END OF SECTION

SECTION 03740 - MODIFICATIONS AND REPAIR TO EXISTING CONCRETE

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and cut, chip, repair, demolish, excavate, or otherwise modify parts of existing structures or appurtenances as shown on the sketches and as specified herein.

B. Work under this Section shall include repairs to existing deteriorated concrete. Repairs are separated into three basic categories as follows:

1) Surface deterioration, greater than 1/2” and less than 2” depth, no exposed rebar.

2) Surface deterioration, greater than 2” and less than 3”, with exposed rebar, no rebar deterioration.

3) Surface deterioration, greater than 3” to maximum 16” with exposed, deteriorated and/or missing rebar.

1.2 RELATED WORK

A. Cast-In-Place Concrete is included in Section 03301.

B. Grout is included in Section 03600.

1.3 GENERAL

A. No existing structure or concrete shall be shifted, cut, removed, or otherwise altered until written authorization is given by the Engineer.

B. When removing materials or portions of existing structures and when making openings in existing structures, take all precautions and use all necessary barriers and other protective devices so as not to damage the structures beyond the limits necessary for the new work, nor to damage the structures or contents by falling or flying debris. Unless otherwise permitted, line drilling will be required in cutting existing concrete.

C. Manufacturer qualifications: The manufacturer of the specified products shall have a minimum of 10 years’ experience in the manufacture of such products and shall have an ongoing program of training, certifying and technically supporting the Contractor’s personnel.

D. Contractor qualifications: Contractors shall complete a program of instruction in the application of the approved manufacturer’s material and provide certification from the manufacturer attesting to their training and status as an approved applicator.

E. Furnish a notarized certificate stating that the materials specified meet the project requirements and submit the manufacturer’s current printed literature on the specified product.

1.4 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1) ASTM D570 - Standard Test Method for Water Absorption of Plastics.

2) ASTM D1653, Method B - Standard Test Method for Water Vaspor Permeability of Organic Coating Films.

3) ASTM D 790 - Standard Test Method for flexural properties of unreinforced and reinforced plastics and electrical insulating materials.

4) ASTM D638 - Standard Test Method for Tensile Properties of Plastics.

5) ASTM D732 - Standard Test Method for Shear Strength of Plastics by Punch Tool

6) ASTM D695 - Standard Test Method for Compressive Properties Rigid Plastics.

7) ASTM C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear

8) ASTM D1525 - Standard Test Method for Vicat Softening Temperature of Plastics.

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

PART 2 PRODUCTS

2.1 MATERIALS

A. Epoxy Bonding Compound:

1) The epoxy bonding compound shall be furnished in two components for combining immediately prior to use in accordance with the manufacturer's written instructions and as specified herein.

2) The components of the epoxy resin system shall conform to the following requirements:

a. Component A - Component A shall be a modified epoxy resin of the epichlorohydrin bisphenol A condensation type, containing suitable viscosity control agents and having an epoxide equivalent of 180 to 200.

b. Component B - Component B shall be primarily a reaction product of an alkyl glycidyl ether and a polyfunctional aliphatic amine containing suitable viscosity agents modified with 2, 4, 6 tri (dimethylamino-methyl) phenol.

c. The component ratio of B:A shall be 1:1 by volume.

d. The resultant compound shall be polysulfide free.

3) Properties of Mixed Components:

a. Solids Content: 100 percent by weight

b. Pot Life: 20 to 30 minutes at 73 Degrees F

c. Tack-Free Time (thin film): 3 to 5 hrs at 73 Degrees F

d. Final Cure ASTM D695: 3 days at 73 Degrees F (ASTM D695 percent ultimate strength)

e. Initial Viscosity (A+B): 2400 to 3200 cps minimum at 73 Degrees F

f. Color mixed: Straw

4) Properties of Cured Material:

a. Neat Material

(i) Tensile Strength: 5300 psi minimum at (ASTM D638) 14 days 73 Degrees F cure

(ii) Tensile Elongation: 4.8 percent at 14 days (ASTM D638 modified) 73 Degrees F cure

(iii) Compressive Strength: 7000 psi minimum at 28 days 73 Degrees F cure (ASTM D695)

(iv) Compressive Modulus: 250,000 psi minimum at (ASTM D695)1.0 percent maximum (ASTM D570)

(v) Bond Strength: 1500 psi minimum at (Plastic to Hardened) 14 days, 73 Degrees F cure

(vi) Deflection Temperature: 180 Degrees F minimum (ASTM D1525)

5) Epoxy bonding compound shall be Sikadur Hi-Mod as manufactured by Sika Chemical Corp., Lyndhurst, N.J.; W.R. Grace Co., Cambridge, MA; Adhesive Engineering Co., Lawrence, MA or equal.

B. Epoxy Paste

1) General

a. Epoxy Paste shall be a two-component, solvent-free, asbestos free, moisture insensitive epoxy resin material used to bond dissimilar materials to concrete such as setting railing posts, dowels, anchor bolts and all-threads into hardened concrete and shall comply with the requirements of ASTM C881, Type I, Grade 3 and the additional requirements specified herein. It may also be used to patch existing surfaces where the glue line is 1/8-in or less.

2) Material

a. Properties of the cured material:

(i) Compressive Properties (ASTM D695): 10,000 psi minimum at 28 days.

(ii) Tensile Strength (ASTM D638): 3,000 psi minimum at 14 days.

(iii) Elongation at Break: 0.3 percent minimum.

(iv) Flexural Strength (ASTM D790 - Modulus of Rupture): 3,700 psi minimum at 4 days.

(v) Shear Strength (ASTM D732): 2,800 psi minimum at 14 days.

(vi) Water Absorption (ASTM D570): 1.0 percent maximum at 7 days.

(vii) Bond Strength (ASTM C882): 2,000 psi at 14 days moist cure.

(viii) Color: Concrete grey.

3) Approved manufacturer's include:

a. Overhead applications: Sika Corporation, Lyndhurst, NJ - Sikadur Hi-mod LV 31; Master Builders, Inc., Cleveland, OH - Concresive 1438 or equal.

b. Sika Corporation, Lyndhurst, N.J. - Sikadur Hi-mod LV 32; Master Builders, Inc., Cleveland, OH - Concresive 1438 or equal.

C. Non-Shrink Precision Cement Grout, Non-Shrink Cement Grout, Non-Shrink Epoxy Grout and Polymer Modified mortar are included in Section 03600 GROUT.

D. Adhesive Capsule type anchor system shall be equal to Molly parabond two part stud and capsule system by Emhart, Temple, PA or the HVA adhesive Anchoring System by Hilti Fastening Systems, Tulsa, OK. The capsule shall consist of a sealed glass capsule containing premeasured amounts of a polyester or vinylester resin, quartz sand aggregate and a hardener contained in a separate vial within the capsulre.

E. Crack Repair Epoxy Adhesive

1) General

a. Crack Repair Epoxy Adhesive shall be a two-component, solvent-free, moisture insensitive epoxy resin material suitable for crack grouting by injection or gravity feed. It shall be formulated for the specific size of opening or crack being injected.

2) Material

a. Properties of the cured material:

(i) Compressive Properties (ASTM D695): 10,000 psi minimum at 28 days.

(ii) Tensile Strength (ASTM D638): 5,300 psi minimum at 14 days. Elongation at Break - 2 to 5 percent.

(iii) Flexural Strength (ASTM D790 - Modulus of Rupture): 12,000 psi minimum at 14 days (gravity); 4,600 psi minimum at 14 days (injection)

(iv) Shear Strength (ASTM D732): 3,700 psi minimum at 14 days.

(v) Water Absorption (ASTM D570 - 2 hour boil): 1.5 percent

maximum at 7 days.

(vi) Bond Strength (ASTM C882): 2,400 psi at 2 days dry; 2,000 psi at 14 days dry plus 12 days moist.

PART 3 EXECUTION

3.1 GENERAL

A. Cut, chip, repair, reuse, demolish, excavate or otherwise modify parts of the existing structures or appurtenances, as indicated on the sketches, specified herein, or necessary to permit completion of the Work. All work shall comply with other requirements of this of Section and as shown on the sketches.

B. All commercial products specified in this Section shall be stored, mixed and applied in strict compliance with the manufacturer's recommendations.

C. In all cases where concrete is repaired in the vicinity of an expansion joint or control joint the repairs shall be made to preserve the isolation between components on either side of the joint.

D. When drilling holes for dowels/bolts at new or existing concrete, drilling shall stop if rebar is encountered. As approved by the Engineer, the hole location shall be relocated to avoid rebar. Rebar shall not be cut without prior approval by the Engineer. Where possible, rebar locations shall be identified prior to drilling using "rebar locators" so that drilled hole locations may be adjusted to avoid rebar interference.

3.2 REPAIRING EXISTING CONCRETE

A. Remove all deteriorated materials, dirt, oil, grease, and all other bond inhibiting materials from the surface by mechanical means, i.e. - waterblasting, sandblasting, grinding, etc., as approved by the Engineer. Be sure the areas are not less than 1/2-in in depth. Irregular voids or surface stones need not be removed if they are sound, free of laitance, and firmly embedded into parent concrete, subject to the Engineer's final inspection.

B. If reinforcing steel is exposed, it must be mechanically cleaned to remove all contaminants, rust, etc., as approved by the Engineer. If half of the diameter of the reinforcing steel is exposed, chip out behind the steel. The distance chipped behind the steel shall be a minimum of 1/2-in. Reinforcing to be saved shall not be damaged during the demolition operation.

C. After cleaning the exposed reinforcement, it is determined that more than ¼ of the effective cross sectional area has been lost, chip the concrete back along the bar a minimum of 18 bar diameters in each direction from the damaged section and replace the bar with new reinforcement of similar size. Lap the new bar 18 diameters to the exposed non-corroded section. Alternatively, contractor may drill and epoxy grout new rebar in to sound concrete adjacent to deteriorated bar. Embed new bar per grout manufacturer’s requirements.

D. Thoroughly wash the roughened concrete surfaces and keep the surfaces saturated for at least 6 hours before placing new concrete. All free water shall be removed prior to placing the concrete. An epoxy bonding compound as specified may be used in lieu of saturating surface for 6 hours in accordance with repair material manufacturer’s requirements.

E. Repair mortar shall be placed/pumped to a thickness to match the existing surface.

1) Repair mortar shall be Nonshrink cementitious grout as specified in Section 03600.

F. When the finish surface is not specified to be lined the color of new concrete in the exposed surfaces shall match the color of the existing adjoining concrete as closely as possible.

3.3 CRACK REPAIR

A. Cracks on horizontal surfaces shall be repaired by gravity feeding crack sealant into cracks per manufacturer's recommendations. If cracks are less than 1/16-in in thickness they shall be pressure injected.

B. Cracks on vertical surfaces shall be repaired by pressure injecting crack sealant through valves sealed to surface with crack repair epoxy adhesive per manufacturer's recommendations.

END OF SECTION

SECTION 15010 - TESTING PIPING SYSTEMS

PART 1 GENERAL

1.1 DESCRIPTION

A. Perform pressure testing of water mains and sewage force mains using Contractor's qualified personnel or employ and pay for a qualified organization to perform specified services.

1.2 RELATED SECTIONS

A. Section 15062 – Ductile Iron Pipe and Fittings

B. Other Sections as applicable.

1.3 REFERENCES

A. AWWA C600 – Installation of Ductile-Iron Mains and their Appurtenances

B. AWWA C605 – Underground Installation of PVC and Molecularly Oriented PVCO Pressure Pipe and Fittings

C. ASTM F2164-18 – Standard Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure

1.4 DESCRIPTION

A. Perform testing of piping systems in accordance with the latest edition of the AWWA REFERENCES and as specified above.

B. Provide instrument required for testing of piping systems.

1) Make instruments available to Engineer to facilitate spot checks during testing.

2) Retain possession of instruments; remove from site at completion of services.

C. Provide all water required for flushing and testing. The Contractor shall obtain a construction meter from the local municipality at current rates and pay for meter rental and all water used.

D. Provide all necessary pumping equipment and other equipment, materials, and facilities required for proper completion of the flushing and testing specified.

E. Source and quality of water, procedure, and test equipment shall be acceptable to the Engineer. Length of tested line shall not exceed 2,000 feet.

F. All tests shall be made in the presence of the Engineer. Notify Engineer at least 48 hours before any Work is to be inspected or tested.

G. If inspection or test shows defects, the piping system(s) shall be repaired or replaced, and inspection repeated, until such piping is acceptable to the Engineer.

H. All pipe, fittings, valves, and joints shall be carefully examined during test. Leaky joints shall be tightened by remaking the joint.

I. Sections of the system may be tested separately. It shall be distinctly understood that any defect which may subsequently develop in section already tested and accepted shall promptly be corrected and that section retested.

J. Disposal of the water used for testing shall be subject to the approval of the Engineer.

1.5 QUALITY ASSURANCE

A. The organization which performs the testing shall, prior to testing, provide their qualifications and demonstrate their ability to perform the services to the satisfaction of the Engineer.

1.6 SUBMITTALS

A. Preliminary

1) Submit three copies of documentation to confirm compliance with Quality Assurance provisions:

a. Organization supervisor and personnel training and qualifications.

b. Specimen copy of each of the report forms proposed for use.

B. At least 14 days prior to Contractor's request for final inspection, submit three copies of final reports on applicable reporting forms, for review.

1) Each individual final reporting form must bear the signature of the person who recorded data and that of the supervisor of the reporting organization.

2) Identify instruments of all types which were used and last date of calibration of each.

1.7 JOB CONDITIONS

A. Prior to start of testing of piping systems, verify that required "Job Conditions" are met:

1) System or system element installation is complete.

2) All required materials, water, instruments, etc. are on hand.

3) All other preparations are completed.

1.8 TESTING PROCEDURES

A. Gravity Sewer System:

1) Deflection Testing

a. PVC pipe shall be tested for excessive deflection by means of a "Go, No-Go" mandrel or sewer ball. A 7 1/2% Deflection Mandrel shall be pulled through each manhole section to determine if excessive deflection has taken place. If the mandrel fails to be pulled through the sewer pipe, the Contractor shall attempt to pull the mandrel through from the other end of the manhole section. If the mandrel fails to be pulled through, again, the Contractor shall repair or replace that portion of the sewer main which has exceeded the 7 1/2% allowable pipe deflection.

b. The Deflection Mandrel to be used for testing shall be submitted to the Engineer for approval prior to use. Each mandrel shall be constructed and utilized in accordance with the Uni-Bell Handbook of P.V.C. Pipe and the North American Pipe Corporation.

c. Deflection Testing shall not take place until thirty days following the final backfilling over the pipe. This will allow time for settlement of all the backfill material. The Engineer's representative shall be present at all deflection tests.

d. As an alternative to Deflection Mandrel testing, deflection testing may be performed by lamping if approved by the Owner and Engineer. Sewer lamping shall be witnessed by the Engineer and a representative of the Owner.

2) Exfiltration and Infiltration Testing

a. Leakage tests by exfiltration and infiltration, as described below, will be made on all pipe. The Engineer shall have the option of determining which test(s) shall be employed. Generally, if the groundwater table is below the bottom of the pipe an exfiltration test shall be used. All other pipe shall be tested for infiltration.

b. Exfiltration Test

(i) Exfiltration tests will be made on the pipe before or after backfilling at the discretion of the Engineer. The length of the sewer to be tested shall be such that the head over the crown of the upstream end is not less than 2 feet and the head over the downstream crown is not more than 6 feet unless directed otherwise by the Engineer. The sewer shall be plugged by pneumatic bags or mechanical plugs in such a manner that the air can be released from the sewer while it is being filled with water. The test shall be continued for one hour and provisions shall be made for measuring the amount of water required to maintain the water at a constant level during this period. If test results are unsatisfactory, the Engineer may direct that additional tests are made on any or all of the pipe.

(ii) If any joint shows an appreciable amount of leakage, the jointing material shall be removed and joint remade. If any pipe is defective, it shall be removed and replaced. No amount of leakage will be accepted. If the amount of leakage indicates defective joints or broken pipes, they shall be corrected by the Contractor.

c. Infiltration Test

(i) Pipe shall be tested for infiltration after the backfill has been placed. Infiltration tests shall be made under the supervision of the Engineer, and the length of line to be tested shall be as directed by the Engineer. There shall be no allowable leakage.

(ii) Manhole exfiltration leakage shall not exceed 4 gallons per day per unit.

(iii) Sewer pipe exfiltration leakage shall not exceed 10 gallons per day per inch diameter per mile in a two-hour test period for any length of section tested.

(iv) Visible manhole or sewer pipe infiltration leakage shall not be acceptable.

(v) Rates of infiltration shall be determined by means of a V-notch weir to be provided and installed by the Contractor in an approved manner, and at such times and locations as may be directed by the Engineer.

(vi) If an inspection of the completed sewer or any part thereof shows any manholes, pipes, or joints which allow the infiltration of water in a noticeable stream or jet, the defective work or material shall be replaced or repaired as directed.

(vii) All water used in testing and flushing shall be furnished at the Contractor's expense.

3) The sanitary sewer system shall be televised prior to final acceptance by the Engineer or the Owner. Video recording and reporting shall be reviewed. Contractor shall be responsible for correcting any deficiencies prior to acceptance by the Owner or submittal to any permitting agency. Testing and corrections shall be at the Contractor’s expense.

B. Pressure Piping Systems

1) Water, sewer, and drainage pressure piping shall pass a hydrostatic pressure test and a leakage test as defined below before acceptance. The pressure and leakage test shall be made after all jointing operations are completed and after backfilling is completed. All concrete reaction blocks, or other bracing and restraining facilities, shall be in place at least 14 days before the initial filling of the line.

2) The pressure and leakage tests may be applied to an individual section of line isolated between the existing line valves or may be applied to shorter sections of line at the Contractor’s option. If shorter sections are tested, test plugs or bulkheads as required at the ends of the test section shall be furnished and installed by the Contractor at his expense, together with all anchors, braces, and other devices required to withstand the hydrostatic pressure on such plug or plugs, without imposing any hydraulic thrust on the pipe line or any part thereof. The Contractor shall be solely responsible for any and all damage to the pipeline, and/or to any other facility, which may result from the failure of test plugs furnished by them or supports therefore, in any case.

3) Hydrostatic Tests:

a. The section of line to be tested shall be slowly filled with water and all air expelled from the pipe. Care shall be taken that all air

valves are installed and open in the section being filled, and that the rate of filling does not exceed the venting capacity of the air valves.

b. Hydrostatic test pressure shall be as follows:

System	Test Pressure
Wastewater Force Main	150 psi
Potable Water Main	150 psi
Other Pressure Pipe	1.5 times maximum operation pressure at the lowest elevation of the test section.

c. After the pipe has been laid, all newly laid pipe of any valved section thereof shall be subjected to a hydrostatic pressure test.

(i) Test pressure shall:

(a) Not exceed pipe or thrust-restraint design pressures.
(b) Be of at least 2-hour duration.
(c) Not vary by more than ±5 psi (0.35 Bar) for the duration of the test.
(d) Not exceed twice the rated pressure of the valves or hydrants when the pressure boundary of the test section includes closed gate valves or hydrants. NOTE: Valves shall not be operated in either direction at differential pressures exceeding the rated pressures.
(e) Not exceed the rated pressure of the valves when the pressure boundary of the test section includes closed valves.

(ii) Each valved section of pipe shall be filled with water slowly and the specified test pressure based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. Valves shall not be operated in either the opening or closing direction at differential pressures above the rated pressure. The system shall be allowed to stabilize at the test pressure before conducting the leakage test.

d. Examination: Any exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damaged or defective pipe fittings, valves, or hydrants that are discovered following the pressure test shall be repaired or replaced with sound material and the test shall be repeated until it is satisfactory to the Engineer.

(i) Leakage Test

(a) A leakage test shall be conducted concurrently with the pressure test. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or valved section thereof, to maintain pressure within 5 psi (0.35 Bar) of the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water. Leakage SHALL NOT BE MEASURED BY A DROP IN PRESSURE IN A TEST SECTION OVER A PERIOD OF TIME.

(b) No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{SD * P^{1/2}}{148{,}000}$$

In which L is the allowable leakage, in gallons per hour; S is the length of pipe tested in feet; D is the nominal diameter of the pipe in inches; and P is the average test pressure during the leakage test in pounds per square inch.

(c) To obtain leakage in liter/hour, multiply the values in the table by 3.785.

(d) When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gal/h/in (0.0012 L/h/mm) of nominal valve size shall be allowed.

(e) When hydrants are in the test section, the test shall be made against the closed hydrant.

(f) Acceptance shall be determined on the basis of allowable leakage. If any test of pipe laid discloses leakage greater than that specified in Section “b” above, Contractor shall, at his own expense, locate and make repairs as necessary until the leakage is within the specified allowance.

(g) All visible leaks are to be repaired regardless of the amount of leakage.

e. For hydrostatic testing of HDPE, Contractor shall adhere to the requirements of ASTM F2164.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL

A. Prior to testing, pig and flush all piping systems with water to remove all debris in the system. Pigging of lines 12” and smaller is not required unless the line becomes contaminated.

B. No separate payment for testing shall be made.

END OF SECTION

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SECTION 15062 - DUCTILE IRON PIPE AND FITTINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Ductile iron pipe and fittings piping shall be installed in those locations and depths as shown on the Drawings.

B. The equipment and materials specified herein is intended to be standard and ductile iron pipe and fittings used in transporting water and wastewater.

1.2 RELATED SECTIONS

A. Section 01340 – Shop Drawings, Working Drawings and Samples

B. Section 15010 – Testing Piping Systems

C. Section 15100 - Valves and Appurtenances

D. Other Sections as Applicable.

1.3 REFERENCES

A. ASTM International, (ASTM)

1) ASTM B 117-99(2007) – Standard Practice for Operating Salt Spray (Fog) Apparatus.

2) ASTM C 413-01(2006) – Standard Test Method for Absorption of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.

3) ASTM C 868-02(2008) – Standard Test Method for Chemical Resistance of Protective Linings.

4) ASTM D 149-09 – Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.

5) ASTM D 870-09 – Standard Practice for Testing Water Resistance of Coatings Using Water Immersion.

6) ASTM D 1653-03(2008) – Standard Test Methods for Water Vapor Transmission of Organic Coating Films.

7) ASTM D 2370-98(2002) – Standard Test Method for Tensile Properties of Organic Coatings.

8) ASTM D 2240-05 – Standard Test Method for Rubber Property—Durometer Hardness.

9) ASTM D2583-07 – Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.

10) ASTM D 2794-93(2004) – Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).

11) ASTM D 4400-99(2007) – Standard Test Method for Sag Resistance of Paints Using a Multinotch Applicator.

12) ASTM D 4060-14 – Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.

13) ASTM D 4541-09 – Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

14) ASTM G 8-96(2003)e1 - Standard Test Methods for Cathodic Disbonding of Pipeline Coatings.

15) ASTM G 210-13 – Standard Practice for Operating the Severe Wastewater Analysis Testing Apparatus (S.W.A.T.).

16) ASTM A307 Grade B - Low-Carbon Steel Bolts for Flanged Pipe.

B. ANSI/AWWA C10 - Cement-Mortar Lining for Ductile Iron and Gray Iron Pipe and Fittings for Water.

C. ANSI/AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.

D. ANSI/AWWA C110 - Ductile Iron and Gray Iron Fittings 3 inch through 48 inch for Water and Other Liquids.

E. ANSI/AWWA C150 - Thickness Design of Ductile Iron Pipe.

F. ANSI/AWWA C151 - American National Standard for Ductile Iron Pipe, Centrifugally Cast.

G. ANSI/AWWA C153 - Ductile Iron Compact and Gray Iron Fittings 3 inch through 16 inch for Water and Other Liquids.

H. ANSI/AWWA C600 - Installation of Ductile Iron Water Mains and Their Appurtenances.

I. ANSI/AWWA C651 - Disinfecting Water Mains.

J. ASME/ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 125.

K. ASME/ANSI B16.5 - Pipe Flanges and Flanged Fittings, Class 150 (Flat Face Flange).

L. ASME/ANSI B16.42 - Ductile Iron Pipe flanges and Flanged Fittings, Class 150 (Flat Face Flange).

M. Ductile Iron Pipe Research Association - Thrust Restraint Design for Ductile Iron Pipe.

1.4 SUBMITTALS

A. Submit a list of materials to be furnished, with the names of the suppliers and the date of delivery.

B. Submit sworn certificates of foundry material and strength tests, and their results. In addition, all ductile iron pipe and fittings may be inspected at the foundry for compliance with the Specifications by an independent testing laboratory selected by the Owners. The manufacturer's cooperation shall be required in these inspections. The cost of foundry inspections requested by the Owner will be borne by the Contractor.

C. Waiving of the inspection privileges shall not relieve the Contractor or manufacturer of the responsibility of furnishing pipe and fittings meeting the Specification.

D. Shop Drawings shall be submitted in accordance with Section 01340 and shall include dimensioning, methods and location of supports and all other pertinent technical specifications for all pipe and fittings to be furnished. Shop drawings shall be prepared by the pipe and fittings manufacturer.

E. Manufacturer shall furnish a laying schedule providing a location, type, and size of all pipe joints.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Ductile iron pipe and fittings shall be furnished by manufacturers who are fully experienced, reputable, and qualified in the manufacture of the materials. The pipe and fittings shall be designed, constructed, and installed in accordance with the best practices and methods and shall comply with the Specifications in all respects. Acceptable manufacturers include:

1) American Cast Iron Pipe Company

2) US Pipe

2.2 COMPRESSION JOINT PIPE AND FITTINGS

A. Pipe shall conform to ANSI/AWWA C151/A21.51 and C150/A21.50 and shall conform to Rule 62-555.322, F.A.C.

B. Fittings shall conform to ANSI/AWWA C110/A21.10 and C153/A21.53 and shall conform to Rule 62-555.322, F.A.C.

C. Rubber gaskets shall conform to ANSI/AWWA C111/A21.11.

D. Thickness shall be minimum pressure Class 350 through 12" and pressure Class 300 in sizes 14" and larger.

E. Install compression joint pipe below ground. Provide sufficient quantities of lubricant and gaskets.

2.3 MECHANICAL JOINT PIPE AND FITTINGS

A. Pipe shall conform to ANSI/AWWA A21.50/C151 and C150/A21.50 and shall conform to Rule 62-555.322, F.A.C.

B. Fittings shall conform to ANSI/AWWA C110/A21.10 & C153/A21.53 and shall conform to Rule 62-555.322, F.A.C.

C. Thickness shall be minimum pressure Class 350 through 12" and pressure Class 300 in sizes 14" and larger.

D. Rubber gaskets shall conform to ANSI/AWWA C111/A21.11.

E. Bolts for mechanical joint pipe shall be tee-head design. Nuts and bolts shall be high-strength low alloy steel.

F. Mechanical joint pipe shall be installed below ground.

G. Furnish with sufficient supply of accessories, ie, gaskets, bolts, and glands, as required for each joint.

2.4 FLANGED JOINT PIPE AND FITTINGS

A. Pipe and fittings shall conform to ANSI/AWWA C115/A21.15 and shall conform to Rule 62-555.322, F.A.C.

B. Thickness shall be minimum pressure Class 350 through 12" and pressure Class 300 in sizes 14" and larger.

C. Flanges and flanged fittings shall be flat face conforming to ANSI/AWWA C110/A21.10. Full face 1/8 inch thick rubber ring gaskets shall conform to ANSI/AWWA C110/A21.10.

D. Flanges shall be ductile iron. Cast iron flanges will not be allowed.

E. Flanged ductile iron pipe shall have factory applied screwed long hub flanges. Flanges shall be faced and drilled after being screwed on the pipe, with flanges true to 90 degrees with the pipe axis and shall be flush with end of pipe conforming to ANSI B16.1 Class 125.

F. Bolts for flange pipe shall be low-carbon steel conforming to ASTM A307 Grade B.

G. Flanged joints shall be used for above ground piping and exposed piping in vaults and in indoor pipe galleries.

2.5 GROOVED END PIPE AND FITTINGS

A. Grooved end pipe and fittings shall be acceptable for above-ground installation and shall conform to Rule 62-555.322, F.A.C.

B. Pipe shall conform to ANSI/AWWA C606.

C. Grooved end pipe shall be minimum thickness to conform to former Class 53.

D. Grooved end joints shall be flexible type, radius cut grooved, conforming to AWWA C606.

E. Grooved end fittings shall be ANSI B16.1, radius cut grooved, rigid joint, as manufactured by Victaulic Company, Gustin-Bacon, or approved equal.

F. Grooved end pipe adapter flanges shall be ductile iron, ASTM A536, Victaulic, Gustin-Bacon, or approved equal.

G. Bolts shall be manufactured standard.

H. Gaskets for grooved end joints shall be manufacturer's flush-seal type specifically designed for cast surfaces. Properties shall be as designated in ASTM D 2000. Dimensions shall conform to AWWA C606. Lubricant shall be manufacturer's standard.

I. Install in accordance with manufacturer's printed instructions. Dress cut ends of pipe for couplings and adapters as recommended.

2.6 LININGS AND COATINGS

A. Pipe and fittings for potable water service shall be cement mortar lined in accordance with ANSI/AWWA C104/A21.4. Cement lining shall be Type 2 Portland Cement, a sulfate resistant cement.

B. Pipe and fittings for wastewater service shall be ceramic epoxy lined with Protecto 401 or approved equal. The lining must be factory applied by certified installers and warrantied by the pipe manufacturer.

C. Performance Criteria Requirements must be met:

1) Abrasion: (ASTM D4060-07, CS-17 wheel, 1,000 grams) – 41 mg loss. (BS EN 598:2007+A1:2009, 50,000 cycles) – 0.6 mils loss.

2) Adhesion: (ASTM D 4541) – Not less than 3,000 psi, DIP.

3) Severe Wastewater Analysis Test: (ASTM G 210-13) – Initial electrochemical impedance of 11.8 log-Z at 0.001 Hz (ohms•cm^2). No blistering, cracking, checking or loss of adhesion. Not less than 88% retained impedance and no more than 1.26 ohms•cm^2 reduction in log-Z following 28 days exposure.

4) Cathodic Disbondment: ASTM G 8 (1.5 V) Classification Group A. No more than 0.00 inch (0.00 mm) disbonded equivalent circle diameter.

5) Chemical Resistance: (ASTM C 868-02, 25 percent sulfuric acid, 100 degrees F, 100 days – (NACE TM0174-2002, 6 months continuous immersion, 50 percent sulfuric acid, 13 percent sodium hypochlorite, 5 percent sodium hydroxide, 75 degrees F – No effect.

6) Dielectric Strength: (ASTM D 149-09) – greater than 600 volts per mil

7) Hardness: (ASTM D 2240): Shore D hardness of 79.

8) Immersion: 140°F (60°C) De-ionized Water Immersion. No blistering, cracking or delamination of film after 5,000 hours continuous immersion.

9) Impact: (ASTM D 2794-04) – No visible cracking or delamination after 160 inch-pounds (18.0 J) direct impact.

10) Salt Spray (ASTM B 117-09): No blistering, cracking, rusting or delamination of film. No rust creepage at scribe after 1,000 hrs.

11) Water Absorption (ASTM C 413-01(2006) – 0.0 percent water absorption.

12) Water Vapor Transmission (ASTM D 1653-03(2008) Method B, Wet Cup, Condition C) – 1.25 g/m2 per 24 h water vapor transmission and 0.09 perms water vapor permeance.

D. Below ground pipe and fittings shall receive a manufacturer's standard exterior bituminous coating per AWWA C151 for ductile iron pipe, AWWA C115 for flange pipe and AWWA C110 for fittings.

E. Pipe and fittings exposed to view in the finished work shall not receive the standard bituminous or asphalt coat on the outside surfaces but shall be shop primed on the outside with one coat of Tnemec Series N140 Pota-Pox Plus or Tnemec Series 20HS Pota-Pox. Should portions of the pipe inadvertently be given the outside coating of coal tar enamel instead of the rust inhibitive primer as required for exposed piping, the surfaces shall be sealed with a non-bleeding sealer coat. Sealer shall be a part of the work of this Section.

F. Pipe and fitting installations in corrosive soils between the limits shown on the drawings or as required by the Engineer shall be fully encased in an 8 mil polyethylene sleeve in accordance with ANSI/AWWA C105/A21.5 Method "A".

2.7 SPECIAL PIPE AND FITTING

A. Long span flange pipe shall be minimum pressure Class 350. Gaskets shall be Toruseal type with O-ring or equal.

B. Wall castings shall be of the size and types shown on the Drawings and bituminous coated.

C. Flexible joint (ball joint or river crossing) type pipe shall comply with ANSI/AWWA C151/A21.51 and ANSI/AWWA C110/A21.10. Pipe shall provide a variable deflection of up to 15 degrees. The spherical threaded socket shall be manufactured in conformance with AWWA C110 and ANSI B2.1.

2.8 RESTRAINED JOINTS

A. The location and number of restrained joints are shown on the drawings and details.

B. Joints shall be the standard design of the pipe and fitting manufacturer and shall provide a 2:1 safety factor.

C. Restrained joints shall be designed for a pressure class rating of 350 psi in sizes 4 inch through 12 inch and 300 psi for 14 inch through 64 inch unless shown otherwise on the drawings.

D. Bolts and nuts for restrained joints shall be low alloy, high strength steel.

E. Restrained joints are to meet the applicable requirements of ANSI/AWWA C110/A21.10 and shall be manufacturer’s standard, Mega lug by EBAA Iron Inc. or approved equal.

PART 3 EXECUTION

3.1 HANDLING PIPE AND FITTINGS

A. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe or coatings. Pipe or fittings shall not be dropped. All pipe or fittings shall be examined before laying. No piece shall be installed which is found to be defective. Any damage to the pipe coatings shall be required as directed by the Engineer.

B. All pipe and fittings shall be subjected to a careful inspection prior to being laid or installed.

C. If any defective pipe is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional expense to the Owner. All pipe and fittings shall be thoroughly cleaned before laying, shall be kept clean until they are used in the work, and when installed or until they are used in the work, and when installed or laid, shall conform to the lines and grades required.

3.2 LAYING PIPE AND FITTINGS

A. Ductile iron pipe and fittings shall be installed in accordance with requirements of ANSI/AWWA C600 except as otherwise provided herein.

B. All pipe shall be sound and clean before laying. When laying is not in progress, including lunchtime, the open ends of the pipe shall be closed by watertight plugs or other approved means.

C. Suitable excavations shall be made in the trench bottom to receive pipe with raised bells.

D. As soon as the excavation is completed to the normal grade of the bottom of the trench, immediately place screen gravel or crushed stone (where applicable) bedding in the trench, and then the pipe shall be firmly bedded in this material to conform accurately to the line and grade indicated on the Drawings. Blocking under the pipe will not be permitted. Bedding shall conform with Type 2 condition unless otherwise specified.

E. When cutting pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Cut ends of pipe to be used with a "Tyton" type bell shall be beveled to conform to the manufactured spigot end. The lining shall remain undamaged.

3.3 JOINTS

A. Push-on joints shall be made in strict accordance with the manufacturer's instructions. Pipe shall be laid with bell ends looking ahead. A rubber gasket shall be inserted in the groove of the bell end of the pipe, and the joint surfaces cleaned and lubricated. The plain end of the pipe is to be aligned with the bell of the pipe to which it is to be joined and pushed home with a jack or by other means. After joining the pipe, a metal feeler shall be used to make certain that the rubber gasket is correctly located.

B. Mechanical joints at valves, fittings, and where designated on the Drawings and as specified, shall be in accordance with the "Notes on Method of Installation" under ANSI A21.11 and the instructions of the manufacturer. To assemble the joints in the field, thoroughly clean the joint surfaces and rubber gasket with soapy water before tightening bolts. Bolts shall be tight to the specified torques. Under no condition shall extension wrenches, pipe over handle or ordinary ratchet wrenches be used to secure greater leverage.

C. Ball joints, where designated on the drawings and as specified, shall be installed in strict accordance with the manufacturer's instructions. Where ball joint assemblies occur at the face of structures or tanks, the socket end shall be at the structure or tank and the ball end assembled to the socket.

D. Flanged joints shall be in accordance with ANSI A21.15 including its Appendix "A" and the instructions of the manufacturer. Flanged joints shall be fitted so that the contact faces bear uniformly on the gasket and then are made up with relatively uniform bolt stress.

E. All valves, hydrants, fittings and other appurtenances needed upon the pipelines shall be set and jointed as indicated on the Drawings or as required by the manufacturer.

F. Unless otherwise noted, underground piping shall be push-on joint or mechanical joint with restraints as needed and above ground or exposed piping shall be flanged.

G. Deflected bell pipe shown on the Drawings is shown only to assistance in illustrating a preferred means of installation in specific locations and is not intended to indicate all deflected bell pipe necessary to affect the installation as shown in plan and profile views. The cost of all such deflections shall be included within the bid price for furnishing and installing the pipe.

H. When it is necessary to deflect pipe from a straight line in either the vertical or horizontal plane, or where long radius curves are permitted, the amount of deflection shall not exceed 50% of the maximum deflection allowed by manufacturer.

3.4 RESTRAINED JOINTS

A. Section of piping designated on the Drawings as having restrained joints or those requiring restrained joints shall be constructed using mechanical or compression joint pipe and fittings with restraining devices.

B. Restrained pipe joints that achieve restraint by incorporating cut out sections in the wall of the pipe shall have a minimum wall thickness at the point of cut out that corresponds with the minimum specified wall thickness for the rest of the pipe.

C. The minimum number of restrained joints required for resisting forces at fittings and changes in direction of pipe shall be determined from the length of restrained pipe on each side of fittings and changes in direction necessary to develop adequate resisting friction with the soil. This shall be determined in accordance with the requirements of the Ductile Iron Pipe Research Association: Thrust Restraint Design for Ductile Iron Pipe.

3.5 PIPE THRUST BLOCKS

A. Concrete thrust blocks are not an acceptable alternative to restrained joints. Concrete thrust blocks may only be used on a case-by-case basis as approved by the Engineer.

3.6 CLEANING AND FLUSHING

A. The pipe shall be thoroughly cleaned of all foreign matter before installation. It is the Contractor's responsibility to insure cleanliness of the pipe during installation and backfilling. At the conclusion of the work, the Contractor shall thoroughly clean the entire pipe by flushing with water or other materials which may have entered during the construction period. Debris cleaned from the lines shall be removed from the lowest outlet. If, after this cleaning, obstructions remain, they shall be removed. After the pipe is cleaned, the Engineer will examine the pipe for leaks. If defective pipes or joints are discovered at this time, they shall be repaired by the Contractor.

B. The method required for use is the passage of a sufficient number of "pigs" through the pipeline to affect the cleaning of the system.

C. Passage of the cleaning "pigs" through the system shall be constantly monitored, controlled. Pigs entered into the system shall be individually parked and identified so that their exiting from the system can be confirmed.

D. The Contractor must demonstrate to the satisfaction of the proper authority(s) that this work will be performed by experienced and knowledgeable supervision and personnel who have properly, safely and effectively provided for the cleaning of comparable systems in other applications. These personnel will be required to provide acceptable procedures prior to the work being initiated, that will clearly illustrate they are capable and have the means on hand to resolve potential or real problems that may occur with the cleaning pigs in the system. The Contractor shall provide evidence of qualification by providing copies of his/her state certification or license to perform such work as herein describe. Such documentation shall be included as part of the submittal process.

E. Report Completion: The Contractor shall provide a written report upon completion of line cleaning to outline and detail information acquired during the cleaning process about the system or to confirm existing information.

F. Cost of pigging the pipelines shall be included in the unit price for furnishing and installing the pipe and fittings. No additional cost for pigging will be allowed.

3.7 PRESSURE AND LEAKAGE TESTS

A. Hydrostatic pressure and leakage test shall conform to AWWA C600, with the exception that the Contractor shall furnish all gauges, meters, pressure pumps and other equipment needed to test the line.

B. The pressure required for the field hydrostatic pressure test shall be minimum 150 psi. The Contractor shall provide temporary plugs and blocking necessary to maintain the required test pressure. Corporation cocks at least 3/4 inches in diameter, pipe riser and angle globe valves shall be provided at each pipe dead-end in order to bleed air from the line. Duration of pressure test shall be at least two (2) hours. The cost of these items shall be included as a part of testing and is included in the cost to furnish and install pipe and fittings.

C. The leakage test shall be a concurrent test, at the maximum operating pressure as determined by the Engineer, with the pressure test and shall be not less than two hours in duration. All leaks evident at the surface shall be repaired and leakage eliminated regardless of total leakage as shown by test. Lines which fail to meet tests shall be repaired and retested as necessary until test requirements are compiled with. Defective materials, pipes, valves, and accessories shall be removed and replaced. The pipelines shall be tested in such sections as may be directed by the Engineer by shutting valves or installing temporary plugs as required. The pipe shall be filled with water, all air removed, and the test pressure maintained in the pipe for the entire test period by means of a force pump to be furnished by the Contractor. Accurate means shall be provided for measuring the water required at this pressure. The amount of water required is a measure of the leakage.

D. The amount of leakage which will be permitted shall be in accordance with AWWA C600 for all pressure lines.

E. The Contractor must submit their plan for testing to the Engineer for review at least fourteen (14) days before starting the test. The Contractor shall remove and adequately dispose of all blocking material and equipment after completion and acceptance of the field hydrostatic test, unless otherwise directed by the Engineer. Any damage to the pipe coating shall be repaired by the Contractor. Lines shall be totally free and clean prior to final acceptance.

3.8 DISINFECTING

A. Before being placed in service, all potable water pipelines shall be chlorinated in accordance with AWWA C651, "Standard Procedure for Disinfecting Water Mains." The procedure shall be approved by the Engineer. The location of the chlorination and sampling points will be determined by the Engineer in the field. Taps for chlorination and sampling shall be uncovered and backfilled by the Contractor as required.

B. The general procedure for chlorination shall be first to flush all dirty or discolored water from the lines, and then introduce chlorine in approved dosages through a tap at one end, while water is being withdrawn at the other end of the line. The chlorine solution shall remain in the pipeline for at least 24 hours.

C. Following the chlorination period, all treated water shall be flushed from the lines at their extremities and replaced with water from the distribution system. Bacteriological sampling and analysis of the replacement water shall then be made by the Engineer in full accordance with AWWA C651. The Contractor will be required to re-chlorinate, if necessary. The line shall not be placed in service until the requirements of the State and County Public Health Department are met.

D. Special disinfecting procedures shall be used in connections to existing mains, and where the method outlined above is not practical.

E. The Contractor shall make all arrangements necessary with the County Health Department for the collection and examination of samples of water from disinfected water mains. These samples shall be examined for compliance with Department of Health and Rehabilitative Services requirements. Sampling shall be made daily and continuously until two successive examinations are found satisfactory. If unsatisfactory, the line shall be flushed and disinfected again. The cost of sampling, flushing and disinfecting shall be included in the contract price and no additional charge shall be made to the Owner for this work.

F. Repairs and touch-up shall be performed in accordance with the manufacture's recommended repair and touch-up procedures.

G. All field cut ends shall be repaired and sealed prior to the installation.

END OF SECTION

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SECTION 15100 - VALVES AND APPURTENANCES

PART 1 GENERAL

1.1 DESCRIPTION

A. Furnish labor, materials, equipment, and incidentals required for operation of all valves and appurtenances as shown on the Drawings and as specified herein.

B. The equipment shall include the following:

1) Air Release Valves
2) Backflow Prevention Assembly
3) Ball Valves
4) Butterfly Valves
5) Check Valves
6) Detector Tape
7) Fire Hydrants
8) Flexible Connectors
9) Gate Valves
10) Gate Valves (Wheel Style)
11) Link Seals and Wall Sleeves
12) Plug Valves
13) Pressure Gauge Assembly
14) Retainer Glands
15) Strainers
16) Service Connections
17) Tapping Sleeves
18) Unions
19) Valve Boxes
20) Pipe Couplings

1.2 RELATED SECTIONS

A. Section 02221 – Trenching, Bedding, and Backfill for Pipe

B. Section 15010 – Testing Piping Systems

C. Section 15062 – Ductile Iron Pipe and Fittings

1.3 REFERENCES

A. ANSI/AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. through 12 in. (100 mm through 300 mm), for Water Transmission and Distribution.

B. ANSI/AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 in. through 48 in. (350 mm through 1200 mm), for Water Transmission and Distribution.

C. ANSI/AWWA C906 – AWWA C906 Polyethylene (PE) Pressure Pipe & Fittings - 4 Inch Through 63 Inch for Water Distribution

D. Manufactures Standardization Society (MSS) for the Valve and Fitting Industry

E. Other references as stated below.

1.4 QUALIFICATIONS

A. Valves and appurtenances shall be products of well-established reputable firms who are fully experienced, and qualified in the manufacture of the particular equipment to be furnished in the business of manufacturing of the specific product for a minimum of ten (10) years. The equipment shall be designed, constructed, and installed in accordance with the best practices and methods and shall comply with these specifications, as applicable.

1.5 SUBMITTALS

A. Within 30 days after contract execution, submit a list of valves to be furnished, with the names of suppliers, and the date of delivery.

B. Complete shop drawings of all valves and appurtenances shall be submitted in accordance with the requirements of Section 01340.

1.6 TOOLS

A. Special tools, handles, or wrenches, if required for normal operation and maintenance of the specified valves, shall be supplied with the equipment furnished.

1.7 SUBSTITUTIONS

A. Substitutions are not permitted unless otherwise stated.

B. All valves and appurtenances shall be of the size of the valve being replaced and all similar valves shall be from one manufacturer.

C. Valves and appurtenances shall have the name of the manufacturer and the working pressure for which they are designed cast in raised letters upon some appropriate part of the body.

PART 2 PRODUCTS

2.1 AIR RELEASE VALVES

A. Sewer Force Main Air Release Valves – System shall be a combination of one sewage air release valve and one sewage air/vacuum valve with dual isolation plug valves. Valve bodies and covers shall be of ductile iron construction in accordance with ASTM A536. All internal parts shall be of stainless steel, ASTM A240 - Type 304 and ASTM A276 - Type 303. The venting orifice shall be 5/16" in diameter with stainless steel seat. The inlet openings shall be a minimum of 2" NPT screwed connection for both valves. The valves shall be fully capable of operation in sewage force main. Both valves shall include a back-flushing feature for periodic cleaning of the internal mechanism. The overall height shall not exceed 22 inches. Valves shall be manufactured by Val-Matic Corporation or approved equal.

B. Water Main Air Release Valves – Valve body and cover shall be of ductile iron construction, per ASTM A536. All internal parts shall be of stainless steel, ASTM A240 – Type 304 for the float, and ASTM A296 – Type 316 for the linkage. The venting orifice shall be 3/16" diameter with brass seat. The inlet opening shall be a 2" NPT screwed connection. The overall height shall not exceed 13 inches. Valves shall be manufactured by Valve and Primer Corporation, model number APCO 200A, or approved equal.

2.2 BACKFLOW PREVENTION ASSEMBLY

A. The assembly shall conform to the latest revision of ANSI/AWWA C510 and shall be capable of withstanding a working pressure of at least 150 psi without damage to working parts or impairment of function. It shall consist of two internally loaded, independently operating check valves, located between two tightly closing resilient-seated shut off valves, with four properly placed resilient-seated test cocks.

2.3 BALL VALVES

A. Stainless Steel Ball Valves

1) Ball valve shall be tight closing, shaft-mounted complying with Fed. Spec. WW-V-35, Type II, Class C, Style 3. Valve design shall eliminate metal-to-metal contact or wedging in the sealing action. Design pressure rating shall be greater than 150 psi.

2) Valve body shall be one- or two-piece stainless steel ASTM A351. Ball shall be stainless steel ASTM A276. Seat ring shall be reinforced TFE.

3) Valve shall have a stainless steel 1/4 turn lever arm. Ends shall be threaded. Ball valve shall be Figure No. T-580-S6-R-66 as manufactured by Nibco, Inc. or equal.

B. PVC Ball Valves

1) Ball valves 2” and smaller for potable water service shall be schedule 80 NIBCO Model D.

2.4 BUTTERFLY VALVES

A. Butterfly valves and operators shall conform to the latest revision of ANSI/AWWA C504 standard for rubber-seated butterfly valves. Valves shall be Class 150 A or B, and shall be Mueller, Pratt, Clow, DeZurik, or approved equal.

2.5 CHECK VALVES

A. AIR CUSHIONED SWING CHECK VALVES (3-INCH AND LARGER)

1) Unless otherwise indicated or specified, check valves 3-inches and larger shall be air cushioned swing check with outside lever and weight and a totally enclosed side mounted external air cushion. Valves shall have ductile flanged ends faced and drilled in accordance with ANSI Standard. Check Valves shall have ductile iron bodies, having integral flanges with the following components of stainless steel: body ring, disc ring, clapper hinge shaft, hinge shaft key, clapper spacers, disc stud, disc stud nut and bushing, disc retaining washer and cotter pin. The hinge pin shall extend outside the ductile iron body through lubricated stainless steel bushings and outside packed glands on each side of the valve. Each bushing shall be provided with a buttonhead grease fitting. Stainless steel shall be at least 18-8 nickel-chromium content. Check valves shall be tested at the factory and shall be drip tight under a hydrostatic pressure of 200 psi applied to the downstream side of the disc. A certified test report shall be furnished with each valve.

2) Valves shall be APCO Series 6000, G.A. Industries or approved equal.

B. SWING CHECK VALVES (2-1/2-INCH AND SMALLER) FOR LIQUID SERVICE

1) Swing check valves for steam, water, oil, or gas in sizes 2-1/2-inch and smaller shall be suitable for a steam pressure of 150 psi and a cold water pressure of 300 psi. They shall have screwed ends, unless otherwise shown, and screwed caps.

2) The valve body and cap shall be of bronze to ASTM B 61 with threaded ends to ANSI/ASME Bl.20.1.

3) Valves for steam service shall have bronze discs, and for cold water, oil, and gas service replaceable composition discs.

4) The hinge pins shall be of bronze or stainless steel.

5) Suppliers or Equal

6) Crane Company.

7) Milwaukee Valve Company.

8) Stockham Valves and Fittings.

9) Val-Matic.

10) APCO.

C. PVC CHECK VALVES (2-1/2-INCH AND SMALLER)

1) Check valves shall be swing check type or ball check type manufactured from PVC compounds. Swing check valves shall be furnished with Teflon

seats, Teflon seals and flanged end connections. Ball check valves shall be furnished with Viton seats, Viton seals and threaded ends.

2) Ball check valves shall be provided on piping less than 3-inches in diameter. Ball check valves shall be true union type.

3) Swing check valves shall be provided on piping 3-inches in diameter and larger.

4) Suppliers, or Equal

5) Asahi-America.

6) Harrington Industrial Plastics, Inc.

7) Nibco, Inc. (GS Chemtrol).

2.6 DETECTOR TAPE

A. Detector tape shall be 3" wide, blue tape for water mains, green tape for force mains, with a metallized foil core laminated between 2 layers of plastic film. The words "CAUTION WATER LINE BURIED BELOW" or "CAUTION FORCE MAIN BURIED BELOW" shall be printed at 30" intervals along the tape. Tape shall be placed 18" below grade above all PVC mains and services, or as recommended by manufacturer. Non-metallic tape shall be used above ductile iron pipe.

2.7 FIRE HYDRANTS

A. Fire hydrants shall have a minimum 5 1/4" valve opening and shall open against the pressure and close with the flow. Hydrants shall meet or exceed the requirements of the latest editions of ANSI/AWWA C502 or C503 and shall comply with Factory Mutual Research Corporation and Underwriters Laboratories UL246 Standard.

B. The depth of bury, measured from the bottom of the connecting pipe to the ground line of the hydrant, shall be three feet six inches minimum. Exact depth at each location shall be determined by depth of line to which the hydrant is connected. Inlet connection shall be six-inch mechanical joint. A typical detail is shown in the Contract Drawings.

C. Blue reflective pavement markers shall be provided in the center of the nearest lanes of road pavement adjacent to all fire hydrant locations. Hydrants maintained by the City shall be painted in accordance with City standards. Hydrants privately maintained shall be painted yellow.

D. All fire hydrants shall be Mueller Super Centurion Model 200 or American Darling Model B84B. No substitutions shall be permitted.

2.8 FLEXIBLE CONNECTORS

A. Body and follower flange shall be iron. Bolt circle sizes and spacing shall conform to ASA 125 flange. Gasket shall be Nitrile (Buna-N) per ASTM D2000. Cross and tee bolts shall conform to ANSI A21.11. Coupling adapters shall be Smith-Blair or approved equal flexible connector

B. Flexible connectors or rubber expansion joints shall be spool type containing elastomers woven with nylon fabric and nylon tire core cord reinforced with wire.

C. Elastomers shall be nitrile (BUNA-N) unless otherwise depicted on the Drawings.

D. All elastomers design for exterior applications shall have a factory applied UV coating.

E. Backing plates and hardware shall be 316L stainless steel.

F. Flexible connectors shall be manufactured by Proco series 230 or Approved Equal.

2.9 GATE VALVES

A. Gate valves shall be ductile iron body, fully resilient seat, non-rising stem sealed with O-rings, double disc, type 304 stainless steel bolting, rated at 250 psi and conforming to the latest revision of ANSI/AWWA C515. Exposed valves shall be outside screw and yoke type.

B. Gate valves shall be Mueller or approved equal.

2.10 GATE VALVES (WHEEL STYLE)

A. Exposed wheel gate valves, unless otherwise specified or approved, shall be ductile iron body, bronze-mounted, double disc type, with ductile flanged ends, and shall conform to the AWWA Standard Specification for Gate Valves for Ordinary Water Works Service, Designation C500. Exposed valves shall be outside screw and yoke type.

B. Face-to-face dimension shall conform to ANSI Standard Face-to-Face and End-to-End Dimensions of Ferrous Valves, (ANSI B16.10) for ductile iron valves.

C. Bronze gate rings shall be fitted into grooves of dovetail or similar shape in the gates. For grooves or other shapes, the rings shall be firmly attached to the gates with bronze rivets.

D. Gate valves shall have a resilient rubber-seated ring or wedge, permanently bonded to the wedge disc, and complying with AWWA C509.

E. Stuffing box follower bolts shall be of steel, and the nuts shall be of bronze.

F. The design of the valves shall be such as to permit packing the valves without undue leakage while they are wide open and in service. O-ring stuffing boxes may be used.

G. Chain wheel operators shall be furnished with the valves. Such operators shall be designed with adequate strength for the valves with which they are supplied and shall provide for easy operation of the valve. Chains for valve operators shall be stainless steel. Gate valves shall be as manufactured by the Mueller Company, Clow Valve Company, or equal.

H. Where required, gate valves shall be provided with a box, cast in the slab, and a box cover. The depth of the valve box shall not be less than the slab thickness. Box cover opening shall be for valve wheel. The floor box and cover shall be equal to those manufactured by Rodney Hunt Machine Company or Clow Corporation.

I. Gate valves for diesel fuel service shall have API approval. Bodies shall be ductile iron.

2.11 LINK SEALS AND WALL SLEEVES

A. The pipe-to-wall penetration closures shall be "Link-Seal" as manufactured by Thunderline Corp., Belleville, MI 48111. Seals shall be modular mechanical type, consisting of interlocking synthetic rubber links shaped to fill continuously the annular space between the pipe and wall opening. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut. Seals shall be installed such that bolt heads are facing the inside of the structure and shall be accessible from grade without the need for excavation. After the seal assembly is positioned in the wall sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide an absolutely water-tight seal between the pipe and wall opening. The seal shall be constructed so as to provide electrical insulation between the pipe and wall, thus reducing chances of cathodic reaction between these two members.

B. Contractor shall determine the required inside diameter of each individual wall sleeve before ordering, fabricating, or installing. The inside diameter of each wall sleeve shall be sized as recommended by the manufacturer to fit the pipe and Link-Seal to assure a water-tight joint.

C. Wall sleeve shall be specially designed to mate with the Link-Seal. The wall sleeve shall be heavy wall welded or seamless steel pipe. The sleeve shall have a full-circle continuously-welded water stop plate on the sleeve O.D. which acts as the sleeve anchor and water stop. Wall sleeve shall be model WS by Thunderline Corp.

2.12 PLUG VALVES

A. Plug valves shall be non-lubricated eccentric type with resilient faced plugs and shall be furnished with end connections as shown on the plans. Flanged valves shall be faced and drilled in conformance with ANSI B16.1 Class 125 standard. Mechanical joint ends shall be in conformance with AWWA C111. Bell ends shall be in conformance with AWWA C100 Class B.

B. Unless otherwise specified on the plans, port areas for all valves shall be min. 80% of full pipe area.

C. Valve bodies shall be of ASTM A536 Grade 65-45-12 ductile iron in compliance with AWWA Standard C517. All exposed nuts, bolts, springs, washers, etc. shall be zinc plated. Resilient plug facings shall be Neoprene or Buna-N, on a single piece plug. The plug shall be of sufficient construction so that no strengthening member is required opposite the face.

D. Valves shall be furnished with corrosion resistant seats which comply with AWWA Standard C507 Section 7 paragraph 7.2 and with AWWA Standard C504 Section 3.5. The seat shall be in the body only. Seat ring shall be adjustable and replaceable.

E. Valves shall be furnished with replaceable, sleeve-type bearings in the upper and lower journals. These bearings shall comply with AWWA Standard C507 Section 8 paragraphs 8.1, 8.3 and 8.5 and with AWWA Standard C504 Section 3.6.

F. Valve shaft seals or packing shall be adjustable and replaceable without removing the valve from service or interrupting service with flow in either direction. Shaft seals shall comply with AWWA Standard C507 Section 10 and with AWWA C507 Section 111.

G. Valve pressure ratings shall be as follows and shall be established by hydrostatic tests as specified by ANSI Standard B16.1. Pressure ratings shall be 175 psi for valves through 12", 150 psi for valves in sizes 14" through 36" and 125 psi for valves in sizes 42" through 54". Valves shall be capable of providing drip-tight shutoff up to the full valve rating with pressure in either direction.

H. All valves 8 inches and larger shall be equipped with gear actuators with hand wheels. All gearing shall be enclosed and suitable for running in oil, with seals provided on all shafts to prevent entry of dirt and water into the actuator. All shaft bearings shall be furnished with permanently lubricated bronze bearing bushings. Actuator shall clearly indicate valve position. An adjustable stop shall be provided. Construction of actuator housing shall be cast iron or steel.

I. Plug valves installed such that actuators are 6 feet or more above the floor shall have chain-wheels and chains provided.

J. For plug valves with extended shafts and actuators, the actuators shall be mounted on floor stands where indicated on the Drawings or shall have removable hand-wheels where floor stands are not called for. Six inch sleeves shall be provided for extended shafts in all floors. Where necessary, covers shall be provided. Shafts shall be of adequate strength to operate the valve. Floor stands and covers, where called for, shall be cast iron. Floor stands shall be equipped with valve position indicators and a lock for the hand-wheel.

K. All plug valves shall be installed so that the direction of flow through the valve is in accordance with the manufacturer's recommendations.

L. Valves and actuators shall be as manufactured by DeZurik.

2.13 PRESSURE GAUGE ASSEMBLY

A. Pressure gauge shall be direct-mounted with a minimum 4-1/2 inch diameter dial with a clear glass crystal window constructed to the following standards:

1) Accuracy – 1% full scale grade A ASME B40, 100

2) Weather Protection – Dry Case International Protection Rating (IP) IP54

3) Fill - Glycerin filled, hermetically sealed IP65

4) Case type – Open front 304 stainless steel case

5) Dial – Aluminum dial, brushed aluminum background, black figures and graduations.

6) Bourdon Tube and Socket – 316L/316L Stainless steel

7) Scale and range – As depicted on Drawings.

8) Manufacture – ISO 9001 registered.

9) Pressure gauge shall be manufactured by Ashcroft Type 1009 or approved shown as indicated on the Contract Drawings.

B. All pressure gauges for wastewater applications shall be mounted to a Pressure Sensor.

1) Pressure Sensors shall be of the wafer type, designed to fit between standard ANSI B16.1 Class125/ANSI B16.5 Class 150 pipeline flanges. The face-to-face of the entire sensor shall be no longer than specifications for butterfly valves - MSS-SP67.

2) Pressure Sensors shall be flow through design with a nitrile (BUNA-N) elastomer sensing ring around the full circumference. There shall be no dead ends or crevices, and flow passage shall make the sensor self-cleaning.

3) The sensing ring shall have a cavity behind the ring filled with ethylene glycol fluid to transfer pressure to the gauge.

4) Pressure Sensor shall be manufactured by Dwyer or approved equal as shown on the Contract Drawings.

C. Pressure gauge assembly shall include ½" brass fittings, ball valves, snubbers or gauge guards as depicted on the Drawings. Pressure gauges and sensors shall be rated for vacuum conditions and negative pressures.

2.14 RETAINER GLANDS

A. Retainer glands shall conform to the latest revision of ANSI/AWWA C111/A21.11. All glands shall be manufactured from ductile iron as listed by Underwriters Laboratories for 250 psi minimum water pressure rating, manufactured by Clow Corporation, EBAA Iron, or approved equal.

2.15 STRAINERS

A. Strainers shall be of the "Y" type, shall have bronze bodies with a removable bronze screen, and shall be as manufactured by Watts Regulator Company, Lawrence, MA.

2.16 SERVICE CONNECTIONS

A. Service saddles shall be ductile iron, epoxy or nylon coated, with double stainless steel straps, or a single wide strap. Saddles shall conform to the latest revisions of ANSI/AWWA C111/21.11 and ASTM A588.

B. Service lines shall be polyethylene (PE) tubing as described in ANSI/AWWA C901, latest revision, with a working pressure of 200 psi (DR 9). Pipe joints shall be of the compression type, with totally confined grip seal and coupling nut. Polyethylene shall be extruded from PE 3408 high molecular weight materials and must conform to ASTM D2737.

C. Corporation stops shall be manufactured of brass alloy in accordance with ASTM B62 with threaded ends and shall be Ford or approved equal.

D. Meter stops shall be the 90 degree lockwing type and shall be of bronze construction in accordance with ASTM B62. Meter stops shall be closed button design, with a resilient "O" ring, sealed against external leakage at the top. Stops shall be equipped with a meter coupling nut on the outlet side, as manufactured by Mueller, Ford or approved equal.

E. All meters (2 1/2” and smaller) and meter boxes will be supplied and installed by the municipality at the owner's expense. Meters larger than 2 ½ inches will have special installation requirements.

2.17 TAPPING SLEEVES

A. Tapping sleeves shall be ductile iron or stainless steel, mechanical or joint, as stated on the Drawings, manufactured by Clow, or approved equal.

2.18 UNIONS

A. Unions on ferrous pipe, 2 inch diameter and smaller, shall be 150 lb malleable iron, and zinc-coated. Unions on water piping, 2 1/2 inch diameter and larger, shall be 125 lb pound flange pattern, and zinc-coated. Gaskets for flanged unions shall be of the best quality fiber or plastic. Unions shall not be concealed in walls, ceilings, or partitions.

2.19 VALVE BOXES

A. Valve boxes for water mains and sewer force mains shall be U.S. Foundry Model 7500, marked "Water" or "Sewer", or approved equal.

B. Valve boxes for blow-off assembly shall be U.S. Foundry Model 7630 (No. 3) or approved equal.

2.20 PIPE COUPLINGS

A. Pipe couplings shall be style 38 all 316L stainless steel by Piping Specialties Dresser, Inc.

PART 3 EXECUTION

3.1 INSTALLATION

A. Valves and appurtenances shall be installed in the locations shown, true to alignment and rigidly supported. Any damage to the above items shall be repaired to the satisfaction of the Engineer before they are installed.

B. Install floor boxes, brackets, extension rods, guides, and the various types of operators and appurtenances that are in masonry floors or walls and install concrete inserts for hangers and supports as soon as forms are erected and before concrete is poured. Before setting these items, the Contractor shall check all plans and figures having direct bearing on the locations of the valves and appurtenances, and he shall be responsible for the proper location of these items during the construction of the structures.

C. Flanged joints shall be made with stainless steel bolts, nuts, and washers. Mechanical joints shall be made with mild corrosion-resistant alloy steel bolts and nuts. All exposed bolts shall be painted the same color as the pipe. All buried bolts and nuts shall be heavily coated with two (2) coats of bituminous paint.

D. Prior to assembly of split couplings, the grooves and other parts shall be thoroughly cleaned. The ends of the pipes and the outsides of the gaskets shall be moderately coated with petroleum jelly, cup grease, soft soap or graphite paste, and the gasket shall be slipped over one pipe end. After the other pipe has been brought to the correct position, the gasket shall be centered properly over the pipe ends with the lips against the pipes. The housing sections shall then be placed. After the bolts have been inserted, the nuts shall be tightened until the housing sections are firmly in contact, metal-to-metal, without excessive bolt tension.

E. Prior to the installation of sleeve-type couplings, the pipe ends shall be cleaned thoroughly. Soapy water may be used as a gasket lubricant. A follower and gasket, in that order, shall be slipped over each pipe to a distance of about 6 inches from the end, and the middle ring shall be placed on the already laid pipe end until it is properly centered over the joint. The other pipe end shall be inserted into the middle pipe already laid. The gaskets and followers shall then be pressed evenly and firmly into the middle ring flares. After the bolts have been inserted and all nuts have been made up fingertight, diametrically opposite nuts shall be progressively and uniformly tightened all around the joint, preferably by use of a torque wrench of the appropriate size and torque for the bolts.

3.2 SHOP PAINTING

A. Ferrous surfaces of valves and appurtenances shall receive an exterior coating of rust-inhibitive primer. Interior coatings shall be the manufacturer's standard except that valves for potable water lines shall be coated with paints approved by EPA, FDA, and AWWA for potable water service. All pipe connection openings shall be capped after shop painting to prevent the entry of foreign matter prior to installation.

3.3 FIELD PAINTING

A. All above ground valves and appurtenances shall be painted in accordance with City standards.

3.4 INSPECTION AND TESTING

A. Completed pipe shall be subjected to hydrostatic pressure test per Section 15010. All leaks shall be repaired and lines retested until approved by the Owner.

END OF SECTION

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SECTION 16000 - ELECTRICAL GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 SCOPE

A. Provide all labor, materials, tools, supplies, equipment, and temporary utilities to complete the work shown on the Drawings and specified herein for lighting systems. All systems are to be completely installed and fully operational. Specifically, the work includes, but is not limited to:

1) Electric services, secondary feeders, branch circuits, contactors, all connections to controls, and equipment

2) Installation of underground conduits and splices

3) Complete lighting systems

4) Complete grounding system including system and equipment

1.2 RELATED DOCUMENTS

A. The general provisions of the Contract, including General Conditions and Special Conditions, apply to all the work specified herein.

1.3 LAWS, PERMITS, FEES AND NOTICES

A. Secure and pay all permits, fees, and licenses necessary for the proper execution and completion of the work. Submit all notices and comply with all laws, ordinances, rules and regulations of any public agency bearing on the work. Contractor shall be a licensed electrical contractor in the county of construction.

1.4 DEPARTURES

A. If any departures from the Contract Drawings of Specifications are deemed necessary, details of such departures and the reasons therefore shall be submitted as soon as practicable to the ENGINEER for advance written approval.

1.5 BASIS FOR WIRING DESIGNS

A. The Contract Drawings and Specifications describe specific sizes of switches, breakers, fuses, conduits, conductors, motor starters and other items of wiring equipment. These sizes are based on specific items of power consuming equipment (heaters, lights, motors for fans, compressors, pumps, etc.). Wherever another trade provides power consuming equipment that differs from the Drawings and Specifications, the wiring for such equipment shall be changed to proper sizes to match at no additional expense to the OWNER.

1.6 INTERPRETATION OF DRAWINGS

A. General: The Drawings are diagrammatic and are not intended to show exact locations of Raceway runs, outlet boxes, junction boxes, pull boxes, etc. The locations of equipment, appliances, fixtures, Raceways, outlets, boxes and similar devices shown on the Drawings are approximate only. Exact locations shall be determined and coordinated in the field. The right is reserved to change, without additional cost, the location of any outlet within the same room or general area before it is permanently installed. Obtain all information relevant to the placing of electrical work and in case of interference with other work, proceed as directed by the ENGINEER.

B. Discrepancies: Notify the ENGINEER of any discrepancies found during construction of the project. The ENGINEER will provide written instructions as to how to proceed with that portion of work. If a conflict exists between the Contract Documents and an applicable code or standard, the most stringent requirement shall apply.

C. Wiring: Each three-phase circuit shall be run in a separate Raceway unless otherwise shown on the Drawings. Unless otherwise accepted by the Engineer, Raceway shall not be installed exposed. Where circuits are shown as "home-runs" all necessary fittings, supports, and boxes shall be provided for a complete raceway installation.

D. Layout: Circuit layouts are not intended to show the number of fittings, or other installation details. Connections to equipment shall be made as required, and in accordance with the accepted shop and manufacturer's setting drawings.

E. Coordination: Coordinate final equipment locations with drawings and other disciplines. Layout before installation so that all trades may install equipment in available space. Provide coordination as required for installation in a neat and workmanlike manner.

F. Drawing Conflicts: Where drawing details, plans or specification requirements are in conflict and where sizes of the same item run are shown to be different within the contract documents, the most stringent requirement shall be included in the Contract. Systems and equipment called for in the specification or as shown on the drawings shall be provided as if it was required by both the drawings and specifications. Prior to ordering or installation of any portion of work, which appears to be in conflict, such work shall be brought to Architect's attention for direction as to what is to be provided.

1.7 EXCAVATING FOR ELECTRICAL WORK

A. General – Excavation or drilling, backfill and repair of paving and grassing shall be in the bid of the electrical contractor. The actual work need not be performed by electrical trades. However, the electrical contractor is responsible for all excavation, drilling, dewatering, backfilling, tamping, and repair of pavements and grassing required in support of electrical work. All areas disturbed by electrical work shall be repaired to their original condition, or as indicated on the drawings.

B. Coordination

1) The electrical contractor must check for existing utilities before

commencing any excavation or drilling.

2) Contract drawings and other trades are to be consulted to avoid interferences with other utilities on this project.

3) In the event of damage to existing utilities, the OWNER and ENGINEER shall be immediately notified, and damage shall be immediately repaired.

C. Precautions – The electrical contractor must take every reasonable precaution to avoid interferences. In the vicinity of a suspected interference, excavations shall be dug by hand.

1.8 JOB SITE VISIT

A. Visit the project site before submitting a bid. Verify all dimensions shown on the Contract Drawings and determine the characteristics of existing facilities which will affect performance of the work, but which are not shown on the Drawings or described within these Specifications.

1.9 CODES AND STANDARDS

A. Applicable provisions of the following codes and standards, and other codes and standards required by the State of Florida and local jurisdictions, are hereby imposed on a general basis for electrical work (in addition to specific applications specified by individual work sections of these specifications).

1) U.L. – Electrical materials shall be approved by the Underwriters' Laboratories, Inc. This applies to materials which are covered by U.L. standards.

2) NEC – National Electrical Code (NFPA-70-2014)

3) OSHA – Standards of the Occupational Safety and Health Administration are to be complied with.

4) NEMA – National Electrical Manufacturers Association Standards are to be met wherever standards have been established by that agency, and proof is specifically required with material submittals for switchboards, motor control centers, panelboards, cable trays, motors, switches, circuit breakers, and fuses.

5) ANSI – American National Standards Institute

6) Florida Building Code (2017 – 6th Edition)

1.10 ELECTRICAL SUBMITTALS

A. The CONTRACTOR shall submit shop drawings, samples and certificates in accordance with the Special Conditions for additional instructions on substitutions. Submittals will not be accepted for partial systems. Submit all materials for each specifications section at one time. Submittals must be arranged, correlated, indexed and bound in orderly sets for ease of review.

B. Shop drawings and manufacturer’s data sheets are required for all electrical materials. Samples are to be supplied for any substitute as requested by the ENGINEER.

C. Submit Shop Drawings, manufacturer's data, and certifications on all items of electrical work prior to the time such equipment and materials are to be ordered. Order no equipment or materials without approval from the ENGINEER.

1.11 OPERATION AND MAINTENANCE MANUALS

A. The CONTRACTOR shall submit Operation and Maintenance (O&M) Manuals in accordance with Division 1, General Requirements. O&M Manuals must contain, but are not limited to, the following:

1) Brief description of system and basic features

2) Manufacturer's name and model numbers of all components of the system

3) List of local factory authorized service companies

4) Operating instructions, including preparation for starting up, seasonal changes, shut down and service

5) Maintenance instruction

6) Possible breakdowns and repairs

7) Manufacturer's literature describing each piece of equipment

8) Control diagrams by the control manufacturer

9) Description of sequence by the control manufacturer

10) Parts list

11) Wiring diagrams

1.12 SPARE PARTS

A. Submit in accordance with Division 1, General Requirements, a list of Recommended Spare Parts for all major items of equipment. Include descriptions of each part, part number, and cost.

1.13 PROJECT DOCUMENTS

A. For "As Built" drawing requirements, see Division 1.

B. In addition, each "As Built" single line diagram shall be framed under glass and mounted on wall near respective contactors and controls.

PART 2 PRODUCTS

2.1 GENERAL

A. Electrical Temporary Facilities – The CONTRACTOR shall include in his bid the cost of furnishing, installing and maintaining all materials and equipment required to provide temporary light and power to perform the work of all trades during construction and until work is completed. Adequate lighting and receptacle outlets for operation of hand tools shall be provided throughout the project, including shanties, trailers, field offices, temporary toilet enclosures, and shall be extended as construction progresses.

B. All reasonable safety requirements shall be observed to protect workers and the public from shock and fire hazards.

1) Ground fault interrupters shall be employed in accordance with Codes.

2) Ground wires are required in all circuits. Ground poles are required on all outlets. All metallic cases shall be grounded.

3) Rain-tight cabinets shall be used for all equipment employed in wet areas.

2.2 ELECTRICAL PRODUCTS

A. Unless otherwise indicated in writing by the ENGINEER, the products to be furnished under this specification shall be the manufacturer's latest design. Where two or more units of the same class of equipment are required, these units shall be products of the same purpose and rating shall be interchangeable throughout the project.

B. All products shall be newly manufactured. Defective equipment or equipment damaged in the course of the installation or a test shall be replaced or repaired in a manner meeting the approval of the ENGINEER, at no additional expense to the OWNER.

2.3 SUBSTITUTIONS

A. Comply with instruction in the Contract General Conditions and Special Conditions regarding substitutions.

2.4 ELECTRICAL IDENTIFICATION

A. Color Coding – Conductor colors shall be in accordance with NEC and NEMA requirements. Refer also to applicable sections of these specifications. Three-phase feeder and branch circuits shall be identified as follows:

120/240/208 3-PH	**277/480 3-PH**	**120/240/208 1-PH**
A – Black	A – Brown	A – Black
B – Red	B – Orange	B – Red
C – Blue	C – Yellow	N – White
N - White	N – Gray	
Green or bare for grounding conductors		
Green with Yellow trace for Special Grounding		

2.5 NAMEPLATE

A. The following items shall be equipped with nameplates – All motors, motor starters, motor control centers, pushbutton stations, control panels, time switches, disconnect or relays in separate enclosures, transformers, receptacles, wall switches, high voltage boxes, and cabinets. All light switches and outlets shall carry a phenolic plate with the supply circuit number. Electrical systems shall be identified at junction and pull boxes, terminal cabinets and equipment racks.

B. Nameplates shall adequately describe the function of the particular equipment involved. Nameplates for panelboards and switchboards shall include the panel designation, voltage and phase of the supply. For example, "Panel A, 277 / 480 V, 3-phase, 4-wire." The name of the machine on the motor nameplates for a particular machine shall be the same as the one used on all motor starters, disconnect and P.B. station nameplates for that machine. Nameplates shall be laminated phenolic plastic, white front and back with black core, with lettering etched through the outer covering; black engraved letters on white background. Lettering shall be 3/16 inch high at pushbutton stations, thermal overload switches, receptacles, wall switches and similar devices, where the nameplate is attached to the device plate. At all other locations, lettering shall be 1/4 inch high, unless otherwise detailed on the drawings. Nameplates shall be securely fastened to the equipment with No. 4 Phillips, rough-head, cadmium-plated, steel self-tapping screws or nickel-plated brass bolts. Motor nameplates may be non-ferrous metal not less than 0.03 inch thick, die stamped. In lieu of separate plastic nameplates, engraving directly on device plates is acceptable. Engraved lettering shall be filled with contrasting enamel. Equipment nameplate schedule for all equipment shall be submitted with shop drawing submittal for ENGINEER's approval.

C. All junction and splice boxes shall be labeled using permanent shipping tags attached to boxes, not covers.

2.6 WIRE AND CABLE IDENTIFICATION

A. All wire and cable shall be identified at each termination point and at each pull box, splice box, junction box, or manhole. Provide permanent, waterproof, non-metallic (paper unacceptable) tags indicating the circuit number in 3/16 inch letters. Circuit numbers shall be protected with clear shrinkable tubing.

PART 3 EXECUTION

3.1 DELIVERY, STORAGE AND HANDLING

A. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels and similar information needed for distinct identification; adequately packaged or protected to prevent deterioration during shipment, storage and handling. Store in a dry, well ventilated, indoor space, except where prepared and protected by the manufacturer specifically for exterior storage. Comply with OWNER's instruction for storage locations.

3.2 ELECTRICAL COORDINATION

A. The CONTRACTOR is responsible for coordination with the OWNER, ENGINEER, the power company, and the telephone company on all matters that have a bearing on the electrical work.

B. The Drawings indicate the extent, the general location, and arrangement of equipment, conduit, and wiring. Study the Drawings, including details, so the equipment shall be properly located and readily accessible. Locate all electrical equipment to avoid interference with mechanical and / or structural features. Make necessary changes in spacings and locations of lighting fixtures, panelboards, cabinets, receptacles and other items of equipment provided that the overall patterns of layouts are not disrupted and remain uniform.

3.3 CUTTING AND PATCHING

A. Cut and prepare all openings, chases, and trenches required for the installation of equipment and materials. Repair, remodel, and refinish in strict conformance with the quality of workmanship and materials in the surroundings. Obtain written permission from the ENGINEER for any alterations to structural members before proceeding. All penetrations through fire walls or floor / ceiling slabs shall be sealed to maintain the fire integrity of the wall or slab.

3.4 MAINTENANCE

A. Render all necessary measures to insure complete protection and maintenance of all systems, materials, and equipment prior to final acceptance. Any materials or equipment not properly maintained or protected to assure a “factory new” condition at the time of final acceptance shall be replaced immediately at no additional cost to the OWNER.

3.5 WATERPROOFING

A. Whenever any work penetrates any waterproof area, seal and render the work waterproof. All work shall be accomplished so as not to void or diminish any waterproofing bond or guarantee.

3.6 TESTS

A. Conduct an operating test of equipment prior to the ENGINEER's approval. The equipment shall be demonstrated to operate in accordance with the requirements of these Specifications. The tests shall be performed in the presence of the ENGINEER or an authorized representative. The CONTRACTOR shall furnish all instruments, electricity and personnel required for the tests.

3.7 CLEANUP

A. Maintain continuous cleanup during the progress of the work, and use appointed storage areas for supplies. The premises shall be kept free from accumulations of waste materials and rubbish.

END OF SECTION

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SECTION 16011 - CODES & STANDARDS

PART 1 GENERAL

1.1 THIS SECTION COVERS THE CODES, SPECIFICATIONS AND STANDARDS CONSIDERED MINIMUM REQUIREMENTS FOR MATERIALS, WORKMANSHIP AND SAFETY FOR ALL DIVISIONS 16 AND RELATED ELECTRICAL WORK.

1.2 SPECIFICATIONS, CODES AND STANDARDS

A. Reference within this Specification to standards, codes or reference specifications implies that any item, product or material so identified must comply with all minimum requirements as stated therein, except packaging and shipping, unless indicated otherwise. Only the latest revised editions are applicable.

Some of the references used in this Division are as follows:

NFPA	National Fire Protective Association
NEC	National Electrical Code
NEMA	National Electrical Manufacturers' Association
U.L.	Underwriters' Laboratories, Inc.
ANSI	American National Standards Institute
FS	Federal Specification

B. The Specifications, codes and standards indicated below and in other Sections, including the current addenda, amendments and errata, referred to by basic designation only, form a part of this specification.

NFPA-70	National Electrical Code (2014 Edition)
NFPA-90A	Air Conditioning & Ventilation (2015 Edition)
NFPA-101	Code for Safety to Life (2015 Edition)
F.B.C.	Florida Building Code (2017 - 6th Edition)

1.3 UNDERWRITERS' LABORATORIES

A. Where materials and equipment are available under the continuing inspection and labeling service of U.L.; provide such material and equipment.

B. Listing by Underwriters' Laboratories shall be evidenced by the label or:

U.L. - Electrical Construction Materials List (Green Book)
U.L. - Electrical Appliance & Utilization Equipment List
U.L. - Building Materials List

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 16050 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 SCOPE

A. Provide all material as required for a complete project as required by the Drawings and in this Specification.

1.2 SHOP DRAWING SUBMITTALS

A. Submit shop drawings for the following:

1) All raceways

2) Wiring and Splices

3) Contactors, Relays, Photocells

4) Poles and Fixtures

PART 2 PRODUCTS

2.1 RACEWAY

A. Galvanized Rigid Conduit (ANSI C80.0) – Rigid galvanized steel conduit "RGS" shall be U.L. Approved, Schedule 40, mild steel pipe, zinc-coated on the inside and outside. Fittings shall be zinc-coated, U.L. Approved.

B. PVC Conduit – Underground PVC conduit shall be Schedule 40 or Schedule 80 unless otherwise noted, and shall be U.L. approved. PVC conduit shall be Schedule 80 when installed above ground.

C. Locations: – Conduit shall be used as follows:

1) All above ground grade exposed conduits shall be hot dipped galvanized rigid steel except otherwise noted on the Drawings.

2) All conduits penetrating rated fire walls or rated fire floors shall be installed with U.L. Approved devices to maintain the fire rating of the wall or floor penetrated.

2.2 WIRE AND CONNECTORS

A. Cable shall be rated for 600 volts and shall meet the requirements below:

1) Conductors shall be stranded.

2) All wire shall be brought to the job in unbroken packages and shall bear the date of manufacturing; not older than 12 months.

3) Type of wire shall be THWN or THHN rated 75 degrees C, suitable for wet locations except where otherwise required by the drawings.

4) No wire smaller than No. 12 AWG shall be used unless specifically indicated.

5) Conductor metal shall be copper.

6) All conductors shall be meggered after installation and insulation must be

in compliance with the Insulated Power Cable Engineers Association Minimum Values of Insulation Resistance.

2.3 BOXES

A. Boxes for wiring devices (switches and receptacles) installed outdoors or wet locations shall be weatherproof fiberglass with polycarbonate cover plates. Junction boxes shall be NEMA 4X or 3R construction as indicated on construction documents. All boxes shall be securely mounted, plumb and level, in readily accessible locations.

B. Pull boxes in ground shall be Pencell HHPL 172012 with green lid marked “ELECTRIC”.

2.4 GROUNDING

A. Grounding and Bonding – All Grounding and Bonding shall be in accordance with NFPA 70 Article 250. Ground all exposed non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in raceways, and neutral conductor of wiring systems.

B. Grounding Conductor – Provide an insulated, green-colored equipment grounding conductor in all feeder and branch circuits. This conductor shall be separate from the electrical system neutral conductor. Conduits will not be approved as grounding conductor.

C. The CONTRACTOR shall install all ground rods, ground wires, and connectors as required for the complete grounding system.

D. All metal parts and grounding conductors in each manhole or pullbox shall be grounded to a local ground rod.

E. Resistance – Readings shall not be taken within 48 hours of a rainfall.

F. The CONTRACTOR shall provide a written report for all grounding test results to the ENGINEER. The test shall include all ground connections. The report shall be signed by the OWNER of the contracting firm and shall include: test date, time, weather conditions on test date, weather conditions 3 days prior to the test date, location, and results.

G. All raceways require grounding conductors; metallic raceways are not adequate grounding paths. Bonding conductors through the raceway systems shall be continuous from main switch ground buses to panel ground bars of panelboards, and from panel grounding bars of panelboards, and motor control centers to branch circuit outlets, motors, lights, etc. These ground conductors are required throughout the project regardless of whether conduit runs or the Cable and Conduit Schedule show ground conductors on the Drawings.

H. All connections made below grade shall be of the exothermic type.

PART 3 EXECUTION

3.1 CONDUIT INSTALLATION

A. General

1) Nylon pull cords shall be installed in all empty conduits. Wire shall not be

installed until all work of any nature that may cause damage is completed, including pouring of concrete. Mechanical means shall not be used in pulling in wires 8 AWG or smaller.

2) The use of running threads is prohibited and where some such device is necessary, split couplings, Erickson couplings, or equal shall be used. Where water-tight conduit installations are required, water-tight conduit unions shall be used.

3) All conduits shall be cleaned by pulling a brush swab through before installing cables.

4) All conduits shall be sealed at each end with electrical putty or Duct Seal. Special care shall be taken at all equipment where entrance of moisture could be detrimental to equipment.

B. Handling

1) Conduits subjected to rough handling or usage shall be removed from the premises.

2) Conduits must be kept dry and free of water or debris with approved pipe plugs or caps. Care shall be given that plugs or caps are installed before pouring of concrete. All spare conduits shall remain plugged or capped upon project completion.

C. Concrete and Masonry

1) Where conduits pass through exterior concrete walls or fittings below grade, the entrances shall be made watertight. This shall be done by providing pipe sleeves in the concrete with 1/2” minimum clearance around the conduits, and caulking with askum and sealant, or by means of conduit entrance seals.

2) Where embedded conduits cross expansion joints, furnish and install offset expansion joints or sliding expansion joints. Sliding expansion joints shall be made with straps and clamps.

D. Panelboards and Boxes

1) Conduits entering panelboards, pull boxes, or outlet boxes shall be secured in place by galvanized locknuts and bushings, one locknut outside and one locknut inside of box with bushing on conduit end. The locknuts shall be tightened against the box without deforming the box. Bushings shall be of the insulating type.

E. Bending

1) Field conduit bends shall be made with standard tools and equipment manufactured especially for conduit bending.

F. Mounting and Concealing

1) Conduit runs shall always be concealed in finished spaces and may be exposed in industrial spaces except where indicated on the Drawings.

2) Exposed runs of conduits shall be installed with runs parallel or perpendicular to walls, structural members or intersections of vertical

planes and ceilings, with right angle turns consisting of symmetrical bends or pull boxes as indicated on the Drawings. Bends and offsets shall be avoided where possible.

3) Where conduits are run individually, they shall be supported by approved pipe straps, secured by means of: 1) toggle bolts or hollow masonry; 2) expansion shields and machine screws or standard preset inserts on concrete or solid masonry; 3)machine screws or bolts on metal surfaces, and wood screws on wood construction. The use of perforated straps or wires will not be permitted.

4) Concrete inserts and pipe straps installed shall be stainless steel unless otherwise noted on the Drawings. All bolts, nuts, washers, and screws shall be stainless steel. Individual hangers, trapeze hanger, and rods shall be prime-coated and painted. Conduit support clamps shall be the two-piece type.

5) Conduit support struts, clamps, bolts, nuts and washers installed outdoors and in corrosive atmosphere indoors or on floors shall be stainless steel.

6) In furred ceilings, conduit runs shall be supported from structure, not furring.

3.2 TERMINATIONS AND SPLICES

A. Terminations of power cable shall be by means of U.L. approved connectors. All connectors shall meet U.L. 486B and shall be compatible with the conductor material.

B. Splicing of power, control, or instrumentation wiring will not be allowed except by written approval of the ENGINEER. Where splicing is allowed, splices shall be made waterproof regardless of location.

3.3 GROUNDING

A. General – Grounding shall be as indicated, and as required by NFPA 70 and ANSI-C2.

B. Grounding Connections – Grounding connections which are buried or otherwise normally inaccessible, and excepting specifically those connections for which access for periodic testing is required, shall be made by exothermic weld. Exothermic welds shall be made strictly in accordance with the weld manufacturer's written recommendations. Welds which have "puffed up" or which show convex surfaces, indicating improper cleaning, are not acceptable. No mechanical connector is required at exothermic weldments.

C. Grounding Grid System – Conductors shall be buried a minimum of 24 inches in the ground. All cable crossings shall be securely bonded and the system connected to the ground system as well as to all equipment and structural steel work, and to all water piping.

D. Grounding Conductors – Conductors shall be insulated copper wire and sized as required by National Electrical Code.

3.4 FIELD TESTS

A. As an exception to requirements that may be stated elsewhere in the Contract, the ENGINEER shall be given five working days' notice prior to each test. The CONTRACTOR shall demonstrate that all circuits and devices are in good operating conditions.

B. Test on 600 volt wiring – Verify all 600 volt wiring has no short circuits or accidental grounds. Perform insulation resistance tests on all wiring using an instrument which applies a voltage of approximately 500 volts to provide a direct reading of resistance. Minimum resistance shall be 1 megohm. The conductor loop resistance of each pair shall also be measured. The mutual capacitance between conductors of each pair shall also be measured. Provide written results for approval.

3.5 WIRE AND CABLE INSTALLATION

A. Conductors shall not be pulled into raceway until:

1) Raceway system has been inspected and approved by the ENGINEER.

2) Plastering and concrete have been completed in affected areas.

3) Raceway system has been freed of moisture and debris.

B. Conductors of No. 8 size and smaller shall be hand pulled. Larger conductors may be installed using power winches. Wire pulling lubricant, where needed, shall be U.L. approved. Wire in panels, cabinets, and gutter shall be neatly grouped, using nylon tie straps, and fanned out to terminals.

C. Building wire conductors THHN / THWN installed below grade, or in concrete slabs on grade, shall have type RHW-USE insulation, 600 volt. Building wire shall be stranded.

D. Each cable or wire in panels, pull boxes, manholes, or troughs shall have a permanent identification, with numbers and letters indicated on the conduit and cable schedule. For underground cable identification tag, see drawing.

E. Lubricants – Lubricants for assisting in the pulling of cables shall be those specifically recommended by the cable manufacturer. The lubricant shall not be deleterious to the cable sheath, jacket, or outer coverings, and shall be U.L. approved. Use Polywater J or equal.

F. Cable Pulling Tensions – Shall not exceed the maximum pulling tension recommended by the cable manufacturer.

3.6 MOUNTING AND SUPPORTING ELECTRIC EQUIPMENT

A. Furnish and install all supports, hangers, and inserts required to mount fixtures, conduits, cables, pull boxes, and other equipment furnished under this section or furnished for installation under this section.

B. All items shall be supported from the structural portion of the building and studs, except standard ceiling-mounted lighting fixtures and small devices, that may be supported from ceiling system where permitted by the ENGINEER. However, no sagging of the ceiling will be permitted. Supports and hangers shall be of types approved by Underwriter's Laboratories.

C. Perforated straps and wire are not permitted for supporting electrical devices. Anchors shall be of approved types.

D. All supports, hangers, hardware, etc. used outdoors, shall be stainless steel and in corrosive atmosphere, or in hazardous areas shall be nonferrous, corrosion resistant, or stainless steel. Supports shall be selected to avoid galvanic reactions. Support devices shall be submitted for approval.

3.7 UNDERGROUND WORK

A. Excavation for Electrical Work:

1) Excavation or drilling, backfill and repair of paving and grassing is to be in the bid of the electrical contractor. The actual work need not be performed by electrical trades. However, the electrical contractor is responsible for all excavation, drilling, dewatering, backfilling, tamping, and repair of pavements and grassing required in support of electrical work. All areas disturbed by electrical work shall be repaired to their original conditions, or as indicated on the Drawings.

B. Coordination:

1) The electrical contractor must check for existing utilities before commencing any excavation or drilling. Contract Drawings and other trades are to be consulted to avoid interference with other utilities on this project. In the event of damage to existing utilities, the OWNER and ENGINEER shall be immediately notified, and the damage shall be immediately repaired at no cost to the Owner.

C. Precautions:

1) The electrical contractor must take every reasonable precaution to avoid interferences. In the vicinity of a suspected interference, excavations shall be dug by hand.

D. Excavating, Drilling and Backfilling

1) Materials for backfill shall be as specified in the plans and specifications.

2) Locate and protect existing utilities and other underground work in a manner which will insure that no damage or service interruption will result from excavating and backfilling.

3) Protect property from damage which might result from excavating and backfilling.

4) Protect persons from injury at excavations, by shoring up, and using barricades, warnings and illumination.

5) Coordinate excavations with weather conditions, to minimize the possibility of washouts, settlements, and other damages and hazards.

6) Dewater excavations as necessary. Protect excavations from inflow of surface water. Pump minor inflow of ground water from excavations; protect excavations from major inflow of ground water by installing temporary sheeting and waterproofing. Provide adequate barriers which will protect other excavations and below grade property from being

damaged by water, sediment, or erosion from or through the electrical work excavations.

7) No organic material is permitted in backfill. All vegetation, peat, sod or other organic matter shall be removed from the premises.

8) Except under roadways, backfill material shall be clean sand or shell rock. No debris or trash may be used as backfill.

9) Under roadways, backfill material shall be the same as comprising the roadbed.

10) Backfill excavations using 8-inch high courses of backfill material, uniformly compacted to 95 percent density per ASTM Standard D1557, using power-driven, hand-operated compaction equipment. Watering the backfill for compaction is not an acceptable method.

11) Backfill to elevations matching adjacent grades. Where subsidence is measurable or observable at electrical work excavations during the warranty period, remove the surface (pavement, lawn or other finish) add backfill material, compact, and replace the surface treatment. Restore the appearance, quality, and condition of the surface or finish to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

12) Where excavation and backfill for electrical work passes through or occurs in a landscaped area, repair or replace the landscape work to match the original condition and quality of work.

13) Where excavation and backfill for electrical work passes through or occurs in an area of paving or flooring, replace and restore the construction and finish of the paving or flooring to match the original condition and quality of the work.

E. Underground

1) Underground conduits not under concrete slabs, shall be buried at least two feet below finished grade for circuits rated 600 volts or less, except under traffic areas, conduits shall be buried at least three feet below finished grade.

2) Where steel conduit penetrates ground or concrete, the conduit shall be painted with two coats of asphaltic base paint one foot on each side of penetration.

3) Transition from PVC to RGS shall be made prior to elbow below grade. Paint RGS with bitumastic, 12 inches above and below grade.

3.8 CONCRETE MANHOLES AND PULL BOXES

A. Provide precast concrete manholes and pull boxes as indicated on the drawings. Manholes and pull boxes shall be installed on firmly compacted ground level and plumb at the elevations indicated on the drawings. Manholes and pull boxes shall be equipped with pulling-in irons opposite and below each ductway entrance. Manholes and pull boxes shall have cable supports so that each cable is supported at a minimum of 3 foot intervals within the manhole or pull box. Cable supports shall be fastened with galvanized bolts and shall be fabricated of fiberglass or galvanized steel.

1) Make provision for drainage and grounding. Install grounding rods at each manhole.

B. Traffic Covers

1) H-2-044 traffic rated covers shall be provided for manholes and pull boxes with identification as follows:

a. “ELECTRIC" where voltages within are 600 volts and less.

b. "SIGNAL" for instrumentation, telephone, and control.

C. Covers and frames shall be cast iron or hot dip galvanized.

End bells shall be cast in boxes by precast manhole manufacturer for all conduit entrances indicated on the drawings.

D. Every manhole shall be equipped with 24" x 24" concrete knockouts for future conduit installation on two opposing walls.

3.9 CONDUIT INSTALLATION

A. General

1) Conduits in structural slabs shall be placed between the upper and the lower layers of reinforcing steel, requiring careful bending of conduits. Conduits embedded in concrete slabs shall be spaced not less than eight inches on centers or as widely spaced as possible where they converge at panels or junction boxes. Conduits running parallel to slab supports, such as beams, columns and structural walls, shall be installed not less than 12 inches from such supporting elements. To prevent displacement during concrete pour, saddle supports for conduit, outlet boxes, junction boxes, inserts, etc., shall be secured.

3.10 WIRE AND CABLE INSTALLATION

A. Installation of Cables in Manholes, Handholes, and Vaults. Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths. Form all cables to closely parallel walls, not to interfere with duct entrances, and support on brackets and cable insulators. In existing manholes, handholes and vaults where new ducts are to be terminated, or where new cables are to be installed, the existing installation of cables, cable supports, and grounding shall be modified as required for a neat and workmanlike installation, with all cables properly arranged and supported. Support cable splices in underground structures by racks on each side of the splice. If splicing is approved, locate splices to prevent cyclic bending in the spliced sheath and out of the water. Install cables at middle and bottom of cable racks, leaving top space opening for future cables, except as otherwise indicated. Provide one spare three-insulator rack arm for each cable rack in each underground structure.

B. Cable Markers (or tags) in Manholes and Handholes

1) Provide cable markers or tags for each cable or wire passing through or leaving manholes or handholes and at each terminal. Tags shall be stainless steel, bronze, lead strap, or copper strip, approximately 1/16 inch thick, or hard plastic 1/8 inch thick, suitable for immersion in salt water, and of sufficient length for imprinting the legend on one line, using raised letters not less than 1/4 inch in size, and shall be permanently marked or stamped with the identification as indicated. Use of two color laminated plastic is acceptable. Plastic markers shall be dark in color, and markings shall be light in color to provide contrast so that identification can be easily read. Fastening material shall be of a type that will not deteriorate when exposed to water with a high saline content.

C. All supports, hangers, hardware, etc. used outdoors, shall be stainless steel. In corrosive atmosphere, or in hazardous areas, shall be non-ferrous, corrosion resistant, or stainless steel. Supports shall be selected to avoid galvanic reactions. Support devices shall be submitted for approval.

D. Spare conduits shall be on top or accessible sides and identified uniquely at each location and active conduits shall be located on the bottom unless noted otherwise.

END OF SECTION

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SECTION 16110 - RACEWAY AND BOXES

PART 1 GENERAL

1.1 SCOPE

A. This Section includes basic materials and electrical methods for all of Division 16, Electrical and Related Work.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Concrete - Division 3

PART 2 PRODUCTS

2.1 RACEWAYS AND FITTINGS

A. Rigid Metal Conduit – Hot-dipped galvanized heavy wall rigid steel conduit shall be used on all electrical and instrumentation systems. Conduit shall conform to Federal Specification WW-C-581d and fittings shall conform to Federal Specification W-F-408, Type I and III, Class 1, Style 2.

B. Liquidtight Flexible Metal Conduit – Flexible metal conduit shall be used on all electrical and instrumentation systems. Liquid tight flexible conduit shall conform to NEC Article 350 as manufactured by Appleton, Robroy, or Anaconda. Fittings shall be as manufactured by Midwest or Robroy and conform to Federal Specification W-F-406b, Type I, Class 3.

C. Rigid Non-Metallic Conduit – Polyvinyl chloride (PVC) conduit, boxes and fittings shall conform to NEMA TC-2 and to Military Specifications MIL-C-23571 for Type II, Schedule 40 and shall be used on specified grounding and underground systems only.

D. Wireways and Auxiliary Gutters – Wireways and auxiliary gutters shall be galvanized steel with removable covers unless indicated as hinged. Components shall be as manufactured by Square 'D', Hoffman, Keystone, or General Electric. All wireways shall be without manufactured knockouts.

2.2 BOXES AND ACCESSORIES

A. Sheet steel boxes and accessories shall conform to Federal Specification W-J-800c, as manufactured by Appleton, Steel City, or Raco.

B. Cast metal ferrous outlets shall conform to Federal Specification W-C-568a, as manufactured by Appleton, Pyle-National, or Crouse-Hinds.

C. Pull boxes and junction boxes larger than 4-11/16" shall be constructed of galvanized steel in accordance with NFPA 70, Articles #314. Boxes shall be as manufactured by Hoffman, Boss, or Keystone. All boxes shall be without manufactured knockouts.

D. Cast, malleable iron outlet boxes shall have threaded conduit entrances and gasketed covers. Aluminum-type is not permitted. Boxes shall have a minimum of two hubs on the bottom, as manufactured by Appleton or Crouse-Hinds.

E. Concrete pull boxes shall be of the open bottom type, with an iron, locking cover marked "ELECTRIC" or "SIGNAL" as applicable, and shall be U.L. Listed and meet all codes.

F. Rigid Conduit Coupling – Where rigid steel conduit is used, jointing conduit runs shall be connected by a threaded coupling or three piece couplings. Threadless coupling will not be permitted.

G. Rigid Conduit Bushing – Where rigid steel conduit is used, all terminations in boxes, panels, etc. shall have locknuts on both sides of equipment, with a bonded, grounding bushing.

H. Field Cut Threads – Field-cut threads must be cleaned with oil and painted with a coat of aluminum, or galvanized paint. Newly cut threads that are not coated will have rust or corrosion develop, and will inhibit the grounding path of the conduit run.

I. Conduit Nipples – The use of all-thread is prohibited.

2.3 EXPANSION FITTINGS

A. Any expansion fittings used shall be manufactured by O-Z Electrical Manufacturing Company, and specified as follows: Rigid metal conduit - Type AX; Electrical metallic tubing - Type TX.

B. Miscellaneous – Coatings – Tnemec 46-465

PART 3 EXECUTION

3.1 RACEWAYS

A. Use rigid, non-metallic conduit as follows, unless noted otherwise: Grounding systems and utility systems only.

B. Paint metal conduit in floor slab or in the ground with 2 coats of Tnemec 46-465.

C. Use liquid tight, flexible metal conduit for all connections to vibrating equipment, such as motors, valves, and devices on piping or ductwork. The maximum length shall be restricted to 18" or less, any longer lengths must have approval. It shall be restricted for use within 24 inches above the floor elevation. (A green bonding conductor will be required in all runs, with other conductors.)

D. Install exposed conduit parallel with, or at right angles to the building lines. Conduit larger than 1", except as indicated, in reinforced concrete slabs shall be parallel with, or at right angles to the supports of the slab. Conduit in concrete shall be located so as not to affect the structural strength of the slabs. Conceal all conduits in walls, above ceilings, in or under slabs or in furring, except in mechanical and electrical rooms and as indicated.

E. Route feeders, home runs, and conduits where indicated, except those minor deviations as approved, will be permitted.

F. All conduits that are embedded in concrete, pass through concrete, or stub-up shall have a 30 mil coating of Tnemec 46-465 over its entire length where embedded in concrete, and 12 inches before entering and 12 inches after exiting the concrete.

3.2 BOXES AND ACCESSORIES

A. Minimum size outlet box shall be 4" square by 1-1/2" deep unless otherwise approved or indicated otherwise.

B. Use cast malleable iron boxes for outlets with gasketed covers for all exterior and for all damp locations.

3.3 MISCELLANEOUS

A. Provide approved fire stopping materials at all chases to prevent drafts.

B. Provide expansion fittings in conduit runs crossing expansion joints in the structure.

C. Provide Jet Line #232 in all empty conduits.

D. Rigid Conduit fitting shall be cast, malleable iron, with stamped, galvanized steel, stainless steel screw covers, and gasket for use inside. Outside cast malleable iron galvanized, stainless steel screw and gasket.

END OF SECTION

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SECTION 16120 - CONDUCTORS

PART 1 GENERAL

This Section includes basic materials and methods for all of Division 16, Electrical and Related Work.

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. Signal Conductors

1.2 APPLICABLE REQUIREMENTS

A. NEC 2014, Article 310 and 400

B. F.S. J-C-30

C. F.S. W-S-6106

PART 2 PRODUCTS

2.1 CONDUCTORS

A. Conductors shall conform to Federal Specification J-C-30 for 600 volt, Types THWN/THHW, or XHHW stranded or as shown on the drawings. Sizes are AWG unless otherwise noted.

B. Grounding conductors larger than Size 1 AWG shall be soft drawn, bare copper or insulated copper. Control conductors for 100 to 600 volt shall be size 14 AWG copper, stranded, and color coded unless indicated otherwise.

C. Control conductors for 50 volt and under shall be plastic jacketed thermostat cable, Size 18 AWG single conductor, copper, multi-conductor as required. Fixture wire shall be Type THWN for all through wiring where permitted.

2.2 PORTABLE CORDS

A. Portable cord shall be stranded copper, UL Listed, and resistant to water, acid, and alkalis.

B. Each cord shall have one green covered conductor that shall be used as a grounding conductor.

2.3 SPLICES AND TERMINATIONS

A. Connections shall comply with Federal Specification W-S-610b. Connectors for temperatures to 105NC shall be Ideal Wing Nut or 3M-Scotchloc.

B. Tape shall be Scotch 33 or slip-knot grey. Voids shall be filled with rubber tape or Scotchfill.

C. Terminal boards shall be General Electric, Type CR151, type A2. Lugs for the terminal boards shall be the locking tongue type. Control terminals and motor connections up to size 3 shall be ring tongue type as manufactured by T&B Sta-Kon.

D. Heat shrink for all splices outdoors. Insulating and sealing of all in-line, cable splices from 16 AWG through 1000 kcmil shall be done in accordance with the instructions provided with the Shrink-Kon heat shrinkable insulators, catalog series HS as manufactured by Thomas & Betts.

E. The connector insulator must be made of thermally stabilized, homogeneous polyolefin having internally applied sealant. It must have Underwriter's Listing (UL48, 90NC, 600V) and be approved for the use. It must be usable without additional covering or adhesive, both indoors and outdoors, in overhead, direct buried, or submersed applications at rated voltage. It must not be adversely affected by moisture, ozone, oils, fuels, mild acids and alkalis, or ultraviolet light. It must be compatible with all commonly used cable jacket materials including rubber, plastic, lead, steel, aluminum, and copper. All conductors larger than #10 shall have Noalox Non-Corrosive Paste applied to wires' ends and terminals before connections are made. This will prevent or retard corrosion.

PART 3 EXECUTION

3.1 CONDUCTORS

A. Conductors size 10 AWG and smaller shall be copper and have insulation colored for phases A, B, and N respectively as follows for single phase systems: 120/240 volts, black, red, and white.

B. All-bonding conductors shall have a green covering and shall be the same size as the circuit conductors unless otherwise indicated.

C. Installation of conductors shall be made only in completed raceway systems and all conductors in any conduit shall be pulled in together.

D. Use wire pulling compounds or lubricants as listed by Underwriters' Laboratories or talc, graphite, or soapstone.

3.2 SPLICES AND TERMINATIONS

A. Use solder-less terminal lugs on all standard conductors. Use approved solder-less connectors for all splices. Keep splices to a minimum.

B. Splice all neutrals prior to connection to wiring devices. Splices other than pre-insulated connectors shall be covered neatly with insulation type equivalent in value to the conductor insulation. Use minimum of 2 layers of tape.

3.3 PHASING AND IDENTIFICATION

A. The phase designation of all secondary conductors shall be the same and shall be indicated in or on all 3-phase outlets, transformers, panelboards, and disconnect switches, and they shall be connected with uniform phase sequence.

B. Control wiring shall have a Brady® label or equal attached, secured with a clear piece of heat shrink tubing over the numbers. The numbers shall be attached 1 inch from each end. Tag each individual conductor or wire with a label stating the terminal designation indicated on schematic diagrams, or given on manufacturer's equipment lists, and at each terminal strip, relay, etc.

3.4 NUMBER OF CONDUCTORS

A. For convenience and simplicity, wire tics are shown only on home runs other than power circuits. The Contractor shall determine the correct combination of wires to be run in all raceways including home runs, branch circuit wiring and switch legs.

B. A green ground wire must be included in all conduits. Neutral wires shall be determined by the load and proper phasing on multi-wire branch circuits.

C. All conductors shall have identification per NEC and local codes.

1) Colored tape for feeder conductors should be secured on the conductor with clear piece of heat shrink tubing.

D. Conduit fill shall be sized per National Electric Code.

3.5 TESTING

A. After wiring has been pulled in raceways and before hook-up, wires shall be subject to an insulation test. A Megohmeter of 500 volts shall be used, and a minimum of 10 megohms will be acceptable. Test shall be witnessed by the ENGINEER. A 48-hour notification must be given before test(s) commence. It is typical that wire was abused during installation, usually due to lack of lubrication. The test will reveal any damage to insulation on wiring.

END OF SECTION

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SECTION 16140 - WIRING DEVICES

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. Basic Materials & Methods

1.2 APPLICABLE DOCUMENTS

A. NEMA WD-1 - Wiring Devices, Non-locking

B. NEMA WD-5 - Wiring Devices, locking type

C. F.S. W-S-896c- Toggle Switch

D. F.S. W-P-455a- Wall Plates

PART 2 PRODUCTS

2.1 RECEPTACLES

A. All receptacles shall be the grounding type, tamper resistance and shall conform to applicable portions of NEMA Standards WD-1 and WD-5. Receptacles shall comply with applicable NEC version of the code.

1) NEMA Configuration - #5-20, duplex, Ivory

2) Hubbell #HBL5262ITR

3) Leviton – TDR20-I

4) NEMA Configuration #1050

5) Hubbell - 7512-G receptacle

6) Hubbell - 7118 stainless steel plate

7) Hubbell - 7914 cord set (length as required)

2.2 SWITCHES

A. Toggle switches shall conform to Federal Specification W-S-896c, A.C., only type switch.

1) 20 ampere, 120-277 volt, Ivory

2) Leviton - 1121-I, 1123-I

3) P & P - 521-I, 523-I

2.3 PLATES AND COVERS

A. Wall plates for recessed devices shall conform to Federal Specification W-P-455a and shall be nylon of Ivory color with matching screws unless indicated otherwise, and of the configuration required for the devices installed.

1) Leviton Hubbell or equal

2) Surface (raised) covers for 4" square boxes shall be 1/2" deep.

3) Surface covers shall be as manufactured by Steel City, Appleton or Raco

of the configuration required. Cover plates indicated (WP) weatherproof shall be made of Type 302 stainless steel with stainless steel springs, screws and gaskets. Sierra Series "WP" of the configuration required.

2.4 ATTACHMENT CAPS AND CONNECTORS

A. Caps shall be NEMA Standard mates to the receptacles and connectors used and shall be as manufactured by Hubbell. Provide one cap for each receptacle other than the duplex type.

B. Electrical contractor shall connect all equipment furnished by Owner or other contractors, including caps and cords and materials required to complete the installation.

PART 3 EXECUTION

3.1 INSTALL PLATES AND COVERS ON ALL OUTLETS. INSTALL ALL DEVICES UNIFORMLY IN EACH AREA. USE 20 AMPERE SWITCHES AND RECEPTACLES EVERYWHERE.

3.2 INSTALL A CORD AND CAP (PLUG) ON ALL EQUIPMENT INDICTED "C & P" ON THE SCHEDULES. CONNECT THE TOP HALF OF SPLIT RECEPTACLES HOT AND USE THE BOTTOM AS THE SWITCHED SECTION. TEST EACH SOCKET OF EACH OUTLET WITH A DEVICE INTENDED FOR THIS PURPOSE. GANG SWITCHES AND DIMMERS WERE FEASIBLE.

3.3 MOUNTING HEIGHTS (TO CENTER LINE OF BOX):

A. Generally, mount outlets 18" up unless noted.

B. Mount switches and dimmers at 48" up.

C. Mount outlets over mirrors 8" higher than mirror.

D. Mount outlets over counters and centered in the back splash where it occurs.

E. Adjust outlet heights in ceramic tile walls to be entirely in or entirely out of the tile.

F. Outlets may be horizontal to meet space conditions.

G. Mount exhaust fan thermostats 2' from ceiling and bypass switch 48" from finished floor.

END OF SECTION

SECTION 16180 - SAFETY SWITCHES, CIRCUIT BREAKERS, AND FUSES

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE:

A. Section 16050 - Basic Electrical Materials and Methods

B. Applicable Documents:

1) NEMA AB-1 - Molded Case Circuit Breakers

2) NEMA IC-1 - Industrial Control

3) F.S. W-S-865c - Enclosed Switches

4) F.S. W-C-375a - Circuit Breakers

5) U.L.-198 – Fuses

6) NEMA FU-1 - Fuses

1.2 SUBMITTALS:

A. Submit Shop Drawings for review including catalog cuts showing sizes, types and characteristics of all products.

PART 2 PRODUCTS

2.1 SAFETY SWITCHES/CIRCUIT BREAKER DISCONNECTS:

A. Safety switches shall conform to Federal Specifications W-S-865c, heavy duty type HD, fusible or non-fusible, with the poles, ampere, voltage and horsepower ratings indicated and shall have solid neutrals and Class R clips. Lugs shall be U.L. listed for copper-aluminum.

B. Enclosures for safety switches shall be NEMA-1, general purpose, except that switches indicated (WP) weatherproof, shall be NEMA-3R unless marked NEMA-4X. Provide hubs as required for NEMA-3R enclosures with suitable gaskets and bonding means.

C. Switches and disconnects shall be as manufactured by Square 'D', General Electric, Siemens, or Eaton.

D. Circuit breaker disconnects may be used in lieu of safety switches providing they comply with the safety switch requirements and are applied within their ratings and a schedule is submitted for approval.

2.2 CIRCUIT BREAKERS, MOLDED CASE:

A. Circuit breakers shall conform to Fed. Spec. W-C-375a and NEMA Standard AB-1 unless indicated otherwise. Circuit breakers shall be of the ampere rating, voltage rating, number of poles and class or interrupting capacity (I.C.) as indicated. Interrupting ratings are given in root mean square (RMS), symmetrical amperes based on NEMA test procedures. Lugs and terminals shall be U.L. listed for copper-aluminum. Accessories shall be 120 volt.

B. Each circuit breaker shall have a trip unit for each pole with elements providing inverse time delay under overload conditions and instantaneous magnetic trip for short circuit protection unless indicated as non-automatic. Trip elements shall operate a common trip bar to open all elements.

2.3 FUSES:

A. Provide rejection fuses for all fusible equipment regardless of which section has furnished such equipment.

B. Fuses shall be of the ratings shown on the drawings, U.L. listed and shall be Bussman Manufacturing Co., Gould-Shawmut Company, CEFCO or approved equal.

C. All fuses shall be current limiting and have an interrupting capacity of at least 200,000 amperes RMS symmetrical.

D. The time-current characteristics and ratings shall be such that positive selective coordination is assured.

E. Fuses, 600 amperes and lower, where applied to general feeder and branch circuit protection, shall conform to U.L. Class RK-1 standards and be Bussmann Type LPN-RK-SP LPS-RK-SP, "Low Peak". Gould-Shawmut dual element "Amp-Trap."

F. Fuses, where required for circuit breaker protection shall conform to U.L. Class RK-1 standards and be Bussmann Type LPN-RK-SP or LPS-RK-SP "Low Peak", or Gould-Shawmut Class RK1 "Amp-Trap."

G. Coordination and current limitations or the protection of each part of the electrical system must be designed around the type and class and manufacturer selected for that type and class.

PART 3 EXECUTION

3.1 INSTALLATION:

A. Mount grouped switches, disconnects and controls on backboards or Unistrut. Provide labels on or in all fusible equipment indicating the type and size replacement fuse required.

B. Generally, mount switches and disconnects between 4' and 5' A.F.F., readily accessible.

3.2 FUSES:

A. Install all fuses as required where indicated on the drawings and where required by the National Electrical Code, special attention shall be given to air conditioning equipment.

B. Provide 10% spares (minimum of three) of each size and type of fuses furnished. Spare fuses shall be placed in a wall mounted cabinet equal to: Bussmann SFC which shall be located in the switchgear room.

END OF SECTION

SECTION 16195 - ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes equipment identification labels.

1.3 SUBMITTALS

A. Product Data – For each electrical identification product indicated.

B. Identification Schedule – An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

B. Comply with NFPA 70 - 2014 Edition.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

PART 2 PRODUCTS

2.1 UNDERGROUND-LINE WARNING TAPE

A. Tape

1) Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical, controls and I&C raceways.

2) Printing on tape shall be permanent and shall not be damaged by burial operations.

3) Tape material and ink shall be chemically inert, and not subject to

degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing

1) Comply with ANSI Z535.1 through ANSI Z 535.5.

2) Inscriptions for Red-Colored Tapes: ELECTRIC LINE, LOW VOLTAGE.

3) Inscriptions for Orange-Colored Tapes: I&C CABLE, OPTICAL FIBER CABLE.

2.2 EQUIPMENT IDENTIFICATION LABELS

A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label – Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

PART 3 EXECUTION

3.1 INSTALLATION

A. Verify identification of each item before installing identification products.

B. Location – Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to services that require finish after completing finish work.

D. Self-Adhesive Identification Products – Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Underground-Line Warning Tape – During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.

3.2 IDENTIFICATION SCHEDULE

A. Locations of Underground Lines – Identify with underground-line warning tape for electrical, controls and I&C wiring and optical fiber cable.

B. Equipment Identification Labels – On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems requiring labels include power, lighting, control, and I&C unless equipment is provided with its own identification.

1) Labeling Instructions

a. Indoor Equipment – Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2 inch high letters on 1-1/2 inch high label; where two lines of text are required, use labels 2 inches high. Utilize

white lettering on black background.

b. Outdoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2 inch high letters on 1-1/2 inch high label; where two lines of text are required, use labels 2 inches high. Utilize white lettering on black background.

2) Equipment to be Labeled

a. Enclosures and electrical cabinets

b. Motor Control Centers

c. Enclosed switches

d. Variable Frequency Drives

e. Monitoring and control equipment

END OF SECTION

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SECTION 16450 - GROUNDING

PART 1 GENERAL

1.1 SCOPE

A. This Section includes basic materials and methods for all Division 16 and related electrical work.

1.2 APPLICABLE REQUIREMENTS

A. NEC 2014, Article 250

PART 2 PRODUCTS

2.1 GROUND RODS

A. Ground rods shall be a minimum of 5/8" diameter by 10' length & copper-clad, unless otherwise specified. Grounding accessories shall be as manufactured by Burndy, Erico or Thompson.

PART 3 EXECUTION

3.1 INSTALLATION

A. End to end fixtures shall be continuously bonded. Grounding contact of receptacles shall be connected to a solidly grounded conduit system or to a system grounding conductor (not the system neutral) by a stranded copper wire not smaller than 12 AWG or shall be grounded in some other approved manner.

B. Bond all metal parts. Make equipment and bus connections with suitable lugs or clamps. Cadweld all wire-to-ground rod joints. Cadweld all wire-to-wire joints size 1/0 AWG and over.

C. Bond all conduits stubbing under switchboards, transformers and similar locations using bonding bushings. Bond each conduit separately.

D. Provide a bonding wire from grounding bushings on all conduit terminated at panels, boxes, wireways, panels, etc.

E. Provide a bond wire in all flexible metal conduits and connect to the boxes at each end in an approved manner.

F. Use PVC for sleeving grounding conductors, except that where sleeves are subject to extreme injury use rigid metal conduit bonded at both ends.

G. Ground all separately derived sources such as transformers to adjacent cold water pipe or building steel in accordance with NEC.

H. Grounding of all equipment should be accomplished with lugs equal to T & B "Locktite" one bolt hole tongue #31003 or equal.

I. All conduit to Service entrance equipment and Transfer Switch along with Load Center shall have Grounding Bushing on all metal conduits and ground to box, cabinet, etc. This will give an added protection in grounding all the electrical systems.

END OF SECTION

SECTION 16500 - LIGHTING

PART 1 GENERAL

1.1 SCOPE OF WORK

A. This Section includes the lighting fixtures, lamps, trim, ballasts, poles, bases, accessories.

1.2 APPLICABLE DOCUMENTS

A. UL-57 - Standard of Electric Fixtures

B. FS-W-L-101 - Lamps, Incandescent

C. FS-W-L-116 - Lamps, Fluorescent

D. FS-W-B-30 - Ballasts

E. FS-W-F-414 - Fixtures, Fluorescent

F. I.E.S. - Illuminating Engineering Society Handbook, 10th Edition

1.3 QUALIFICATIONS

A. Photometric data of independent, nationally recognized testing agencies will be accepted. Photometric data of testing laboratories of fixture manufacturers may be accepted if certified.

1.4 SUBMITTALS

A. Submit Shop Drawings for each luminaire assembly consisting of catalog cuts, photometric data, dimensions, ballast data, voltage, materials finish and installation data. For LED lighting fixtures, submit US DOE LED Lighting Facts label, and IES L70 rated life.

B. Submittals shall be in PDF format, indexed and identified in accordance with schedules.

C. Submit wind load calculations on pole assemblies (pole base, pole and fixture) - based on the wind loading requirements of the current edition of the Florida Building Code (F.B.C.). Indicate shape factors, moments and stresses.

D. Certifications; Two weeks prior to final inspection, submit Certification by the Contractor that the exterior lighting systems have been properly installed and tested.

PART 2 PRODUCTS

2.1 FIXTURES, GENERAL REQUIREMENTS

A. Lighting fixtures shall be as indicated or specified. The details, shapes and dimensions are approximate, and variations, when approved, may be made in order to use stock fixtures.

B. Lighting fixtures shall conform to U.L. publication #57, and shall be complete with lamps and all necessary accessories and fittings.

C. Lens frames shall be supported so as to avoid sagging,and shall be readily removable or suitably hinged and latched. Removable frames shall have adequate means of retention for use when servicing.

D. Incandescent Type Lighting Fixtures and Accessories:

1) Incandescent lamps shall have a rating of 120 or 115-125 volts unless specified otherwise, shall be frosted inside except where clear is specified and shall conform to Spec. W-L-101, as manufactured by General Electric or Sylvania. Lampholders (sockets) shall conform to Spec. W-L-142 and shall be intermediate base unless indicated or specified otherwise.

E. Fluorescent Type Light Fixtures and Accessories:

1) Fluorescent Lamps shall be hot-cathode, rapid start, cool white type unless indicated or specified otherwise. The fluorescent lamps shall conform to Spec. W-L-116, and shall be suitable for operation with the ballasts to which they are connected. Fluorescent lamps shall be as manufactured by General Electric or Sylvania. Fluorescent general purpose lighting fixtures shall conform to Federal Specifications W-F-414, and shall be commercial type unless indicated otherwise.

F. LED Type Light Fixture and Accessories:

1) Correlated Color Temperature (CCT): 4000K. Color Rendering Index (CRI): $\geq$ 85. Drivers shall have a minimum efficiency of 85%. Starting Temperature: -40 degrees C (-40 degrees F). Input Voltage: 120 to 480 (±10%) volt. Power Supplies: Class I or II output. Surge Protection: The system must survive 250 repetitive strikes of “C Low” (C Low: 6kV/1.2 x 50 µs, 10kA/8 x 20 µs) waveforms at 1-minute intervals with less than 10% degradation in clamping voltage. “C Low” waveforms are as defined in IEEE/ASNI C62.41.2-2002, Scenario 1 Location Category C. Power Factor (PF): ≥ 0.90. Total Harmonic Distortion (THD): ≤ 20%. Comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards. Drivers shall be reduction of hazardous substances (ROHS)-compliant. The manufacturer shall have performed reliability tests on the LEDs luminaires complying with Illuminating Engineering Society (IES) LM79 for photometric performance and LM80 for lumen maintenance and L70 life.

G. Plastic lenses shall be made of heat-resistant methyl-methacrylate and the lenses shall be injection molded unless indicated otherwise. Provide a fuse holder and fuse in the primary side of each ungrounded conductor in all ballasts, factory installed.

H. Ballasts shall be UL listed, Class P, high power factor and CBM certified by ETL. Multiple lamp ballasts shall operate lamps out of phase with each other.

I. Ballasts shall conform to Federal Specification W-B-30 and shall be as manufactured by one of the following: General Electric, Jefferson, Universal, or Advance.

J. Fluorescent ballasts shall be U.L. Listed, Class P, high power factor and CBM certified by ETL. Multiple lamp ballasts shall operate lamps out of phase with each other. Ballasts conform to Federal Specification W-B-30 and shall be as manufactured by one of the following: General Electric, Jefferson, Universal, or Advance.

K. Control

1) Provide photocell or astronomical time clock and lighting contactor for control of exterior lights.

2.2 POLES

A. Poles shall be as shown on the drawings, and as specified. Finish shall be as specified on the drawings.

B. The pole and arm assembly shall be designed for wind loading as per current version of the Florida Building Code, as required by wind loading conditions at project site, with an additional 30% gust factor and supporting luminaire(s) and accessories such as shields, banner arms, and banners that have the effective projected areas indicated. The effective projected area of the pole shall be applied at the height of the pole base, as shown on the drawings.

C. Poles shall be embedded and/or anchor-bolt type designed for use with underground supply conductors. Poles shall have handhole having a minimum clear opening of 65 x 125 mm (2.5 x 5 inches). Handhole covers shall be secured by stainless steel captive screws.

D. Provide a steel-grounding stud opposite handhole openings, designed to prevent electrolysis when used with copper wire.

E. Provide a base cover that matches the pole in material and color to conceal the mounting hardware pole-base welds and anchor bolts.

F. Hardware and Accessories: All necessary hardware and specified accessories shall be the product of the pole manufacturer.

G. Provide manufacturer's standard finish, as scheduled on the drawings.

H. Types: (Refer to construction plan documents)

1) Aluminum: Provide specified aluminum poles manufactured of corrosion-resistant AA AAH35.1 aluminum alloys conforming to AASHTO LTS-4. Poles shall be seamless extruded or spun seamless type.

2) Steel: Provide specified steel poles having minimum 11-gauge steel with minimum yield/strength of 48,000 psi and// hot-dipped galvanized// //iron-oxide primed// factory finish. //Galvanized steel poles shall comply with ASTM A123 and A153.

3) Concrete: Provide specified concrete poles conforming to ASTM C1089 with integral cast bases. Poles shall have hollow core suitable as a raceway.

2.3 FOUNDATIONS FOR POLES

A. Foundations shall be cast-in-place concrete, having 3000 psi minimum 28-day compressive strength. Pre-cast concrete base will be acceptable.

B. Foundations shall support the effective projected area of the specified pole, arm(s), luminaire(s), and accessories, such as shields, banner arms, and banners, under wind conditions previously specified in this section.

C. Place concrete in spirally-wrapped treated paper forms for round foundations, and construct forms for square foundations.

D. Rub-finish and round all above-grade concrete edges to approximately 6 mm (0.25-inch) radius.

E. Anchor bolt assemblies and reinforcing of concrete foundations shall be as shown on the drawings. Anchor bolts shall be in a welded cage or properly positioned by the tie-wire to stirrups.

F. Prior to concrete pour, install electrode per Section 1640, GROUNDING.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install lighting in accordance with the NEC, as shown on the drawings, and in accordance with manufacturer's recommendations.

B. Pole Foundations:

1) Excavate only as necessary to provide sufficient working clearance for installation of forms and proper use of tamper to the full depth of the excavation. Prevent surface water from flowing into the excavation. Thoroughly compact backfill with compacting arranged to prevent pressure between conductor, jacket, or sheath, and the end of conduit.

2) Set anchor bolts according to anchor-bolt templates furnished by the pole manufacturer.

3) Install poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location.

4) After the poles have been installed, shimmed, and plumbed, grout the spaces between the pole bases and the concrete base with non-shrink concrete grout material. Provide a plastic or copper tube, of not less than 9 mm (0.375-inch) inside diameter through the grout, tight to the top of the concrete base to prevent moisture weeping from the interior of the pole.

5) Adjust luminaires that require field adjustment or aiming.

3.2 GROUNDING

A. Ground noncurrent-carrying parts of equipment, including metal poles, luminaires, mounting arms, brackets, and metallic enclosures, as specified in Section 1640, GROUNDING. Where copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable and listed for this purpose

3.3 ACCEPTANCE CHECKS AND TESTS

A. Verify operation after installing luminaires and energizing circuits.

END OF SECTION

APPENDIX "A" – REPORT OF GEOTECHNICAL INVESTIGATION

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REPORT OF LIMITED GEOTECHNICAL EXPLORATION

PROPOSED STREET ENHANCEMENTS
NE 32 STREET AND NE 33RD STREET
WEST OF N. OCEAN BLVD. AND EAST OF NE 33RD AVE.
FORT LAUDERDALE, FLORIDA

FOR

CALVIN, GIORDANO & ASSOCIATES, INC.
1800 ELLER DRIVE
SUITE 600
FORT LAUDERDALE, FLORIDA 33316

PREPARED BY

NUTTING ENGINEERS OF FLORIDA, INC.
1310 NEPTUNE DRIVE
BOYNTON BEACH, FLORIDA 33426

ORDER NO. 11036.77

JULY 2019

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July 15, 2019

Mr. Nico Kanelidis, P.E.
Calvin Giordano and Associates, Inc.
1800 Eller Drive, Suite 600
Fort Lauderdale, Florida 33316
Phone: 954-921-7781 Email: nkanelidis@cgasolutions.com

Subject: Report of Limited Geotechnical Exploration
Proposed Street Enhancements
NE 32nd Street and NE 33rd Street
West of North Ocean Boulevard and East of NE 33rd Avenue
Fort Lauderdale, Florida

Dear Mr. Kanelidis:

Nutting Engineers of Florida, Inc. (NE), has performed a Limited Geotechnical Exploration for the proposed street enhancements in Fort Lauderdale, Florida. This exploration was performed in accordance with the written authorization to proceed provided by Calvin Giordano and Associates, Inc. dated June 6, 2019. This study was performed to develop information regarding existing subsurface conditions at specific test locations. This information along with proposed construction information provided was used to develop opinions regarding the pavement. This report presents our findings and recommendations based upon the information examined at the time of this evaluation.

PROJECT INFORMATION

Based on discussions with you, we understand that plans include replacing some median curbing, landscaped curbing, along with the mill and resurface of the above referenced roadways. Some new drainage designs may also be performed which may require regrading of the roadways as well; therefore an understanding of existing pavement sections was desired. Based on this, some information pertaining to the existing site subsurface soils for roadways were needed.

Based on current site elevations and review of plans provided to our office, we estimate that existing grades are within approximately six inches of final elevations; however, the final elevations shall be determined by a civil engineer, or other qualified party. NE should be notified in writing by the client of any changes in the proposed construction along with a request to amend our analysis and/or recommendations within.

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Broward (954) 941-8700 · Port St. Lucie (772) 408-1050 · Miami Dade (305) 624-0060

GENERAL SUBSURFACE CONDITIONS

Soil Survey Maps

As part of the geotechnical exploration, we have reviewed available Natural Resources Conservation Service (NRCS) online soil survey map for Broward County. The USDA online NRCS mapping provides qualitative information about potential general shallow soil conditions in the project vicinity. This information was derived from approximately 6 ft. deep manual auger borings, aerial photo and surface feature interpretation at some point in the past. The NRCS data may or may not reflect actual current site conditions. As indicated in the online Soil Survey Mapping at the time the survey was conducted, one main soil description was identified within the subject roadway section. The soil type was described as Urban land. This map unit consists of areas that are more than 70 percent covered by shopping centers, parking lots, large buildings, streets, and sidewalks, and other structures, so that the natural soils are not readily observable. These soils are best described as Hallandale, Margate, and Basinger series that have been altered by fill spread on the surface to an average thickness of approximately 12 inches. We note that the maximum depth of the survey is six feet.

Subsurface Exploration

NUTTING ENGINEERS OF FLORIDA, INC. performed four Standard Penetration Test (SPT) borings (ASTM D-1586) to depths of fifteen feet below the land surface. In addition. in order to better identify the pavement section materials and thicknesses, six, 6-inch pavement section cores were also performed along the roadway. Four of the cores were performed at the four test boring locations (B-1, B-2, B-4, and B-6), while two additional cores were performed (B-3 and B-5) as requested by your office. We note that the number of borings/cores and locations were determined by Calvin Giordano and Associates, Inc. based on the provided site plan. The boring/core locations were identified in the field using approximate methods; namely, a measuring wheel and available surface controls. As such the soil boring locations should be considered to be approximate.

Asphalt Core Findings

In summary, the thicknesses of the asphalt average approximately two and a half to three and a half inches along NE 33rd Street, while the asphalt thickness was approximately one to one and three-quarters inches along NE 32nd Street. The asphalt was generally observed to consist of one or two lifts of asphalt material. The cores along NE 33rd Street were generally observed to be in good condition and did not have indicators of possible fatigue or failure, while the cores along NE 32nd Street were good in core C-4 and C-5; however the core was poor in C-6. Please refer to the Report of Asphalt Thickness presented in the appendix section of this report for individual results.

The base course consisted of sand and limestone fragments and was found to be approximately four to six inches in thickness. Confirmation of actual LBR value of the base course was not part of our scope of services but may be desired if further evaluation is warranted. We note that below the base course a subbase course consisting of sand soils with trace limestone fragments was present.

Test Boring Results

In general, the soil boring locations recorded below the asphalt pavement section loose to medium dense brown sand and shell (beach sand like) to a depth of fifteen feet, the maximum depth explored. Please see the enclosed soil classification sheet in the Appendix of this report for additional important information regarding these descriptions, the field evaluation and other related information.

Note: Substantially different subsurface conditions may exist at other areas of the site. Buried debris may or may not be identified or adequately delineated by soil borings. Test pit excavation can provide more insight into such conditions and rock lithology if present. Such conditions may be revealed during site development activities (e.g. proof rolling, utility & foundation excavation activities) or other related activities. Should additional assurance be desired by the client, further subsurface investigation could be performed.

Groundwater Information

The immediate groundwater level was measured at the boring locations at the time of drilling. The groundwater level was encountered at an approximate depth of eight feet below the existing ground surface.

The immediate depth to groundwater measurements presented in this report will not provide a reliable indication of stabilized or more long term depth to groundwater at this site. Water table elevations can vary dramatically with time through rainfall, droughts, storm events, flood control activities, nearby surface water bodies, tidal activity, pumping and many other factors. For these reasons, this immediate depth to water data **should not** be relied upon alone for project design considerations.

ANALYSIS AND RECOMMENDATIONS

The test borings performed for the site suggest that the existing site soils appear suitable for development of the new curbing, mill and replacement of asphalt pavement sections, or development of new asphalt pavement sections. Any existing topsoil soils and/or debris shall be removed prior to development of the new features.

In general, pavement areas should be compacted to a minimum of 98 percent of the modified Proctor maximum dry density to a depth of at least 12 inches below the subgrade level. We recommend that stabilized subgrade having a minimum Limerock Bearing Ratio (LBR) of 40 be placed to a depth of approximately one foot below the base course.

The base course will range from approximately 6 to 8 inches and should have a minimum LBR of 100. The pavement material and thickness should be based on design requirements as determined by the project Civil Engineer.

This concludes our scope of services for the project. If additional information is needed or engineering analysis is required, please contact our office to further discuss this project.

GENERAL INFORMATION

Our client for this geotechnical evaluation was:

Mr. Nico Kanelidis, P.E.
Calvin Giordano and Associates, Inc.
1800 Eller Drive, Suite 600
Fort Lauderdale, Florida 33316

The contents of this report are for the exclusive use of the client, the client's design & construction team and governmental authorities for this specific project exclusively. Information conveyed in this report shall not be used or relied upon by other parties or for other projects without the expressed written consent of Nutting Engineers of Florida, Inc. This report discusses geotechnical considerations for this site based upon observed conditions and our understanding of proposed construction for foundation support. Environmental issues including (but not limited to), soil and/or groundwater contamination, and other environmental considerations are beyond our scope of service for this project. As such, this report should not be used or relied upon for evaluation of environmental issues.

Prior to initiating compaction operations, we recommend that representative samples of the structural fill material to be used and acceptable in-place soils be collected and tested to determine their compaction and classification characteristics. The maximum dry density, optimum moisture content, gradation and plasticity characteristics should be determined. These tests are needed for compaction quality control of the structural fill and existing soils, and to determine if the fill material is acceptable.

If conditions are encountered which are not consistent with the findings presented in this report, or if proposed construction is moved from the location investigated, this office shall be notified immediately so that the condition or change can be evaluated and appropriate action taken.

The vibratory compaction equipment may cause vibrations that could be felt by persons within nearby buildings and could potentially induce structural settlements. Additionally, preexisting settlements may exist within these structures that could be construed to have been caused or worsened by the proposed vibratory compaction after the fact. Pre- and post conditions surveys of these structures along with the vibration monitoring during vibratory compaction could be performed to better evaluate this concern.

The contractor should exercise due care during the performance of the vibratory compaction work with due consideration of potential impacts on existing structures. If potential vibrations and impacts are not considered tolerable, then alternate foundation modification techniques should be considered.

The Geotechnical Engineer warrants that the findings and professional advice contained herein, have been presented after being prepared in accordance with general accepted professional practice in the field of foundation engineering, soil mechanics and engineering geology. No other warranties are implied or expressed.

We appreciate the opportunity to be of service on this project. If we can be of any further assistance, or if you need additional information, please contact us at your convenience.

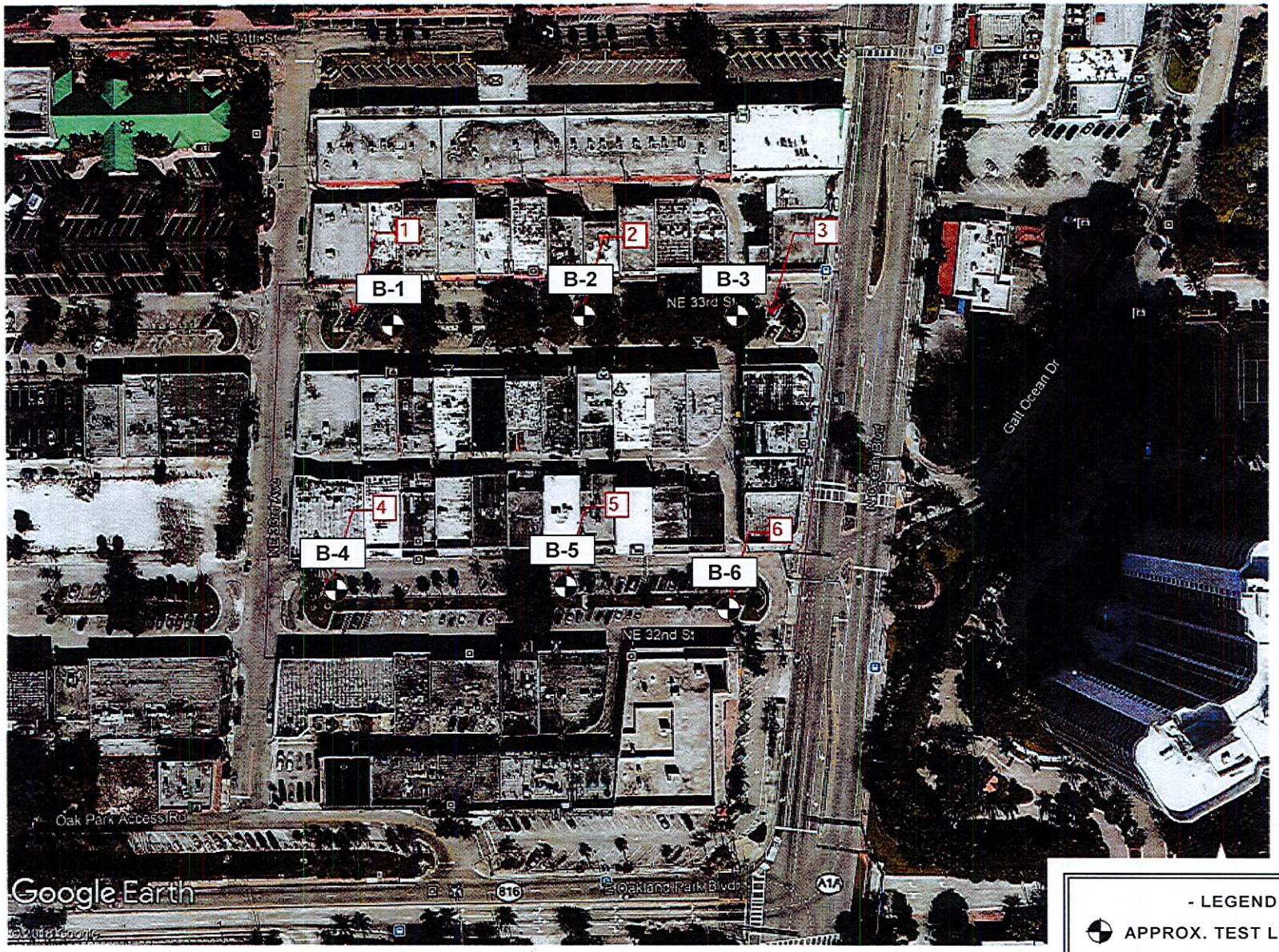
Sincerely,
NUTTING ENGINEERS OF FLORIDA, INC.

Richard C. Wohlfarth, P.E.
Director of Engineering

Christopher E. Gworek, P.E. #69947
Senior Engineer

Appendix: Boring Location Plan
Report of Asphalt Thickness
Test Boring Results
Limitations of Liability
Soil Classification Criteria

REP CALVIN GIORDANO NE 32-33 STREET ENHANCE FLL ASPHALT CEG



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Calvin Giordano & Associates, Inc.
Street Enhancements
NE 32nd Street and NE 33rd Street
Fort Lauderdale, Florida
ORDER NO. 11036.77

APPROXIMATE TEST LOCATION PLAN

GEOTECHNICAL EXPLORATION
— Not to Scale —

FIG. 1

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REPORT OF ASPHALT THICKNESS

Client: Calvin Giordano & Associates, Inc.
Project Name: Street Enhancements
Project Location: NE 32nd Street and NE 33rd Street, West of N. Ocean Blvd., Fort Lauderdale, Fl
Order No. 11036.77

Asphalt Core No.	Thickness #1	Thickness #2	Thickness #3	Thickness #4	Average Thickness (inches)	Base Course Thickness (Approx. inches)
C-1	2.404	2.393	2.543	2.453	2.45	6
C-2	3.563	3.597	3.697	3.637	3.62	4
C-3	2.635	2.597	2.541	2.573	2.59	6
C-4	1.770	1.870	1.798	1.739	1.79	4
C-5	1.213	1.450	1.342	1.360	1.34	6
C-6	1.044	0.955	1.160	1.074	1.058	5

Note: Asphalt Thickness was Determined Using Caliper. Base Course measured as an approximate.

TABLE ASPHALT THICKNESS CALGIO NE 32-33 ST FLL CEG

1310 Neptune Drive • Boynton Beach, Florida 33426 • (561) 736-4900 • Fax (561) 737-9975
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BORING NUMBER B-1

PROJECT NUMBER 11036.77
CLIENT Calvin Giordano & Associates, Inc.
PROJECT NAME Street Enhancements
PROJECT LOCATION NE 32nd Street and NE 33rd Street, Fort Lauderdale, Florida

DATE STARTED 6/29/19 COMPLETED 6/29/19
SURFACE ELEVATION REFERENCE Approx. @ Road Crown
DRILLING METHOD Standard Penetration Boring
GROUND WATER LEVELS:
LOGGED BY T. Lovett CHECKED BY C. Gworek
▽ AT TIME OF DRILLING 8.0 ft
APPROXIMATE LOCATION OF BORING As located on site plan

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	Blows	N-Value
0		ASPHALT 3", basecourse 7"			
		Lt. brown fine SAND	AU 1		
			AU 2		
5			SS 3	8-7-8-9	15
			SS 4	6-6-3-4	9
		▽ Gray fine SAND	SS 5	2-1-4-8	5
10			SS 6	4-6-7-8	13
			SS 7	6-6-9-10	15
15		Bottom of hole at 15.0 feet.			

▲ SPT N VALUE ▲
10 20 30 40
PL MC LL
20 40 60 80
□ FINES CONTENT (%) □
20 40 60 80

TEST NUTTING BOREHOLE 1-11036.77 CALVIN GIORDANO & ASSOCIATES - STREET ENHANCEMENTS NE 32ND STREET & NE 33RD STREET FORT LAUDERDALE.GPJ GINT US.GDT 7/8/19

Disclaimer Nutting Engineers of Florida, Inc. accepts no liability for the consequences of the independent interpretation of drilling logs by others.

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Boynton Beach, Fl., 33426
Telephone: 561-736-4900
Fax: 561-737-9975

BORING NUMBER B-2

PROJECT NUMBER 11036.77
CLIENT Calvin Giordano & Associates, Inc.
PROJECT NAME Street Enhancements
PROJECT LOCATION NE 32nd Street and NE 33rd Street, Fort Lauderdale, Florida

DATE STARTED 6/29/19 COMPLETED 6/29/19
SURFACE ELEVATION REFERENCE Approx. @ Road Crown
DRILLING METHOD Standard Penetration Boring
GROUND WATER LEVELS:
LOGGED BY T. Lovett CHECKED BY C. Gworek
▽ AT TIME OF DRILLING 8.0 ft
APPROXIMATE LOCATION OF BORING As located on site plan

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	Blows	N-Value	▲ SPT N VALUE ▲ 10 20 30 40 / PL MC LL 20 40 60 80 / □ FINES CONTENT (%) □ 20 40 60 80
0		ASPHALT 4", basecourse 6"				
		Lt. brown fine SAND	AU 1			
			AU 2			
5			SS 3	7-7-7-8	14	▲
			SS 4	6-5-4-4	9	▲
		▽ Gray fine SAND and SHELL	SS 5	2-2-4-6	6	▲
10			SS 6	5-5-8-8	13	▲
15			SS 7	5-6-10-12	16	▲
		Bottom of hole at 15.0 feet.				

TEST NUTTING BOREHOLE 1-11036.77 CALVIN GIORDANO & ASSOCIATES - STREET ENHANCEMENTS NE 32ND STREET & NE 33RD STREET FORT LAUDERDALE.GPJ GINT US.GDT 7/8/19

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Fax: 561-737-9975

BORING NUMBER B-3

PROJECT NUMBER 11036.77

CLIENT Calvin Giordano & Associates, Inc. PROJECT NAME Street Enhancements

PROJECT LOCATION NE 32nd Street and NE 33rd Street, Fort Lauderdale, Florida

DATE STARTED 6/29/19 COMPLETED 6/29/19 SURFACE ELEVATION REFERENCE Approx. @ Road Crown

DRILLING METHOD Auger Boring GROUND WATER LEVELS:

LOGGED BY T. Lovett CHECKED BY C. Gworek AT TIME OF DRILLING >0.9'

APPROXIMATE LOCATION OF BORING As located on site plan

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	Blows	N-Value	▲ SPT N VALUE ▲ 10 20 30 40 / PL MC LL 20 40 60 80 / □ FINES CONTENT (%) □ 20 40 60 80
0		ASPHALT 3", basecourse 5"	AU 1			
		Lt. brown fine SAND				
		Bottom of hole at 0.9 feet.				

TEST NUTTING BOREHOLE 1-11036.77 CALVIN GIORDANO & ASSOCIATES - STREET ENHANCEMENTS NE 32ND STREET & NE 33RD STREET FORT LAUDERDALE.GPJ GINT US.GDT 7/8/19

Disclaimer Nutting Engineers of Florida, Inc. accepts no liability for the consequences of the independent interpretation of drilling logs by others.

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Boynton Beach, Fl., 33426
Telephone: 561-736-4900
Fax: 561-737-9975

BORING NUMBER B-4

PROJECT NUMBER 11036.77

CLIENT Calvin Giordano & Associates, Inc.

PROJECT NAME Street Enhancements

PROJECT LOCATION NE 32nd Street and NE 33rd Street, Fort Lauderdale, Florida

DATE STARTED 6/29/19 COMPLETED 6/29/19

SURFACE ELEVATION REFERENCE Approx. @ Road Crown

DRILLING METHOD Auger Boring

GROUND WATER LEVELS:

LOGGED BY T. Lovett CHECKED BY C. Gworek

▽ AT TIME OF DRILLING 8.0 ft

APPROXIMATE LOCATION OF BORING As located on site plan

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	Blows	N-Value
0		ASPHALT 2", basecourse 5"	AU 1		
		Lt. brown coarse SAND	AU 2		
5			SS 3	9-9-8-7	17
		Lt. brown coarse SAND and SHELL	SS 4	8-9-8-9	17
		▽	SS 5	5-5-5-8	10
10			SS 6	4-5-6-7	11
			SS 7	5-7-10-14	17
15		Bottom of hole at 15.0 feet.			

▲ SPT N VALUE ▲
10 20 30 40
PL MC LL
20 40 60 80
□ FINES CONTENT (%) □
20 40 60 80

TEST NUTTING BOREHOLE 1-11036.77 CALVIN GIORDANO & ASSOCIATES - STREET ENHANCEMENTS NE 32ND STREET & NE 33RD STREET FORT LAUDERDALE.GPJ GINT US.GDT 7/8/19

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BORING NUMBER B-5

PROJECT NUMBER 11036.77
CLIENT Calvin Giordano & Associates, Inc. PROJECT NAME Street Enhancements
PROJECT LOCATION NE 32nd Street and NE 33rd Street, Fort Lauderdale, Florida

DATE STARTED 6/29/19 COMPLETED 6/29/19 SURFACE ELEVATION REFERENCE Approx. @ Road Crown
DRILLING METHOD Auger Boring GROUND WATER LEVELS:
LOGGED BY T. Lovett CHECKED BY C. Gworek AT TIME OF DRILLING >0.8'
APPROXIMATE LOCATION OF BORING As located on site plan

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	Blows	N-Value	▲ SPT N VALUE ▲ 10 20 30 40 / PL MC LL 20 40 60 80 / □ FINES CONTENT (%) □ 20 40 60 80
0		ASPHALT 2", basecourse 5"	AU 1			
		Lt. brown fine SAND				
		Bottom of hole at 0.8 feet.				

TEST NUTTING BOREHOLE 1-11036.77 CALVIN GIORDANO & ASSOCIATES - STREET ENHANCEMENTS NE 32ND STREET & NE 33RD STREET FORT LAUDERDALE.GPJ GINT US.GDT 7/8/19

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BORING NUMBER B-6

PROJECT NUMBER 11036.77
CLIENT Calvin Giordano & Associates, Inc.
PROJECT NAME Street Enhancements
PROJECT LOCATION NE 32nd Street and NE 33rd Street, Fort Lauderdale, Florida

DATE STARTED 6/29/19 COMPLETED 6/29/19
SURFACE ELEVATION REFERENCE Approx. @ Road Crown
DRILLING METHOD Auger Boring
GROUND WATER LEVELS:
LOGGED BY T. Lovett CHECKED BY C. Gworek
▽ AT TIME OF DRILLING 8.0 ft
APPROXIMATE LOCATION OF BORING As located on site plan

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	Blows	N-Value
0		ASPHALT 1", basecourse 5"			
		Lt. brown coarse SAND	AU 1		
			AU 2		
5			SS 3	10-12-15-15	27
		Lt. brown coarse SAND and SHELL	SS 4	8-10-9-10	19
		▽	SS 5	4-5-6-9	11
10			SS 6	5-6-8-7	14
		Gray coarse SAND and SHELL	SS 7	6-7-10-10	17
15		Bottom of hole at 15.0 feet.			

▲ SPT N VALUE ▲
10 20 30 40
PL MC LL
20 40 60 80
□ FINES CONTENT (%) □
20 40 60 80

TEST NUTTING BOREHOLE 1-11036.77 CALVIN GIORDANO & ASSOCIATES - STREET ENHANCEMENTS NE 32ND STREET & NE 33RD STREET FORT LAUDERDALE.GPJ GINT US.GDT 7/8/19

Disclaimer Nutting Engineers of Florida, Inc. accepts no liability for the consequences of the independent interpretation of drilling logs by others.

LIMITATIONS OF LIABLILITY

WARRANTY

We warranty that the services performed by Nutting Engineers of Florida, Inc. are conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession in our area currently practicing under similar conditions at the time our services were performed. ***No other warranties, expressed or implied, are made***. While the services of Nutting Engineers of Florida, Inc. are a valuable and integral part of the design and construction teams, we do not warrant, guarantee or insure the quality, completeness, or satisfactory performance of designs, construction plans, specifications we have not prepared, nor the ultimate performance of building site materials or assembly/construction.

SUBSURFACE EXPLORATION

Subsurface exploration is normally accomplished by test borings; test pits are sometimes employed. The method of determining the boring location and the surface elevation at the boring is noted in the report. This information is represented in the soil boring logs and/or a drawing. The location and elevation of the borings should be considered accurate only to the degree inherent with the method used and may be approximate.

The soil boring log includes sampling information, description of the materials recovered, approximate depths of boundaries between soil and rock strata as encountered and immediate depth to water data. The log represents conditions recorded specifically at the location where and when the boring was made. Site conditions may vary through time as will subsurface conditions. The boundaries between different soil strata as encountered are indicated at specific depths; however, these depths are in fact approximate and dependent upon the frequency of sampling, nature and consistency of the respective strata. Substantial variation between soil borings may commonly exist in subsurface conditions. Water level readings are made at the time and under conditions stated on the boring logs. Water levels change with time, precipitation, canal level, local well drawdown and other factors. Water level data provided on soil boring logs shall not be relied upon for groundwater based design or construction considerations.

LABORATORY AND FIELD TESTS

Tests are performed in *general* accordance with specific ASTM Standards unless otherwise indicated. All criteria included in a given ASTM Standard are not always required and performed. Each test boring report indicates the measurements and data developed at each specific test location.

ANALYSIS AND RECOMMENDATIONS

The geotechnical report is prepared primarily to aid in the design of site work and structural foundations. Although the information in the report is expected to be sufficient for these purposes, it shall not be utilized to determine the cost of construction nor to stand alone as a construction specification. Contractors shall verify subsurface conditions as may be appropriate prior to undertaking subsurface work.

Report recommendations are based primarily on data from test borings made at the locations shown on the test boring reports. Soil variations commonly exist between boring locations. Such variations may not become evident until construction. Test pits sometimes provide valuable supplemental information that derived from soil borings. If variations are then noted, the geotechnical engineer shall be contacted in writing immediately so that field conditions can be examined and recommendations revised if necessary.

The geotechnical report states our understanding as to the location, dimensions and structural features proposed for the site. ***Any significant changes of the site improvements or site conditions must be communicated in writing to the geotechnical engineer immediately*** so that the geotechnical analysis, conclusions, and recommendations can be reviewed and appropriately adjusted as necessary.

CONSTRUCTION OBSERVATION

Construction observation and testing is an important element of geotechnical services. The geotechnical engineer's field representative (G.E.F.R.) is the "owner's representative" observing the work of the contractor, performing tests and reporting data from such tests and observations. ***The geotechnical engineer's field representative does not direct the contractor's construction means, methods, operations or personnel.*** The G.E.F.R. does not interfere with the relationship between the owner and the contractor and, except as an observer, does not become a substitute owner on site. The G.E.F.R. is responsible for his/her safety, but has no responsibility for the safety of other personnel at the site. The G.E.F.R. is an important member of a team whose responsibility is to observe and test the work being done and report to the owner whether that work is being carried out in general conformance with the plans and specifications. The enclosed report may be relied upon solely by the named client.

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SOIL AND ROCK CLASSIFICATION CRITERIA

SAND/SILT

N-VALUE (bpf)	RELATIVE DENSITY
0 – 4	Very Loose
5 – 10	Loose
11 – 29	Medium
30 – 49	Dense
>50	Very dense
100	Refusal

CLAY/SILTY CLAY

N-VALUE (bpf)	UNCONFINED COMP. STRENGTH (tsf)	CONSISTENCY
<2	<0.25	v. Soft
2 – 4	0.25 – 0.50	Soft
5 – 8	0.50 – 1.00	Medium
9 – 15	1.00 – 2.00	Stiff
16 – 30	2.00 – 4.00	v. Stiff
>30	>4.00	Hard

ROCK

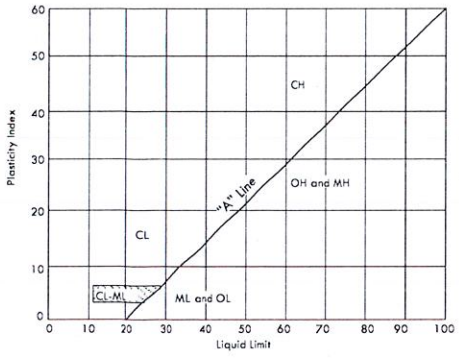
N-VALUE (bpf)	RELATIVE HARDNESS	ROCK CHARACTERISTICS
N≥ 100	Hard to v. hard	Local rock formations vary in hardness from soft to very hard within short vertical and horizontal distances and often contain vertical solution holes of 3 to 36 inch diameter to varying depths and horizontal solution features. Rock may be brittle to split spoon impact, but more resistant to excavation.
25≤ N ≤ 100	Medium hard to hard	
5≤ N ≤ 25	Soft to medium hard	

PARTICLE SIZE

Boulder	>12 in.
Cobble	3 to 12 in.
Gravel	4.76 mm to 3 in.
Sand	0.074 mm to 4.76 mm
Silt	0.005 mm to 0.074 mm
Clay	<0.005 mm

DESCRIPTION MODIFIERS

0 – 5%	Slight trace
6 – 10%	Trace
11 – 20%	Little
21 – 35%	Some
>35%	And

Major Divisions			Group Symbols	Typical names	Laboratory classification criteria
Coarse-grained soils (More than half of material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravels (Little or no fines)	GW	Well-graded gavels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: Less than five percent……GW, GP, SW, SP; More than 12 percent……GM, GC, SM, SC; 5 to 12 percent……*Borderline cases requiring dual systems***
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_z = \frac{(D_{30})^2}{D_{10} x D_{60}}$ *between* 1 and 3
		Gravels with fines (Appreciable amount of fines)	GW* d / u	Silty gravels, gravel-sand-silt mixtures	Not meeting all gradation requirements for GW
			GC	Clayey gravels, gravel-sand-clay mixtures	Atterberg limits below "A" line or P.I. less than 4 / Atterberg limits above "A" line with P.I. greater than 7 — Above "A" line with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols.
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_z = \frac{(D_{30})^2}{D_{10} x D_{60}}$ *between* 1 and 3
			SP	Poorly graded sands, gravelly sands, little or no fines	Not meeting all gradation requirements for SW
		Sands with fines (Appreciable amount of fines)	SM* d / u	Silty sands, sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4 / Atterberg limits above "A" line with P.I. more than 7 — Limits plotting in hatched zone with P.I. between 4 and 7 are *borderline* cases requiring use of dual system.
			SC	Clayey sands, sand-clay mixtures	
Fine-grained soils (More than half of material is smaller than No. 200 sieve size)	Silts and clays (Liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy, clays, silty clays, lean clays	
			OL	Organic silts and organic silty clays of low plasticity	
	Silts and clays (Liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	
			CH	Inorganic clays or high plasticity, fat clays	
			OH	Organic clays of medium to high plasticity, organic silts	
	Highly organic soils		PT	Peat and other highly organic soils	

Plasticity Chart

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