide a smooth rubbed finish for exposed formed concrete surfaces and surfaces that are to be covered with a coating or covering material applied directly to concrete. Remove fins and projects, patch defective areas with cement grout, and rub smooth.

Slab Trowel Finish: Apply trowel finish to interior monolithic slab surfaces that are exposed-to-view or are to be covered with resilient covering, paint or other thinfilm coating. Consolidate concrete surface by finish troweling, free of trowel marks, uniform in texture and appearance.

Drives, Walks, Curbs and Gutter Finishing: After striking-off and consolidating, smooth the concrete surface by screeding and floating. Work edges of slabs, gutters, and other formed joints

with an edging tool to a 1/2" radius.

After floating and when excess moisture or surface sheen has disappeared, complete surface finishing as follows:

Broom finish, by drawing a fine-hair broom perpendicular to line of traffic, as acceptable to the ENGINEER.

Curing: Begin initial curing as soon as free water has disappeared from exposed surfaces. Where possible, keep continuously moist for not less than 72 hours. Cure formed surfaces by moist curing until forms are removed. Continue curing by use of moisture-retaining cover or membrane-forming curing compound. Apply curing compound according to manufacturer's instructions and Federal Specification TT-C-00800. Provide protections as required to prevent damage to exposed concrete surfaces.

EXPOSED AGGREGATE FINISH:

Areas of concrete calling for an exposed aggregate finish shall be finished in the same manner as other sidewalks described above. However, edges do not require tooling.

After screeding and broom finishing, apply surface retarder in accordance with manufacturer's instructions, protecting adjacent concrete areas from retardant. When depth of retarded mortar is at a depth approximately half the width of the pea gravel (generally 12 to 24 hours after application), expose aggregate by removing surface paste with a garden hose, stiff broom, or pressure washer.

END OF SECTION 03305

SECTION 13120 – PRE-ENGINEERED BATH HOUSE

PART 1 - GENERAL

RELATED DOCUMENTS:

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

DESCRIPTION OF WORK:

This section covers the construction and placing of the pre-engineered precast concrete flush toilet building (“pre-engineered bath house”), as shown on the drawings and described herein.

QUALITY ASSURANCE:

Codes and Standards:

ASTM C33	Concrete Aggregates
ASTM C39	Method of Test for Compressive Strength of Cylindrical Concrete Specimens
ASTM C94	Standard Specification for Ready-Mixed Concrete
ASTM C143	Method of Test for Slump of Concrete
ASTM C150	Standard Specification for Portland Cement
ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM A185	Standard Specification for Steel Welded Wire Reinforcement, Plain, or Concrete
ASTM C192	Method of Making and Curing Test Specimens in the Laboratory
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C309	Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bar for Concrete Reinforcement
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcine Natural Pozzolan for Use in Concrete
ASTM C979	Standard Specification for Pigments for Integrally Colored Concrete
ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort

ACI 211.1	Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 306	Cold Weather Concreting
ACI 318	Building Code Requirements Structural Concrete and Commentary (includes Errata)
PCI MNL 116	Quality Control for Plants and Production of Precast Prestressed Concrete Products

Manufacturer Criteria: The manufacturer supplying the pre-engineered bath house shall meet the following criteria:

- Manufacturer must be ISO 9001 certified at the time of bid.
- Manufacturing plant must be PCI certified at the time of bid.
- Manufacturer must not have defaulted on any contract within the last five (5) years.
- Manufacturer must provide stamped, engineered drawings prepared by a professional engineer licensed in the State of North Carolina prior to acceptance.
- Manufacturer shall provide a warranty against defects in material and workmanship for a period of twenty (20) years on all concrete components. The warranty is valid only when concrete is used within the specified loadings. Furthermore, said warranty includes only the related material necessary for the construction and fabrication of said concrete components.
- UL 752 Bullet Resistance on 4” thick concrete samples.

Basis of Design: The basis of design for the pre-engineered bath house is the Denali flush precast concrete flush toilet building as produced by CXT Incorporated:

CXT, Incorporated  
Spokane Industrial Park  
3808 North Sullivan Road, Building 7  
Spokane, WA 99216

Substitutions for the basis of design shall be submitted to the OWNER demonstrating that the proposed system meets or exceeds the basis of design in all respects a minimum of 15 business days prior to the bid date.

Included Options: The following options from the basis of design Manufacturer, or their satisfactory equivalent from an approved alternate, are to be provided with the pre-engineered bath house:

- Stainless steel plumbing fixtures
- ADA accessible hi/lo drinking fountain
- Electric hand dryers
- Electric water heater
- Horizontal lap wall texture

Design Criteria: The pre-engineered bath house shall be designed to meet all local, state, and

federal codes and shall be accessible in accordance with the Americans with Disabilities Act. Manufacturer's sealed drawings shall indicate design criteria utilized.

## PART 2 - PRODUCTS

### MATERIALS:

#### Concrete – General

- The concrete mix design is designed to ACI 211.1 to produce concrete of good workability.
- Concrete will contain a minimum of 675 pounds of cementitious material per yard. Cement is a low alkali type I/II or III conforming to ASTM C-150.
- Coarse aggregates used in the concrete mix design will conform to ASTM C33 with the designated size of coarse aggregate #67.
- Maximum water/cement ratio will not exceed .45.
- Air-entraining admixtures will conform to ASTM C260. Water reducing admixtures will conform to ASTM C494, Type A.
- If Self Compacting Concrete (SCC) is used, it must conform to ASTM C1611.

#### Colored Concrete

- Color additives will conform to ASTM C979. A 12" x 12" x 1" color sample is available for customer approval.
- The following will contain colored concrete:
  - Toilet building roof panels.
  - Building walls.
  - Screen panels.
- The same brand and type of color additive are used throughout the manufacturing process.
- All ingredients are weighed and the mixing operation are adequate to ensure uniform dispersion of the color.

#### Concrete Reinforcement

- All reinforcing steel will conform to ASTM A615. All welded wire fabric will conform to ASTM A185.
- All reinforcement is new, free of dirt, oil, paint, grease, loose mill scale and loose or thick rust when placed.
- Details not shown on drawings or specified are to ACI318.
- Steel reinforcement is centered in the cross-sectional area of the walls and will have at least 1¼" of cover on the under surface of the floor.
- The maximum allowable variation for center-center spacing of reinforcing steel is ½".
- Full lengths of reinforcing steel are used when possible. When splices are necessary on long runs, splices are alternated from opposite sides of the components for adjacent steel bars.
- Lap bars under #4 a minimum of 12" bar diameters.
- Lap bars larger than #4 a minimum of 24" bar diameters.

- Reinforcing bars are bent cold. No bars partially embedded in concrete are field bent unless approved by the customer.

#### Caulking, Grout, Adhesive and Sealer

- Caulking service temperatures from -40°F to +194°F.
- Interior and exterior joints are caulked with a paintable polyurethane sealant.
- Grout is a non-shrink type and are painted to match the color of surrounding concrete as nearly as possible.
- Cement base coating is formulated with a very fine aggregate system and is a built-in bonding agent.

#### Paint

- All paints and materials will conform to all federal specifications or be similar “top-of-the-line-components.”
- Type of paints for toilets.
  - Inside concrete surfaces.
    - Interior floors will be a chemical resistant urethane. The color will be gray.
    - Interior walls and ceilings will be a modified acrylic, water repellent penetrating stain. The color will be white followed by a clear acrylic anti-graffiti sealer.
  - Metal surfaces both inside and out.
    - DTM ALKYD.
  - Exterior concrete surfaces.
    - Exterior slab will be clear sealer.
    - Exterior walls and roof will be a water repellent penetrating stain in the same color as the walls or roof followed by a clear acrylic anti-graffiti sealer.

#### Grab Bars

- Grab bars will be 18-gauge, type 304 stainless steel with 1½” clearance. Grab bars will each be able to withstand 300-pound top loading.

#### Toilet Paper Dispenser

- Dispenser will be constructed of ¼” thick, type 304 stainless steel. Dispenser will be capable of holding three (3) standard rolls of toilet paper. Toilet paper holder fastening

#### Steel Doors

- Doors will be flush panel type 1¾” thick, minimum 16-gauge galvanized steel, top painted with DTM ALKYD.
- Door frames will be knockdown or welded type, single rabbet, minimum 16-gauge prime coated steel top painted with DTM ALKYD, width to suit wall thickness. Three (3) rubber door silencers will be provided on latch side of frame.
- Doors shall meet a 130 MPH wind rating.

#### Door Hinges

- Door hinges will be three (3) per door with dull chrome plating 4½” x 4½”, adjustable

tension, and automatic closing for each door.

#### Lockset

- Lockset will meet ANSI A156.2 Series 4000, Grade 1 cylindrical lockset for exterior door.
- Lever handle both inside and out.
- Either handle operates latch unless outside handle is locked by inside push-button.
- Push-button will automatically release when inside lever handle is turned or door is closed.
- Emergency slot on exterior so door can be unlocked from the outside with a coin, screwdriver etc.
- Inside lever always active.
- U.S. 26D finish.

#### Dead Bolt

- Certified ANSI/BHMA A156.5-2001 Grade 1.
- Heavy duty tamper resistant.
- 2¾" backset.
- U.S. 26D finish.

#### Doorstop

- Doorstop will be a dome style stop meeting ANSI 156.16.

#### Double Coat Hook

- Coat hook will be 304 stainless steel 16-gauge (1.5mm), formed construction with a satin finish and have ¾" x ⅞" nail in anchor. Upper hook will extend at least 2½" from the wall. Lower hook will extend at least 1¼" from the wall.

#### Door Sweep

- Door sweep will be provided at the bottom of door and will be an adjustable brush type.

#### Wall Vent

- Wall vent will be crank operated allowing the unit to be opened or closed. Crank will be removable. Vent cover will be 14-gauge 304 stainless steel and anchored into the concrete wall with high strength anti-rust tap con fasteners. Vent to come with insect screen. Cover to be recessed a minimum ¾" on exterior walls with a 45-degree bevel. Interior to be flush mounted. Wall vent will not protrude from the wall.

#### Signs

- Signs to have raised pictograms, letters, and braille to meet ADA.

#### Windows

- Window frames will be constructed from steel.
- Window glazing will be ⅜" thick translucent pebble finished mar-resistant Lexan.
- Windows to have ¾" recess with 45-degree bevel.

- Window frames to have vandal resistant fasteners.
- Gable window to be 4 x 4 x ¼ tube steel.
- Windows shall meet a 130 MPH wind rating.

#### Mirrors

- Mirror to be 18” x 36” frameless 430 18-gauge stainless steel with #8 bright polish.

#### Plumbing

- All fixtures to meet ANSI A112.19.2.
- Plumbing will be concealed in the service area.
- Flush valve – Concealed closet flush-o-meter constructed of rough brass. Furnish valve with integral vacuum breaker and wall mounted push button. Valve will be of a water saver type with a flow of 1.6 gallons per flush.
- Hammer arrester – Installed on water line.
- Hose bib – Available in the chase area.
- Lavatory – Vitreous china with back splashguard, front overflow opening, equipped with brass trap and drainpipe without stopper. Sink will be 20” wide x 18” front to back x 5¾” deep with ADA trap cover. Optional stainless steel fixtures available.
- Main shut-off valve and drain.
- Toilet – Constructed of vitreous china, wall hung, with siphon jet action. Toilet will have a back spud for a concealed flush valve connection and will be mounted with the top of the seat 18” above the finished floor. Seat will be heavy duty solid plastic with an open front. Optional stainless steel fixtures available.
- Trap primer distribution unit.
- Waste and vent material – ABS or PVC plastic and will be plumbed to meet Uniform Building Codes.
- Water material – Copper tubing Type L, hard drawn. A gate valve will be provided at the inlet end of the water line. All water lines will be of a size to provide proper flushing action based on a nominal water pressure of 40 psi.
- Water valve – Self-closing water set with indexed push button.
- Optional 4-gallon mini tank water heater.

#### Electrical

- All components are UL listed.
- Breaker panel – 100 amps, mounted to meet electrical code.
- Interior lighting – Vandal resistant fixtures with built-in occupancy sensor, energy efficient LED lights, and lifetime warranty.
- Exterior lighting – Vandal resistant fixtures with built-in photoelectric switch, energy efficient LED lights.
- Exhaust fans – All wet location motion activated with speed control in chase area to control CFM.
- Wiring – Conduit, surface mounted in the service area and concealed in the user compartments. All wire will be copper.
- Optional warm air, ADA compliant, vandal resistant hand dryers available.



## MANUFACTURE:

### Finishing Concrete

- All exterior building walls and exterior screen walls will be any one of the available textures.
- All exterior surfaces of the roof panels will be cast to simulate any one of the available textures. The underside of the overhang will have a smooth finish.

### Cracks and Patching

- Cracks in concrete components which are judged to affect the structural integrity of the building will be rejected.
- Small holes, depressions, and air voids will be patched with a suitable material. The patch will match the finish and texture of the surrounding surface.
- Patching will not be allowed on defective areas if the structural integrity of the building is affected.

## FINISHING AND FABRICATION:

### Structural Joints

- Wall components will be joined together with two (2) welded plate pairs at each joint. Each weld plate will be 6" long and located one (1) pair in the top quarter and one (1) pair in the bottom quarter of the seam. Weld plates will be anchored into the concrete panel and welded together with a continuous weld.
- The inside seams will be a paintable caulk. The outside seams will use a caulk in a coordinating building color or clear.
- Walls and roof will be joined with weld plates, 3" x 6" at each building corner.
- The joint between the floor slab and walls will be joined with a grout mixture on the inside, a matching colored caulk on the outside and two (2) weld plates 6" long per wall.

### Painting/Staining

- An appropriate curing time will be allowed before paint is applied to concrete.
- Schedule of finishes.
  - Inside concrete surfaces.
    - Inside floors will be one (1) coat of one (1) part water based chemical resistant urethane.
    - Interior walls and ceilings will be two (2) coats of a modified acrylic, water repellent penetrating stain, followed by one (1) coat of clear sealer.
  - Metal surfaces both inside and out.
    - Two (2) coats of DTM ALKYD.
  - Exterior concrete surfaces.
    - Exterior walls will be two (2) coats of water repellent penetrating stain in the same color as the walls or roof followed by one (1) coat of clear acrylic anti-

graffiti sealer.

TESTING:

The following tests will be performed on concrete used in the manufacture of toilets. Testing will only be performed by qualified individuals who have been certified ACI Technician Grade 1. Sampling will be in accordance with ASTM C172.

- The air content of the concrete will be checked per ASTM C231 on the first batch of concrete. The air content will be in the range of 5.0% +/- 2.0%.
- The compressive strength of the cylinders will be tested to ASTM C39. We will make one (1) cylinder for release, one (1) for seven (7) days and one (1) for 28 days. The release must be a minimum strength of 2500 psi, the 7-day must be a minimum of 4500 psi and the 28-day must be a minimum of 5000 psi.
- A copy of all test reports will be available to the customer as soon as 28-day test results are available.

PART 3 - EXECUTION

CONTRACTOR shall deliver and install the pre-engineered bath house according to Manufacturer's instructions. All connections to the pre-installed facilities in the bath house (plumbing, electrical, etc.) shall be made by an appropriately licensed contractor.

END OF SECTION 13120

SECTION 15130 - WATER SERVICES

PART 1 - GENERAL

RELATED DOCUMENTS:

The general provisions of the Contract, including the General and Special Conditions and Division - 1 Specification sections apply to work of this section.

DESCRIPTION:

The extent of work covering services includes furnishing, installing and making operational all water service items as indicated on the drawings and specified herein.

CONTRACTOR will provide staking and flagging. OWNER will determine location of services and coordinate with the water service customer.

QUALITY ASSURANCE:

Codes and Standards: Comply with the provisions of the following codes and standards except as otherwise shown or specified.

AWWA: All applicable standards  
NSF - 61

Manufacturer's Capabilities: Supplier of water service items shall be regularly engaged in the manufacture of products of types and sizes required, and which have been in satisfactory use for not less than five years in similar service.

SUBMITTALS:

Shop Drawings: Submit shop drawings or product data for all water service items.

PART 2 - PRODUCTS

GENERAL:

Provide factory-fabricated water service materials as hereinafter specified for use in the manner indicated. Provide products of the type, size and pressure-rating indicated or required. All service material shall be rated for minimum of 150 psi.

SERVICE SADDLES:

Service saddles, shall be bronze with AWWA Taper (CC) threads as manufactured by Mueller Company, Ford Meter Box Co., A.Y. McDonald or equal.

BALL CORPORATION STOPS (LEAD FREE):

Corporation stops shall have inlet connections with AWWA Taper (CC) thread, and outlet connection with CTS O.D. P.E. tubing. Stops shall be Insta-Tite as manufactured by Mueller or CTS compression outlet by Ford Meter Co., A.Y. McDonald or equal.

BALL ANGLE STOPS (LEAD FREE):

Angle stops shall have inlet compression connection for CTS O.D. PE tubing, and outlet shall be meter saddle nut, as manufactured by Mueller Co., Ford Meter Box Co., A.Y. McDonald or equal.

SERVICE TUBING:

Service tubing shall conform to ASTM specification D 2737, SDR 9, CTS O.D. Service tubing shall be NSF approved.

SERVICE CASING:

Service casing shall conform to ASTM D 2241 Sch. 40 PVC.

METER (LOW LEAD):

Water meters shall conform to AWWA Standard C 700. Meter shall read in U.S. gallons per minute. Main case, register case and lid shall be bronze with frost-proof bottom, lined to prevent corrosion. Must be in compliance with NSF-61, Meter to be Model SR11 by Sensus, Elster, Neptune or equal.

BACKFLOW PREVENTER:

Backflow preventer shall be bronze body construction, (lead free), two compact acetyl resin plastic replaceable check modules, with buna "N" seals, stainless steel springs, "O" ring union seals and one union with the union nut drilled to accept a tamper-proofing lock wire. The backflow preventer shall have NPT threaded female union inlet, NPT threaded female outlet and sized to fit the service meter installed. Preventer shall be Watts LF7R or equal.

METER BOX:

Meter Box shall be oval shaped, Class 30 cast iron type, complete with cover, in conformance with ASTM-48. Boxes shall be equal to Sigma MB-382, Capital Foundry MBX-1 Star Pipe Products, Model 0017.

PART 3 - EXECUTION

GENERAL:

Install all water service items as shown on the drawings, complying with manufacturer's instructions and as directed. Provide water service materials of required size to complete and make ready for service to customer.

Services shall be installed prior to pressure testing and disinfecting the water main(s) except for services added by OWNER after acceptance of the main. Flushing, pressure testing and disinfection of services shall be performed in accordance with the PRESSURIZED PIPING GENERAL PROVISIONS section.

WATER SERVICE:

New water service connection shall include service saddle, corporation stop, angle stop, meter, meter box, service tubing and backflow preventer, if required.

Services on HDPE water main must have ENGINEER's approval.

END OF SECTION 15130



The Specification Sections applying to the Electrical Work for the Slocum Creek Park – Phase IV Improvements in Havelock, North Carolina are as follows:

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8/1/2017



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## **SECTION 16100 - GENERAL ELECTRICAL REQUIREMENTS**

The Electrical Contractor must organize his work and secure material in a manner that will expedite the project thus completing the project on schedule. Conditions of the Contract, Form of Construction Contract, Notice to Bidders, Supplementary General Conditions, General Specifications and all of which are a part of these specifications.

The electrical work shall be part of the general contract.

The Contractor shall refer to the Notice to Bidders, Instructions to Bidders and General Conditions of the Contract, Form of Construction Contract, Supplementary General Conditions, General Specifications and all Division 16 Electrical Specifications all of which are a part of these specifications.

Refer to drawings for exact dimensions and layout.

### **PART 1 GENERAL**

1.01 These specifications and the accompanying plans are intended to describe the installation of a complete electrical system in this building complex. The work to be done under these specifications shall include the furnishing of all labor, equipment and materials required to provide a complete and working electrical system as shown on the plans and as outlined in these specifications.

### **PART 2 GENERAL**

2.01 The contract shall include all labor, materials, permits, etc. necessary for the completion of the work. All materials, shall be new except as specifically noted, and shall have Underwriter's Laboratory approval or U.L. re-examination listing, and shall be installed in accordance with the best practice by experienced mechanics.

2.02 The electrical plans are diagrammatic only and are not intended to show all details of the work. The location of all conduit work is approximate and the Electrical Contractor shall make any necessary changes in the location to avoid piers, beams, footings, plumbing, duct and other obstructions at no additional cost to the owner.

2.03 The spirit as well as the letter of the plans and specifications work shall be executed according to the true intent and meaning of plans and specifications, both of which are intended to include everything requisite for a complete electrical system.

2.04 The Electrical Contractor shall comply with all state and Underwriter's requirements, ordinances or rules governing work of the character including the current edition of the National Electrical Code and OSHA and all applicable local codes.

2.05 Should any error or omission exist in either or both of these plans and specifications, or conflict one with the other, the Contractor shall not avail himself of such unintentional error,

omission or conflict, but shall have same explained and adjusted before signing the contract or proceeding with the work, otherwise, he shall at his expense supply the proper materials and labor to make good any damage to or defect in his work caused by such error, omission or conflict.

### **PART 3 SAMPLES**

3.01 All materials, equipment and accessories entering into the work area are subject to the approval or disapproval of the Engineer. No samples are required to be submitted with bid documents. Name of equipment suppliers shall be provided on the Bid Form where required.

3.02 The samples required by the Engineer shall be submitted after the award of the contract and acceptance of the Contractor's bond. All samples shall be delivered to a location designated by the Engineer.

3.03 No inspection or test shall be made except upon formal notice to the Engineer from the Contractor by letter or telegram. Contractor shall furnish all labor and appliances for tests and shall meet all expenses of said test.

3.04 In all cases where devices or part of the equipment is herein referred to in the singular number, it is intended that such referred shall apply to as many devices as are required to complete the installation.

### **PART 4 SPECIAL CONDITIONS**

4.01 Everything necessary for the completion and successful operation of the work, whether or not here definitely specified or indicated on the drawings, shall be furnished and installed as well and faithfully as if so indicated and specified.

4.02 Contractor shall store all materials in trailers each night. No materials shall be left in the institution.

4.03 System voltage shall be the following:

120/230 VAC, single phase, 3 wire, 60 hertz

### **PART 5 PAINTING**

5.01 All factory finished metal surfaces damaged during installation shall be restored to their original condition.

### **PART 6 SUPERVISION AND SUPERINTENDENCE**

6.01 This Contractor shall during the progress of the work, maintain a competent superintendent who shall not be changed except if he proves unsatisfactory to the Contractor or the Engineer.

## **PART 7 WORKMANSHIP**

7.01 Only the finest quality workmanship shall be acceptable and any shoddy work shall be removed without delay and such materials shall not be re-used without the consent of the Engineer.

7.02 The Electrical Contractor's foreman shall be thoroughly experienced in the installation of electric wiring as covered by the plans and specifications and he shall remain on the job continually while the work is in progress. His qualifications, and ability shall be acceptable to the Engineer.

## **PART 8 INSPECTION AND TESTS**

8.01 The system shall be installed in strict accordance with the regulations of the local and State Codes and ordinances.

8.02 The final inspection and tests shall be made only after the Engineer shall be satisfied that the work described in these specifications has been completely installed in accordance with the spirit and intent of these specifications. The acceptance of the work shall not in any way prejudice the rights to demand the replacement of defective materials or workmanship. The Electrical Contractor shall furnish instruments, special apparatus, and expert service to make all necessary tests to show that the system is absolutely clear of improper grounds and short circuits and to demonstrate that the entire equipment as to capacity, quality, and completeness is properly installed to meet all requirements of these specifications and defects shall be remedied without delay. Electrical Certificate shall be by the State Electrical Inspector for the applicable part of the project under their jurisdiction.. Electrical contractor shall coordinate all state electrical inspections through the State Construction Office.

The Electrical Contractor shall notify the local electrical inspector and schedule required inspections including rough-in, and final inspections. A "certificate of approval" shall be obtained from the local Electrical Inspector after project final inspection approval.

## **PART 9 VISIT TO SITE**

9.01 All bidders shall visit the site and thoroughly familiarize themselves with the existing conditions before submitting their bids. No allowances will be made for a lack of knowledge of existing conditions.

## **PART 10 GUARANTEES**

10.01 The contractor shall deliver the systems to the owner in first class operating condition in every respect and shall guarantee as specified in Instructions To Bidders and General Conditions of the Contract for one full year after final acceptance of the project

## **PART 11 LIQUIDATED DAMAGES**

11.01 Refer to General Conditions

## **PART 12 COORDINATION**

12.01 The electrical contractor shall be responsible for any delays in construction caused by the Electrical Contractor.

## **PART 13 FEES AND PERMITS**

13.01 Contractor shall acquire and pay for all fees and permits required by authorities.

## **PART 14 CONTRACTOR DEFINED**

14.01 The words "Contractor", "contractor" and "Electrical Contractor" are used in this section are synonymous.

## **PART 15 ACCEPTANCE**

15.01 The entire electrical construction will be accepted as a unit. There will be no partial acceptance.

## **PART 16 DAMAGES**

16.01 This contractor shall be responsible for damage to the work of others or the property and any damage by this contractor shall be repaired or replaced by this contractor at no cost to the owner.

## **PART 17 RECORD DRAWINGS**

17.01 The contractor shall furnish to the Engineer drawings of any arrangements installed differently from those shown on the Engineer's contract drawings.

## **PART 18 SUBSTITUTE MATERIALS**

18.01 A 10 day prior approval before the bid date shall be required for any substitutions than the materials listed in the specifications.

**\*\*\*END OF SECTION\*\*\***

## **SECTION 16111 - CONDUIT**

### **PART 1 GENERAL**

#### **1.01 WORK INCLUDED**

- A. Electrical Metallic Tubing and Fittings
- B. Non Metallic Conduit and Fittings
- C. Rigid Metal Conduit and Fittings

#### **1.02 REFERENCES**

- A. ANSI C80.3 Electrical Metallic Tubing, zinc coated
- B. ANSI/NEMA FB 1 - Fittings and Supports for Conduit and cable assemblies.
- C. FS WW-C-581 - Specifications for Galvanized Rigid Conduit

### **PART 2 PRODUCTS**

#### **2.01 RIGID STEEL CONDUIT:**

- A. Rigid steel conduit: ANSI C80:1; FS WW C 581. Conduits shall be rigid steel hot dipped galvanized zinc, metallized, sherradized mild steel, Schedule 40 size, threaded, manufactured in accordance with Underwriter's Laboratory standard and so labeled.
- B. ACCEPTABLE MANUFACTURERS:
  - 1. National
  - 2. Republic
  - 3. Spang
  - 4. Or Equal
- C. Fittings and Conduit Bodies: ANSI/NEMA FB1; threaded style.

**2.02 PLASTIC CONDUITS AND FITTINGS:**

- A. Conduit NEMA TC2: 40 or 80 PVC manufactured in accordance with Underwriter's Laboratory Standard and UL listed.
- B. Fittings and conduit bodies TC3.
- C. Acceptable Manufacturers:
  - 1. Allied
  - 2. Carbon
  - 3. FRE Conduit

**2.03 FLEXIBLE METALLIC CONDUIT AND FITTINGS**

- A. Conduit FS-WW-C-566 (Aluminum)
- B. Fittings and conduit bodies: ANSI (NEMA FB)

**2.04 CONDUIT SUPPORTS**

- A. Conduit clamps, straps, and supports: malleable iron for riser assemblies.

**2.05 METALLIC CONDUIT AND FITTINGS**

- A. Conduit FS-WW-566 (aluminum)
- B. Fitting and conduit bodies
- C. Acceptable Manufacturers
  - 1. Alflex Corp.
  - 2. Allied
  - 3. Thomas and Betts

**2.06 EMT**

- A. EMT: ANSI C80.3 galvanized tubing.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel only hexagonal threaded connectors unless specified otherwise. Indenter fittings will not be allowed.

**C. ACCEPTABLE MANUFACTURERS**

1. National
2. Republic
3. Spang

**PART 3 EXECUTION****3.01 CONDUIT SIZING, ARRANGEMENT, AND SUPPORTS**

- A. Size conduit for conductor type installed. 3/4" (20mm) minimum size.
- B. Arrange conduit to present a neat appearance.
- C. Route exposed conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.
- D. Maintain minimum 6" clearance between conduit and piping. Maintain 12" (300mm) clearance between conduit and heat sources such as flues, steam pipes, and heating appliances.
- E. Paralleled conduit shall be run straight and true with offsets uniform and symmetrical. Conduit terminals, boxes and cabinets shall be rigidly secured with double locknuts, one inside and one outside and bushings. Insulated bushings of the plastic type shall be used on all conduits 3/4" trade size and larger. Lacquer coating of conduits shall be removed where ground clamps are to be installed.
- F. Group conduit in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.
- G. Do not fasten conduit with wire or perforated pipe straps. Remove all wire used for temporary conduit support during construction, before conductors are pulled.
- H. Exposed conduit shall be securely fastened in place in accordance with the latest issue of the NEC. Horizontal and vertical conduit runs may be supported by one-hole malleable straps, clampbacks or other approved device with suitable bolts, expansion shields where needed or beam clamps for mounting to building structure or special brackets. Adjustable hangers may be used to suspend conduits when separately located. The required strength of the supporting equipment shall be based on the combined weight of conduits, hangers and cables.

**3.02 CONDUIT INSTALLATIONS ABOVE GRADE**

- A. Cut conduit square using a saw or pipe cutter; de-burr cut ends.
- B. Bring conduit to the shoulder of fittings and couplings and fasten securely.
- C. Use conduit hubs or sealing locknuts for fastening conduit to cast boxes, and for fastening conduit to sheet metal boxes in damp or wet locations.
- D. Install no more than the equivalent of four 90-degree bends between boxes.
- E. Use conduit bodies to make sharp changes in direction.
- F. Use hydraulic one shot conduit bender or factory elbows for bends in conduit larger than 2" (50 mm) size.
- G. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.
- H. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture.
- I. Provide No. 12 AWG insulated conductor or suitable pull string in empty conduit, except sleeves and nipples.
- J. Where conduit penetrates fire-rated walls and floors, provide mechanical fire-stop fittings with UL listing fire rating equal to wall or floor rating.
- K. Route exposed surface metal raceway to provide least obvious installation. Utilize corners of rooms as much as possible.
- L. Conduit couplings for CRC and PVC shall be in accordance with NEC.
- M. EMT couplings shall be of the plated steel hexagonal compression type. No POT METAL or INDENTED type couplings shall be utilized.
- N. EMT couplings shall be "concrete tight" where buried in masonry or concrete. Where installed in damp locations fittings shall be of the "raintight" type.



### 3.03 UNDERGROUND CONDUIT INSTALLTION – BELOW GRADE

- A. Underground installation shall conform to ANSI C2 and NFPA 70 except as otherwise specified or indicated.
- B. Direct Burial System: Branch circuit conduit shall be buried directly in earth. Trenches in which conduits are placed shall be excavated by hand or with mechanical trenching equipment. Provide a minimum conduit depth to bottom of trench of 30” for power conductors operated less than 600 volts. Trenches shall not be less than 6” wide, and shall be in straight lines between cable markers. Cable plows shall not be used. Bends in trenches shall have a radius of not less than 36”. Where two or more conduits are laid in parallel in the same trench, they shall be spaced laterally at least 3” apart. When rock is encountered, it shall be removed to a depth of at least 3” below the cable and the space filled with sand or clean earth free from particles larger than ¼”. Provide a plastic warning tape as specified herein. Conduits exposed to physical damage shall be encased in 3” of concrete including service entrance conduits. No concrete encasement is required for Telecommunications, data and audio raceways.
- C. Conduits crossing other metal piping shall be separated from the other pipe by not less than 12” of well tampered earth.
- D. The top of the duct shall not be less than 30” below grade, shall have a minimum slope of 3” in each 100 feet away from buildings and toward other necessary drainage points, and shall run in straight lines except where a change of direction is necessary. As each conduit run is completed, a testing, mandrel not less than 12” long with a diameter of ¼” less than the inside diameter of the duct shall be drawn through each conduit; after which a brush, having stiff bristles, shall be drawn through until the conduit is clear of all particles of earth, sand, or gravel; conduit plugs shall then immediately be installed. There shall not be less then 3” clearance from the conduit to each side of the trench. The bottom of the trenches shall be graded smooth; where rock, soft spots, or sharp edged materials are encountered, excavate the bottom for an additional 3”
- E. Warning Tapes in Earth Trenches: For the purpose of early warning and identification during future trenching or other excavation, continuous identification tapes shall be provided in the trench above direct buried cables. Tape shall be nonmagnetic plastic tape or aluminum foil plastic-backed tape manufactured for the purpose of early warning and identification of utilities buried below the tape. Tape shall be at least 3” in width. Color of tape shall be standard with the manufacturer for the type of utility buried below the tape. Tape shall not have lettering at least 1” high with not less than the following identification of the tape: “BURIED ELECTRIC LINE BELOW”.

- Tape shall be installed according to the printed recommendations of the tape manufacturer as modified herein. Tapes shall be buried at a depth of 6" below the top surface of earth: in pavements, this 6" shall be measured from the top of the subgrade.
- F. Terminate conduits in end bells where duct lines enter handholes.
  - G. Reconditioning of Surfaces:

Unpaved surfaces disturbed during the installation of duct or dirt burial cable shall be restored to their original elevation and condition. Sod or topsoil shall be preserved carefully and replaced after the backfilling is completed. Sod that is damaged shall be replaced by sod of quantity equal to that removed. Where the surface is disturbed a newly seeded area, the restored surface shall be reseeded with the same quality and formula of seed as that used in the original seeding. Compaction shall be in 6" layers.
  - H. Surfaces to be paved shall be restored and soil replaced to meet all requirements for paved road preparation as detailed in the Civil Engineering Specifications including backfill to 95% compaction.
  - I. Cable Pulling: Cables shall be pulled down grade with the feed-in point at the point of the highest elevation. Flexible cable feeds shall be used to convey cables through the opening and into the duct runs. Cable lubricants shall be soapstone, graphite, or talc for rubber or plastic jacketed cables. Cable pulling tensions shall not exceed the maximum pulling tension recommended by the cable manufacturer. If basket-grip type cable pulling devices are used to pull cable in place, cut off the section of the cable under the grip before splicing and terminating.

### **3.04 SCHEDULE OF CONDUIT INSTALLATION**

- A. Interior concealed installation: Electrical metallic tubing for all conduit less than and including 2". Rigid galvanized steel conduit shall be used for all conduit 2 ½" or larger. EMT shall not be installed where:
  - 1. It will be subject to severe physical damage.
  - 2. It will be subject to severe corrosive influence.
  - 3. Tubing, elbows, couplings, and fittings would be in concrete or in direct contact with the earth.
  - 4. It is protecting the service entrance conductors.
- B. Rigid conduit shall be used where subject to sever physical damage. Use rigid galvanized steel conduits for any exterior exposed conduit installation.

- C. Use schedule 40 PVC conduit direct burial for service and branch circuit conduit installed underground.
- D. Use schedule 80 PVC conduit for all conduit above grade.

**\*\*\*END OF SECTION\*\*\***



## **SECTION 16120 – WIRE AND CABLE**

### **PART 1 GENERAL**

#### **1.01 WORK INCLUDED**

- A. Building Wire
- B. Cable
- C. Wiring connections and terminations

#### **1.02 REFERENCES**

- A. NEMA WC-5 thermoplastic insulated wire and cable for the transmission and distribution of Electrical Energy

#### **1.03 SUBMITTALS**

- A. None

### **PART 2 PRODUCTS**

#### **2.01 BUILDING WIRE**

- A. Thermoplastic insulated Building Wire - NEMA WC 5
- B. Branch circuit 10 AWG and Smaller copper solid conductor, 600 volt insulation, THHN/THWN.
- C. Branch circuit -conductors #8 AWG and larger shall be stranded copper conductor 600 volt insulation THHN/THWN. All insulation for #6 and #8 AWG shall be color coded by pigmentation, not tape.
- D. Minimum conductor size for all power and lighting circuits shall be #12 AWG.
- E. All conductors shall be color coded by pigmentation.

#### **2.02 CONDUCTORS**

- A. All conductors shall be tinned soft or annealed copper wire of the quality manufactured in accordance with ASTM specifications. Cutting away of strands to permit inserting into lugs will not be tolerated.

- B. Conductor sizes shall be American Wire gauge sizes as indicated and stranded construction. All wires to be factory marked with stamping every two feet indicating size, type, voltage, rating and manufacturer's name. Wire shall be factory color-coded. Color coding shall be as follows: 120/230 VAC 1 Phase 3 wire: Phase A(1) Black, Phase B (2) Red, Neutral (N) White, and Ground, (G) Green. The system-grounding conductor shall be colored green. The system-grounding conductor shall be colored green. Note the green coding required by NEC for conductors intended solely for the grounding purposed. In multiconductors, the group shall be color coded. All color-coding shall be by pigmentation. Surface colored wires will not be accepted.

### **2.03 ACCEPTABLE MANUFACTURERS**

- A. Phelps Dodge
- B. Houston
- C. Southwire

## **PART 3 EXECUTION**

### **3.01 GENERAL WIRING:**

- A. Use no wire smaller than 12 AWG for power and lighting circuits. For 20 ampere single phase branch circuits longer than 75 feet, use #10 AWG.
- B. Place an equal number of conductors for each phase of a circuit in same raceway or cable.
- C. Splice only in junction or outlet boxes..
- D. Neatly train and lace wiring inside boxes, equipment and panelboards.
- E. Each feeder conductor in pull box or panel containing more than one home run shall be identified by non-magnetic metal tag. Tags shall be one inch in diameter and have stamped numbers and letters 1/2" high. Tape with printed numbers, etc., type identifiers shall be acceptable for temporary use during construction. Thoroughly wipe wire and cable with alcohol to clean surface before applying tape identifiers.

### **3.02 WIRING INSTALLATION IN RACEWAYS**

- A. Pull all conductors into a raceway at the same time. Use UL listed wire pulling lubricants for pulling 4 AWG and larger wires.
- B. Install wire in raceway after all mechanical work likely to injure conductors has been completed.

- C. As far as practicable, all feeder cables shall be continuous from origin to panel termination without running splices in intermediate pull boxes or splicing chambers. Sufficient slack shall be left at the termination to make proper connections. Unless otherwise noted, each conduit raceway shall contain only those conductors constituting a single feeder circuit. All cable terminals, taps and splices shall be made secure with solderless pressure type connectors unless otherwise specified. Where conductors are to be connected to metallic surfaces, the coated surfaces for the metal shall be polished before installing the connector. Marlin twine shall be used to bind cable groups together.
- D. Completely and thoroughly swab raceway system before installing conductors.

### **3.03 CABLE INSTALLATION**

- A. Use suitable cable fittings and connectors.

### **3.04 WIRING CONNECTIONS AND TERMINATIONS**

- A. Splice only in accessible junction boxes, outlets, troughs or handholes if necessary, avoid splicing if possible.
- B. Joints in solid conductors shall be spliced using Ideal “wirenuts”, 3M Company “Scotchlock” or T&B “Piggy” connectors in junction boxes, outlet boxes and lighting fixtures.
  - 1. “Sta-kon” or other permanent type crimp connectors shall not be used for branch circuit connections.
  - 2. Joints in stranded conductors shall be spliced by approved mechanical connectors and gum rubber tape or friction tape. Solderless mechanical connectors for splices and taps, provided with U/L approved insulating covers, may be used instead of mechanical connectors plus tape.
  - 3. Conductors, in all cases, shall be continuous from outlet to outlet and no splicing shall be made except within outlet or junction boxes, troughs, and gutters.
- C. Use compression connectors for copper wire splices and taps 8 AWG and larger. All joints splices and taps and other sections of wiring requiring taping shall be taped with at least two layers of approved gum rubber tape which shall be laid on with half lap followed by at least one layer of friction or plastic tape laid on with half lap. The intent of this specification is that the taping shall be neatly done and form a permanently secured insulation equal to 150 percent of the insulation value of the conductor.

- C. Thoroughly clean wires before installing lugs and connectors.
- D. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.
- E. Terminate spare conductors with electrical tape.

**3.05 FIELD QUALITY CONTROL**

- A. Field inspection and testing shall be performed.
- B. Inspect wire and cable for physical damage and proper connection.
- C. Torque test conductor connections and terminations to manufacturer's recommended value.
- D. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.

**3.06 WIRE AND CABLE INSTALLATION SCHEDULE**

- A. Interior Locations: Building wire in raceways.
- B. Exterior Locations: Building wire in raceways.

**\*\*\*END OF SECTION\*\*\***



## **SECTION 16130 - BOXES**

### **PART 1 GENERAL**

#### **1.01 WORK INCLUDED**

- A. Wall and ceiling outlet boxes
- B. Pulling and junction boxes

#### **1.02 RELATED WORK**

- A. Section 16141 General Purpose Wiring Devices

#### **1.03 REFERENCES**

- A. ANSI/NFHA OS 1 Metal outlet boxes, device boxes, covers and box supports
- B. UL Standard 886
- C. FED. SPEC. W-C-583B

### **PART 2 PRODUCTS**

#### **2.01 OUTLET BOXES**

- A. Cast boxes: cast ferroalloy, deep type, threaded hubs.
- B. ACCEPTABLE MANUFACTURERS
  - 1. RACO
  - 2. STEEL CITY
  - 3. APPLLET

#### **2.02 OUTLET BOXES - SHEET METAL**

- A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1. galvanized steel with 1/2 inch (13 mm) male fixture studs where required. Boxes shall be at least 2-1/2" deep and of sufficient size to accommodate devices noted. Boxes for fixtures shall have mounting lugs or ears for covers. Wall switch outlet boxes shall be set as indicated above finished floor. Where located near doors, they shall be installed on the *lock* side of the door.

**B. ACCEPTABLE MANUFACTURERS**

1. RACO
2. STEEL CITY
3. APPLETON

**2.03 PULL AND JUNCTION BOXES:****A. Sheet metal junction boxes: ANSI/NEKA OS I**

1. Pull and junction boxes shall be fabricated from galvanized sheet steel not less than 16 gauges thick with covers held in place by corrosion resisting machine screws. Boxes shall be furnished and installed where indicated on the plans and where necessary to facilitate cable pulling and splicing. Box size shall be as required by NEC for the number of conduits and conductors entering and leaving it. Where feeder splices are to be made, box shall be large enough to provide ample work space. Boxes shall be installed in locations approved by the Engineer. Exposed junction boxes 4-11/16" x 4" x 4" shall be covered with Bowers #649 and #469 "blank Box covers" respectively.

**2.04 CABLE BOXES:**

- A. The electrical contractor shall furnish and install junction boxes, pull boxes, cable support boxes, and wiring troughs as shown on the drawings, herein specified or otherwise required. All boxes shall be of the code gauge galvanized steel with screw covers fastened with corrosion resistant machine screws and they may be painted or treated to resist corrosion in addition. Boxes shall be supported independently of conduits entering them. Brackets, rod hangers, bolts or other suitable supporting methods may be used.

**PART 3 EXECUTION****3.01 COORDINATION OF BOX LOCATIONS**

- A. Provide electrical boxes as shown on drawings and as required for splices, taps, wire pulling, equipment connections and code compliance.
- B. Electrical box locations shown on contract drawings are approximate unless dimensioned. Verify locations of outlets in work areas prior to rough-in. owner reserves the right to make minor changes in the location of any switch or box without additional cost prior to installation.

- C. Locate and install boxes to allow access. Where installation is inaccessible, coordinate locations and sizes of required access doors.
- D. Locate and install to present a neat appearance.
- E. Before any outlet box or switch for use by other trades is set, the exact location required shall be obtained from the contractor installing the equipment. If not adhered to, the Electrical contractor shall be responsible for changes at no cost to the owner or other trades.

### **3.02 OUTLET BOX INSTALLATION**

- A. Provide surface mounted cast metal outlet boxes for devices as per drawings
- B. Provide recessed sheet metal outlet boxes with masonry plaster ring.
- C. Provide knockout closures for unused openings.
- D. Support boxes independently of conduit.
- E. Use multiple-gang boxes where more than one device is mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage.
- F. Coordinate mounting heights and locations of outlets mounted in enclosures or cabinets.
- G. Position outlets to locate luminaries as shown on Room Floor Plans.
- H. Provide surface mounted boxes when designated; secure boxes to wall and accurately position.
- I. Provide cast outlet boxes in exterior locations exposed to the weather and wet locations.
- J. Align wall mounted outlet boxes for switches, timers and similar devices.
- K. Provide stainless steel bolts and screws in corrosion resistant applications.

### **3.03 PULL AND JUNCTION BOX INSTALLATION**

- A. Install pull boxes and junction boxes above in unobtrusive locations.
- B. Support pull and junction boxes independent of conduit.
- C. Provide stainless steel bolts and screws in corrosion resistant applications.

**\*\*\*END OF SECTION\*\*\***



## **SECTION 16134 – OUTLET BOXES**

### **PART 1 GENERAL**

#### **1.01 WORK INCLUDED**

- A. Outlet Boxes

#### **1.02 RELATED WORK**

- A. Section 16141 - Wiring Devices
- B. Section 16147 - Plate Covers

### **PART 2 COVERS**

#### **2.01 MATERIALS**

- A. Interior Boxes: Cast ferrous metal, shallow type.
- B. For ceilings: 4.5 inch (115 mm) octagonal boxes cast ferrous metal for receiving three or less 3/4" (19mm) conduit.
- C. Surface mounted: 4 inch (102 mm) square cast ferrous metal.
- D. Wiring devices to have #302 stainless steel plates (see 16141).

### **PART 3 INSTALLATION**

- A. Surface mount outlet boxes for surface mounted conduits.
- B. Do not use sectional or handy boxes unless specifically requested.

**\*\*\*END OF SECTION\*\*\***



**SECTION 16190 – SUPPORTING DEVICES****PART 1 GENERAL****1.01 WORK INCLUDED**

- A. Conduit and equipment supports
- B. Fastening hardware

**1.02 RELATED WORK**

- A. Section 16111 - Conduit

**1.03 QUALITY ASSURANCE**

- A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry. Conduit shall be supported in a method and at a spacing as approved by the NEC, except as designated otherwise.

**PART 2 PRODUCTS****2.01 MATERIAL**

- A. Support Channel: stainless steel
- B. Hardware: Corrosion resistant stainless steel

**PART 3 EXECUTION****3.01 INSTALLATION**

- A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors and preset inserts.
- B. Use toggle bolts or hollow wall fasteners in hollow masonry plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.
- C. Do not fasten supports to piping; ductwork, mechanical equipment or conduit.
- D. Do not use powder actuated anchors.
- E. Do not drill structural steel members.

- F. Fabricate supports from structural steel or stainless steel channel, rigidly welded or bolted to present a neat appearance. Use hexagonal bolts with spring lock washers under all nuts.
- G. Support area lighting fixtures with concrete pedestal base per plans
- H. Conduit shall be supported by approved pipe straps or clamps:
  - a. Conduit installed on the interior of exterior building walls shall be spaced off the wall surface a minimum of 1/4 inch using "clamp-backs" or strut.

**\*\*\*END OF SECTION\*\*\***



## **SECTION 16195 – ELECTRICAL IDENTIFICATION**

### **PART 1 GENERAL**

#### **1.01 WORK INCLUDED**

- A. Nameplates and tape labels.
- B. Wire and cable markers.
- C. Conduit color coding.

#### **1.02 RELATED WORK**

- A. Section 16120 - Wire & Cable.

#### **1.03 SUBMITTALS**

- A. Include schedule for nameplates and tape labels.

### **PART 2 PRODUCTS**

#### **2.01 MATERIALS**

- A. Nameplates: Engraved three-layer laminated plastic, blue surface with white core for 120/230 volt equipment. Black surface with white core for 277/480 volt equipment.
- B. Wire and Cable Markers: Metal tags, split sleeve or tubing type.
- C. Self sticking vinyl cloth wire markers.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Degrease and clean surfaces to receive nameplates and tape labels.
- B. Install nameplates and tape labels parallel to equipment lines.
- C. Secure nameplates to equipment fronts using stainless steel self tapping screws. Secure nameplate to inside face of recessed panelboard doors in finished locations. Adhesive to secure plates will not be allowed.
- D. Embossed tape will not be permitted for any application.

- E. Clean wire and cable with alcohol to receive self sticking wire markers.

### **3.02 WIRE IDENTIFICATION**

- A. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on schematic and interconnection diagrams for control wiring.

### **3.03 NAMEPLATE ENGRAVING SCHEDULE**

- A. Provide nameplates to identify all electrical distribution and control equipment, and loads served. Letter height: 1/4 inch (6 mm) for distribution and control equipment identification
- B. Provide nameplates with name, amperage, voltage, and phase.

**\*\*\*END OF SECTION\*\*\***

**SECTION 16450  
GROUNDING**

**PART 1 GENERAL**

**1.01 WORK INCLUDED**

- A. Power system grounding.

**1.02 RELATED WORK**

- A. Section 16111 - Conduit.
- B. Section 16120 - Wires and Cables.

**1.03 REFERENCES**

- A. None

**1.04 REGULATORY REQUIREMENTS**

- A. All grounding shall be in accordance with the requirements of the latest edition of the National Electric Code. The Contractor shall furnish and install complete and effective grounding for the entire electrical system. Use proper grounding locknuts, bonding type bushings where required, or their suitable devices required.

**1.05 TESTS**

- A. Measure ground grid resistance with earth test megger and install up additional ground rods and conductors as required (maximum of 2) until resistance to ground is 25 ohms or less.

**PART 2 PRODUCTS**

**2.01 GROUND BUS**

- A. 2 X 1/4 inch (50 X 6 mm) copper minimum, mounted on insulating standoffs, complete with lugs for connecting grounding cables.
- B. Green equipment grounding conductors carried throughout all conduit runs. Ground conductor shall run from panel ground to equipment.
- C. The raceway shall not be relied on for ground continuity.

**PART3 EXECUTION****3.01 POWER SYSTEM GROUNDING**

- A. Circuit Grounding: Install grounding bushings, grounding studs, and grounding jumpers at pullboxes and panelboxes.
- B. Equipment Grounding Conductors: Provide green insulation, size correlated with overcurrent device protecting the wire, attach to grounding bushings on conduit, to lugs on boxes, and other enclosures. Connection to neutral only at service neutral bar. Maintain grounding and neutral separation throughout system from this point.
- C. Furnish and install double locknuts and insulating bushings, on all conduits entering outer boxes, panelboards, junction boxes, etc., made up tight to insure a continuous ground of minimum resistance from main distribution point on the raceway system. One locknut shall be used on boxes with treated hubs.
- D. All non-current carrying equipment shall be bonded together and grounded. All metallic boxes including outlets shall have a bonding jumper and lug.
- E. Boxes with concentric, eccentric or oversized knockouts shall be provided with bonding bushings and jumpers. The jumper shall be sized per NEC Table 250-94 and lugged to the box.

**3.02 LIGHTNING AND SURGE PROTECTION**

All instrument and control systems, solid state equipment and their individual components, as required including panel mounted units and field mounted units, shall be protected from voltage and/or current surges which may originate as a result of lightning or other external causes on the power and signal wires. Schematics of the instruments submitted for approval to the Engineer shall indicate how this protection will be provided

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and identify the items of equipment which will be used for this purpose. The transient protector shall be a multi-stage surge suppression device which shall effectively alternate most transients encountered in an instrumentation environment.

Transient protectors utilizing single stage suppression devices shall not be acceptable. The surge protective device shall be hybrid transient surge suppression (TVSS) technology. The TVSS unit shall include a two stage protection mechanism for 4 – 20 mA loops consisting of silicone avalanche diodes, transorbs, metal oxide varistors and resistors. A choke impedance nominally low pass filter shall reflect RF and higher frequencies. Surge current for +30 V shall be 4000 A at 52 Joules minimum. 120 VAC protection shall clamp the voltage close to the nominal wave form. The unit shall filter line noise +/- 20% sinewave tracking. The unit shall combine silicone avalanche diodes, metal oxide varistors and capacitors as a multi-stage device system. Response time shall be less than one nanosecond.

Provide a NEMA 4X stainless steel enclosure equipped for rack mounting to house surge protection devices if adequate space is not available in the instrumentation enclosure.

The contractor and equipment supplier shall include surges and lightning protection in the one year warranty against all except a direct hit by lightning.

**\*\*\*END OF SECTION\*\*\***



**SECTION 16471  
CIRCUIT BREAKERS & PANELBOARDS**

**PART 1 GENERAL**

**1.01 WORK INCLUDED**

- A. Distribution Panelboards
- B. Branch Circuit Panelboards
- C. Circuit Breakers

**1.02 REGULATORY REQUIREMENTS**

- A. Construct panelboards to UL standards and provide UL labels.
- B. Width of gutters shall be in accordance with the 2008 National Electric Code, Article 312-8 based on deflection of conductors.
- C. Panelboards identified for use as service equipment shall be so labeled.
- D. Provide “arc flash” warning labels on all panelboards, enclosed circuit breakers and other equipment where this hazard exists.

**PART 2 PRODUCTS**

**2.01 ACCEPTABLE MANUFACTURERS**

- A. Square D
- B. Cutler Hammer
- C. General Electric (Type A series with screw cover)

**2.02 SUBMITTALS**

- A. Submit shop drawings and product data.

### **2.03 ENCLOSURES**

- A. PANELS: Surface mounted complete with panel trim having concealed hinges and trim mounting screws. Provide locking door with flush catch. Panels shall be made of
- B. code gauge steel, galvanized. Front shall be of sheet steel with gray lacquer finish. Fronts shall be furnished with approved adjustable trip clamps as a means of securing the front to the box.
- B. TUBE: Galvanized
- C. KEYS: Provide two keys for each panel. Make keys interchangeable for panels of same voltage.
- D. DIRECTORY: Provide directory holder with glass or plastic plate and metal frame mounted on inside of each door. Circuit directory shall be typewritten.
- E. Provide copper buses in all panelboards throughout.

### **2.04 PANELBOARDS (120/230 VAC SINGLE PHASE)**

- A. Panelboards: Single phase solid neutral design with sequence style bussing and full capacity neutral and grounding buses composed of an assembly of bolt on (as specified) type molded case thermal magnetic circuit breakers. Provide minimum interrupting ratings of 10,000 AIC AIC. Loadcenters are not acceptable. Ground lugs in lieu of buses are not acceptable. Refer to General Electrical notes on plans and panel schedules for circuit breaker interrupting ratings.

### **2.05 CIRCUIT BREAKERS**

- A. Circuit breakers shall be bolt-on type of the indicating variety, providing "ON", "OFF", and "TRIP" positions of the operating handle. When the breaker is tripped automatically, the handle shall assume a middle position between "ON" and "OFF". All multi-pole breakers shall be so designated that an overload on the one pole automatically causes all poles to be open and it shall be common trip. Field installed handle ties shall not be accepted. The circuit breaker shall be quick-make and quick-break on manual as well as automatic operation and have inverse time characteristics secured through the use of bimetallic tripping element supplemented by a magnetic trip.



- B. No half size or tandem circuit breakers will be allowed.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Provide mounting brackets, busbar drillings, and filler pieces for unused spaces.
- B. Prepare and affix typewritten directory to inside cover of panelboards indicating new loads controlled by each circuit.

**\*\*\*END OF SECTION\*\*\***

