DIVISION 22 – PLUMBING SPECIFICATIONS

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SECTION 22 01 00 - PLUMBING GENERAL

PART 1 GENERAL

1.1 STIPULATIONS

A. Drawings and general provisions of the contract documents including General and Supplementary Conditions and Division 1 Specification Section apply to all work in this section.

B. The General Conditions shall be carefully examined before proposals for any work are submitted. Division 22 shall not be interpreted as waiving or overruling any requirements expressed in the General Conditions unless Division 22 specifications contain statements more definitive or more restrictive.

C. Nothing herein contained shall be so construed to relieve the Contractor from doing his work according to the true intent and meaning of these drawings and specifications. He will be held to provide and install all materials and equipment and shall furnish all labor necessary for the complete, prompt and satisfactory execution of the work. He is also responsible for the proper coordination of his work with all other trades.

D. The Contractor shall bear all expenses incidental to the satisfactory completion of the work contained in these specifications and drawings.

1.2 SCOPE

A. Work consists of furnishing all labor, material, equipment and services necessary and reasonably incidental to the proper completion and proper operation of the plumbing systems. The work shall consist of but shall not necessarily be limited to the following:

1. Domestic water system including extension of piping and connections to all equipment, fixtures, water heaters, and accessories. The Domestic water system shall be extended from a point 5 (five) feet beyond the exterior face of the building.
2. Sanitary drain, waste and vent system including connection to all equipment, fixtures, and accessories. The sanitary system shall be extended to a point 5 (five) feet beyond the exterior face of the building. Final installation at the point of connection shall be made.
3. Plumbing Piping as specified in Section 22 05 03.
4. Plumbing Specialties as specified in Section 22 05 08.
5. Plumbing Fixtures as specified in Section 22 40 00.

1.3 DEFINITIONS

A. Words and phrases used throughout the contract documents shall be interpreted as indicated below:

1. Contractor - The person or organization awarded the contract for construction services. In the case of a construction project administered as a multiple-prime contract, the term shall be further defined as the Contractor holding a prime contract for plumbing construction work. The term “Plumbing Contractor” is used interchangeably with the term Contractor.
2. Provide - To furnish and install materials, equipment or systems.
3. Submittals - Submittals shall include manufacturers’ catalog data, shop drawings, calculations, certificates of compliance, testing reports, samples, and operation and maintenance manuals.
4. Professional - The Engineer of record.
5. Work By Others - Work provided by a person or organization other than the Contractor.

1.4 CODES, REFERENCES AND STANDARDS

A. The Contractor shall comply with all laws, ordinances, and regulations of all authorities having jurisdiction, including those of all applicable city, county, state, federal and public utility entities. The Contractor shall obtain

all licenses, permits, etc. and shall pay all associated connection fees, tapping fees, inspection fees, etc. This cost shall be included in the contract price.

B. The publications listed below form a part of this specification. All publications shall be the latest edition as adopted by the authority having jurisdiction. The minimum standard of work under this contract shall be in accordance with the following model building codes:

1. North Carolina State Building Code:

   a. Building, 2012 edition

   b. Plumbing, 2012 edition

   c. Mechanical, 2012 edition

   d. National Electric Code, 2012 edition

   e. Fire Prevention, 2012 edition

   f. Fuel Gas, 2012 edition

C. The publications are referred to in the text by basic designation only.

1. American Iron and Steel Institute (AISI)
   1140 Connecticut Avenue
   Washington, DC 20036

   a. Stainless Steel Tubing — AISI 316L

2. American Water Works Association (AWWA)
   6666 West Quincy Avenue
   Denver, Colorado 80235

a. Cement Mortar Lining for Ductile-Iron Pipe	ANSI A21.4	AWWA C104
b. Rubber Gasket Joints for Ductile-Iron Pipe	ANSI A21.11	AWWA C111
c. Ductile-Iron Pipe	ANSI A21.51	AWWA C151

3. American National Standards Institute (ANSI)
   11 W. 42nd St.
   New York, New York 1003

   American Water Works Association (AWWA)
   6666 West Quincy Avenue
   Denver, Colorado 80235

a. Cement Mortar Lining for Ductile-Iron Pipe	ANSI A21.4	AWWA C104
b. Rubber Gasket Joints for Ductile-Iron Pipe	ANSI A21.11	AWWA C111
c. Ductile-Iron Pipe	ANSI A21.51	AWWA C151
d. Cast Iron Screwed Fittings	ANSI B16.4	
e. Cast Iron Drainage Fittings, Threaded	ANSI B16.12	
f. Pipe Fittings, Bronze, and 250 lb. Cast	ANSI B16.15	
g. Cast Copper Allow Solder-Joint Pressure Fittings	ANSI B16.18	
h. Solder-Joint Fittings, Pressure Wrought Copper and Copper Alloy	ANSI B16.22	
i. Cast Copper Alloy Solder-Joint Drainage Fittings	ANSI B16.23	

j. Bronze Pipe Flanges and Flanged Fittings — ANSI B16.24

k. Solder-joint fittings, Drainage, DWV Wrought — ANSI B16.29

l. Copper and Copper Alloy

m. Gas Water Heaters — ANSI Z-21-10.3

4. American Society of Heating Refrigeration and Air Conditioning Engineers (ASHRAE)
1791 Tullie Circle NE
Atlanta, GA 30329 — ASHRAE 90A

5. American Society of Mechanical Engineers (ASME)
345 East 47th Street
New York, New York 10017

a. Cast Copper Alloy Fittings for Flared Copper Tubes — ASME B16.26

b. ASME Boiler and Pressure Vessel Code.

(1) Section IV Low Pressure Heating Boilers.

(2) Section VIII, Unfired Pressure Vessels.

6. American Society of Testing and Materials (ASTM)
1916 Race Street
Philadelphia, PA 19103

a. Cast Iron Soil Pipe and Fittings Hub and Spigot — ASTM A74

b. Seamless Copper Water Tube — ASTM B88

c. Copper Tube, Drainage DWV — ASTM B306

d. Recommended Practices for Laying Sewer Pipe — ASTM C-12

e. PVC Pipe - Schedule 40 — ASTM D1785

f. Pipe Fittings, PVC, Schedule 40 — ASTM D2466

g. Sand Cone Method — ASTM D1557
Method D and ASTM D1556

h. Billet-Steel Bars for Concrete Reinforcement — ASTM A615

7. Cast Iron Soil Pipe Institute (CISPI)
1400 Chain Bridge Road
McLean, VA 22101

a. Cast Iron Soil Pipe and Fittings for Hubless — CISPI301
Cast Iron Sanitary Systems

8. Compressed Gas Association, Inc. (CGA)
4221 Walney Road, Fifth Floor
Chantilly, VA 20151-2923

a. Pamphlet P-2.1

b. Pamphlet P-2.7

c. Pamphlet V-5

9. Manufacturer's Standardization Society (MSS)
5203 Leesburg Pike, Suite 502
Falls Church, VA 22041

a. Unions, Brass or Bronze, 250 pounds MSS-SP-72

b. Pipe Hangers and Supports – Materials, Design and Manufacturer. MSS-SP58-88

c. Pipe Hangers and Supports – Selection and Application MSS-SP69-91

10. North Carolina Department of Labor
Boiler and Pressure Vessel Division
4 West Edenton Street
Raleigh, North Carolina 27601-1092

a. The Uniform Boiler and Pressure Vessel Act of North Carolina and Administrative Rules - January 1998

11. Plumbing and Drainage Institute (PDI)
45 Bristol Drive, Suite 101
South Easton, MA 02375

a. Shock Absorbers PDI WH 201

1.5 QUALITY ASSURANCE AND COORDINATION

A. The Contractor shall coordinate his work with that of the other trades. Where interference with other trades occurs, the Contractor shall present his solution to the Professional. The Professional shall make the final decision regarding changes to be made in the work.

B. The Contractor shall thoroughly familiarize himself with all specifications and drawings for the project so that he clearly understands his responsibility in relationship to the work to be performed. The Contractor shall plan and perform his work so as to permit the use of the building at the earliest possible date.

C. The Contractor shall guarantee all work, materials and equipment furnished against defects, leaks, performance and non-operation for a period of one (1) year after the date of the Owner's final acceptance, or as indicated in the General Conditions. Defects shall be interpreted as defective materials or equipment or unsatisfactory installation and are not intended to apply to ordinary wear and tear. The Contractor shall pay for any repairs or replacements caused by these defects within the period covered by the guarantee, including all incidental work required to correct the deficiency.

D. The Contractor shall expressly and completely follow all manufacturers' instructions required for validation of the manufacturer's warranty agreement including but not limited to service, maintenance and adjustments of the equipment.

E. The Contractor is responsible for the proper installation of all materials and equipment required for a complete installation within the intent and meaning of the contract documents.

1.6 PROJECT RECORD DRAWINGS

A. Changes from the contract drawings necessary to coordinate the work with other trades, to conform to the building conditions or to conform to the rules and regulations of authorities having jurisdiction shall be made only after obtaining written permission from the Professional.

B. The Contractor shall keep a record of construction changes and deviations from the original contract drawings. All changes shall be recorded on a separate set of prints, which shall be kept at the job site specifically for that purpose. The record shall be made immediately after the work is completed. Documentation shall include:

1. Location and elevation of new and existing utility lines.
2. Points of connection to existing utility pipelines.
3. Changes in pipe routing location.
4. Valve locations.
5. Equipment locations, etc.
6. Actual capacities and values of equipment provided as indicated in equipment schedules

C. The marked-up record set of drawings shall be delivered to the Professional before final acceptance of the Plumbing Contract work.

1.7 FIELD MEASUREMENTS

A. The Contractor is responsible to verify the location of any and all existing underground utilities in the vicinity of his work. When it has been indicated that these utilities are to remain in place, the Contractor shall provide adequate means of support and protection during excavation operations.

B. Before ordering any equipment and material, or performing any work, the Contractor shall verify all measurements and dimensions at the job site. The Contractor is responsible for the correctness of this information.

C. No extra compensation will be considered based on differences between actual dimensions and measurements and those indicated on the drawings.

D. Any difference identified by the Contractor shall be submitted to the Professional for consideration before proceeding with the work.

1.8 PROTECTION OF SERVICES AND EQUIPMENT

A. All existing service utilities shall remain active during construction. Any service underground, aboveground, interior or exterior damaged, broken or otherwise rendered inoperative during the course of construction due to activities on the part of the Contractor shall be properly repaired by the Contractor, at his own expense. The method used in repairing, replacing or maintaining the services shall be submitted to the Professional for review and approval.

B. At his own expense, the Contractor shall protect his work, materials or equipment that is subject to damage during the project duration. All openings into any piping, ducts or equipment shall be securely covered, or otherwise protected, to prevent injury due to carelessly or maliciously dropped tools or materials, grit, dirt, or any foreign material. The Contractor is responsible for all damage until his work is fully and finally accepted.

C. The Contractor is responsible to provide protection for motors, pumps, electrical equipment, and all similar items of equipment from dirt, grime, plaster, water, etc. during all phases of construction. This protection shall be provided by covering equipment with transparent plastic sheeting and/or locating the materials and equipment in an area free from the elements.

1.9 INTERRUPTION OF SERVICES

A. The Contractor shall schedule his work to avoid any major interruption of any utility services.

B. Existing utilities serving occupied facilities shall not be interrupted except when such interruptions have been authorized in writing by the Owner or the Professional. Interruptions may occur only after acceptable temporary utility services have been provided. The Contractor shall provide a minimum of ten-(10) working days notice to the Professional and Owner, and receive written notice to proceed before interrupting any utility.

1.10 CLEANUP

A. The Contractor shall maintain buildings, grounds and public properties free from accumulations of waste

materials, debris and rubbish. At reasonable intervals during the progress of work, and when directed by the Owner's authorized representative, the site and public properties shall be cleaned and waste materials, debris and rubbish disposed of in an appropriate manner. The Contractor shall provide containers for collection of waste materials, debris and rubbish. Waste materials, debris and rubbish shall be removed from the job site and legally disposed of at a landfill area in accordance with all applicable regulations. Burning or burying waste materials, debris or rubbish on project site is not permitted.

B. At the completion of the Project, remove waste materials, rubbish, tools, equipment, machinery, surplus materials, etc., and clean all sight-exposed plumbing fixtures and equipment. Remove grease, dust, dirt, stains, labels, fingerprints and other foreign materials from sight-exposed plumbing fixtures and equipment. Broom clean paved and concrete surfaces. Rake clean other ground surfaces. Repair, patch and touch up marred surfaces to specified finish or to match adjacent surfaces.

1.11 SUBMITTALS

A. General

1. Refer to Section 22 01 00 of this manual for the requirements relating to shop drawings and submittals.

1.12 EXCAVATION, BACKFILLING AND COMPACTION

A. Excavation, Backfilling and Compaction shall comply with Division 2 of the Project Manual.

B. General

1. The Contractor shall notify “ONE CALL” prior to any work.
2. The Contractor shall perform all excavation, backfilling, compaction and necessary finishing for all piping, equipment, and accessories. Piping installation shall be in accordance with local water, sewer and gas utility regulations and applicable state and local codes.
3. The Contractor shall do all bracing, sheathing and shoring necessary to perform and protect his excavations. The Contractor shall provide safety rails, lights, signs, etc. as necessary or required for safety, or as required to conform to governing codes and laws.
4. The Contractor shall provide, maintain, and operate pumping equipment of sufficient capacity to insure that all his excavations and trenches are kept free of water at all times.
5. All surfaces of streets, walkways, seeded areas, or finished grade areas disturbed by the excavation shall be restored to their original condition and/or as indicated on the contract documents.
6. Protect existing structures, utilities, sidewalks, pavements and other facilities not indicated for removal, from damage caused by settlement, lateral movement, undermining, washout and other hazards resulting from excavation operations.
7. Existing utility lines shown on the contract documents do not indicate the exact in-place location of the lines. They do not show every pipe, fitting or appurtenance that may exist at the project site. The location and depth of all utilities shall be marked and recorded prior to any excavation. Should uncharted or incorrectly charted piping or other utilities be uncovered during excavation, contact the Professional immediately for directions before proceeding further with work in this area. Cooperate with owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to the satisfaction of the utility owner.
8. If it becomes necessary to install any lines or equipment in locations other than those shown, the Professional's acceptance shall be obtained before starting the excavation.
9. The presence of explosives on the project site or the use of explosives in the execution of the work under this contract is prohibited.

C. Excavation

1. All plumbing excavation is unclassified.

2. Trenches shall be dug to uniform width not less than 12-inches, nor more than 16-inches wider than the bell diameter of the piping. Trench sides shall be vertical. Excavate trenches to depth indicated or required. Carry depth of trenches for piping as required to establish required slopes and invert elevations. Beyond building perimeter, keep bottom of trenches sufficiently below finished grade to protect against frost. The bottom of trenches shall be accurately graded to provide uniform and smooth flow throughout. Any over-excavation shall be backfilled with modified aggregate and thoroughly tamped.

3. If trench excavation operations are performed when the atmospheric temperature is less than thirty-five (35) degrees Fahrenheit, the Contractor shall provide at his own expense cold weather protection as required to protect excavated trench bottoms from freezing. Piping shall not be placed in a trench containing water, or on a sub-grade containing frost.

4. Take up and re-lay pipe that is not laid true to required alignment or grade. Pipe that has had its joints disturbed after installation shall be taken up and relayed. Deviation from the required lines and grades will not be permitted unless approved by the Professional.

5. Excavation for the various catch basins, pits, manholes, tanks, etc., shall follow the general procedures as outlined above. The excavation shall extend as required for proper installation or construction. Backfill shall be carefully placed in layers and tamped.

   a. The base for all tanks, pits, manholes, etc., shall be a minimum of 12-inches compacted fill in 4 inch layers to ninety-five (95%) percent compaction or as detailed and noted on the contract documents.

6. All underground piping shall be laid on first class granular bedding. The bedding shall be a minimum depth of six (6) inches or 1/4 (one-fourth) the pipe diameter, whichever is greater. The bedding shall provide uniform longitudinal support to the pipe and shall be laid to provide the grade and line as shown on the drawings or as directed by the Professional. Hand tamp the embedment materials under the haunches and around the pipe to the spring-line of the pipe to a compaction density of ninety-five (95) percent. Final embedment for ferrous pipe materials shall extend from the spring-line of the pipe to a depth of 6 inches (minimum) above the top of the pipe. Final embedment for PVC pipe shall extend from the spring-line of the pipe to a depth of 18 inches (minimum) above the top of the pipe.

D. Backfilling

1. Backfilling shall not be undertaken until all tests and inspections have been made. Use care to avoid damaging or displacing piping systems. All backfill material shall be free from cinders, ashes, refuse, organic material, boulders, rocks or stones, frozen soil, or other material that is unsuitable. When the type of backfill material is not indicated on the plans or is not specified, the excavated material may be used, provided that such material consists of loam, clay, sand, gravel, or other material that is suitable for backfilling. From 1-foot above the top of the pipe to the sub-grade of the pavement, material containing stones greater than 6-inches in their greatest dimension may not be used.

2. Backfill shall be carefully performed and the original surface restored.

3. All trench backfill shall be brought to sub-grade ready for base material or topsoil. After the initial aggregate backfill layer has been placed, refill remainder of the trench using backfill materials as follows:

   a. Lawns - Successive 6-inch layers of clean earth backfill material shall be deposited after initial aggregate backfill. This backfill shall consist of excavated material free from large clods of earth and stone. If large stones (greater than 6-inches) are encountered, remove stones from site and haul in clean earth backfill. The entire trench shall be uniformly tamped after each successive layer is deposited. Replace topsoil to approximate depth of existing as final refill operation and crown to such height as required by the Professional. Maintain crowned surface to the satisfaction of the Professional.

   b. Walks and Parking Areas - Clean earth backfill compacted in 6-inch layers to a point 8-inches below the adjacent existing surfaces. Refill the remaining 8-inches with compacted stone and

replace walk or paving as required.

c. Paved Areas - When working within the right-of-way limits of all North Carolina State highways, backfilling must be in conformance with the requirements of the North Carolina Department of Transportation, which is made a part of these specifications by this reference thereto. Trenches located within the areas described above shall be backfilled with aggregate material from the top of the "pipe bedding" to the bottom elevation of the pavement structure and must be spread and compacted in layers not to exceed 4 inches when using a mechanical damper. The Contractor is to understand that payment for special backfilling material shall not be made unless specifically provided in the form of Proposal.

E. Compaction

1. Backfill trenches to point twelve (12) inches above the top of the outside barrel of the pipe. Continue thereafter with the backfill in twelve (12) inch lifts.

2. All backfill shall be compacted to ninety-five (95) percent. Each lift shall be compacted to the specified percent of maximum density obtained at optimum moisture content, in accordance with ASTM D1557, method D and ASTM D1556 sand cone method.

3. Compaction shall be accomplished by approved equipment suited to the soil being compacted. Material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.

4. Thoroughly compact successive layers of backfill material with a vibrating compactor of a type and size satisfactory to the Professional. Compacting of this backfill by puddling or jetting will not be permitted. Use mechanical tampers to compact backfill materials in trench refill operations to produce a density of backfill at the bottom of each layer of not less than 95-percent of the maximum density obtained at optimum moisture content.

5. The use of special equipment such as the "HYDRA-HAMMER" for compaction of backfill is prohibited.

1.13 CONCRETE

A. Reinforcing shall conform to ASTM A-6l5, Grade 60. Concrete exposed to freezing and thawing, salts, sulfates and corrosion shall comply with North Carolina State Building Code.

B. All concrete shall be of minimum 3000 pounds per square inch (psi) strength in 28 (twenty-eight) days. All concrete shall be mixed by machine. No wet or moistened mixture containing cement shall remain unplaced for a period exceeding 30 (thirty) minutes and shall not be used after its initial set. Re-tempering after initial set is prohibited. Exposed surfaces shall be protected from drying for at least 7 (seven) days. All forms shall be built true and rigid. Form removal shall not injure the concrete.

C. All concrete is to be finished with a hard, smooth troweled finish and is to be faced smooth with rounded corners.

1.14 INSPECTION AND TESTING

A. General

1. New plumbing systems and parts of existing systems, which have been altered, extended or repaired, shall be tested to disclose leaks and defects.

2. The Contractor shall notify the Professional a minimum of five (5) working days prior to testing to coordinate the testing and inspection procedures.

3. If the Professional determines that the plumbing systems do not pass the prescribed tests, the Contractor shall be required to make the necessary repairs, at his own expense. The Contractor shall re-inspect and

re-test the systems. Repairing, inspection and testing shall be continued until all systems pass as determined by the Professional.

4. All new, altered, extended or replaced plumbing shall be left uncovered and unconcealed until it has be inspected, tested and accepted by the Professional. Where such work has been covered or concealed before it has been inspected, tested and accepted, it shall be uncovered by the Contractor, at his own expense as directed by the Professional.

5. The Contractor shall furnish all equipment, material, labor, etc. required for testing the plumbing systems.

B. Sanitary, Vent, and Storm Drain Systems

1. The systems shall be tested in accordance with the North Carolina State Building Code, Plumbing.

2. Rough Plumbing - Systems shall be tested upon completion of the rough piping installation and proved watertight. The water test shall be applied to the system either in its entirety or in sections after rough piping has been installed.

   a. Where applied to the entire system, all openings in the piping shall be closed, except the highest opening, and the system filled with water to point of overflow.

   b. Where the system is tested in sections, each opening shall be plugged, except the highest opening of the section under test, and each section shall be filled with water. A section shall not be tested with less than a 10-foot head of water.

   c. All joints or pipes in the building, except the uppermost 10 feet of the system, shall be subjected to a test of less than a 10-foot head of water.

   d. The water shall be kept in the system or in the portion under test for a minimum of 2 (two) hours before inspection starts. The system shall then be inspected to ensure that it is tight at all points.

3. Finished Plumbing - after the plumbing fixtures have been set and their traps filled with water, the plumbing fixture connections shall be tested and proved gas and watertight.

   a. A smoke test shall be made by filling all traps with water and then introducing into the system smoke produced by one or more smoke machines. When the smoke appears at stack openings on the roof, the stack openings shall be closed and a pressure equivalent to a 1-inch water column shall be introduced and maintained for the period of the inspection.

   b. Where the local Authority Having Jurisdiction finds that a smoke test need not be performed, a peppermint test shall be performed. Two (2) ounces of oil of peppermint shall be poured into the roof terminal of every line or stack to be tested. The oil of peppermint shall be followed at once by 10 quarts of hot (140-degrees Fahrenheit) water. All roof vent terminals shall then be sealed. The system shall then be inspected for the detection of odor of peppermint. If odor of peppermint is detected, repairs shall be made and the system shall be retested.

C. Building Sewer

1. The building sewer shall be tested by insertion of a test plug at the point of connection with the public sewer. The building sewer shall then be filled with water under a head of not less than 10-feet. The water level at the top of the test head of water shall not drop for at least 15 (fifteen) minutes.

D. Domestic Water Systems

1. The system shall be tested either in its entirety or in sections.

2. The system shall be tested and proved tight under a water pressure of 150 pounds per square inch for a period of 2 hours.

3. Potable water shall be used for testing.

E. Fuel Gas Systems

1. The systems shall be tested in accordance with NFPA 54.

2. All fuel gas piping shall be pneumatically tested for tightness prior to commencement of gas service. Air or nitrogen shall be used as the test medium. For low pressure systems the piping system shall be pressurized to a minimum of 10 psig for a period of not less than 10 minutes without showing any drop in pressure. For high pressure systems, 5 PSI and greater, the piping system shall be pressurized to at least 50 psig for not less than 10 minutes without showing any loss of pressure. All joints shall be leak tested with detection solution while the system is pressurized. The Contractor shall provide a valved 1/4 inch FPT connection in the system to which shall be attached a 24 hour pressure recording gauge. The Contractor shall arrange for a gas company representative to witness the test. Leaks shall be repaired by tightening or replacing joints. Caulking of joints is not permitted.

1.15 STERILIZATION OF THE DOMESTIC WATER SYSTEM

A. After the system has been tested and approved, the entire new system, including valves and accessories, shall be chlorinated. Disinfecting shall be in accordance with AWWA C651.

B. Chlorine may be applied in any of the following forms:

1. Liquid chlorine gas-water mixture

   a. Chlorine gas-water mixture shall be applied by a solution feed chlorinating device.

2. Calcium hypochlorite and water mixture.

   a. Calcium hypochlorite shall be HTH, Perchlorene and Maxochlor, or accepted substitute. A solution consisting of five (5%) percent powder to ninety-five (95%) percent water by weight shall be prepared. The calcium hypochlorite and water mixture, first made into a paste and then thinned to a slurry, shall be injected or pumped into the system.

C. The system or any part thereof shall be filled with a water/chlorine solution containing at least 50 parts per million of chlorine. The system or part thereof shall be valved off and allowed to stand for 24 hours. Or the system or any part thereof shall be filled with a water/chlorine solution containing at least 200 parts per million of chlorine and allowed to stand for 3 hours. During the chlorination process all valves and accessories shall be operated.

D. After the chlorination process, the chlorine shall be flushed from the system until the system water is equal in chemical and bacteriological composition to those of the permanent source of water supply. Spent chlorinated water shall be disposed of with in an environmentally responsible procedure.

E. The Contractor shall submit samples of the system water to a competent laboratory for analysis. Laboratory tests of the water shall be paid for by the Contractor. The “Water Test Report for Use” shall be submitted to the Engineer of Record for review and approval.

F. Water supply shall not be placed into service until bacteriological test results are found to be satisfactory and the water meets EPA quality standards for drinking water. After acceptance by the Engineer of Record, the “Water Test Report for Use” shall be submitted to the State Construction Office prior to sending a request for Final Acceptance and Occupancy Permit.

1.16 INSTRUCTION OF THE OWNER

A. After acceptance of the Project, the Contractor shall furnish the services of personnel thoroughly familiar with the completed installation to instruct the Owner in the proper operation and maintenance of all equipment and appurtenances provided.

B. The Contractor shall provide the Owner with two (2) weeks advance notice before the instruction session.

1.17 CHASES AND OPENINGS

A. All openings required for the installation of the work shall be coordinated with the other trades. The Contractor shall provide the other trades with sufficient time (one (1) week minimum) for coordination of all openings. The Contractor shall be responsible for cutting and patching all openings necessary for his work. The work shall be performed to the satisfaction of the Professional.

B. Penetrations made in fire rated partitions, floors, etc. shall be sealed with an approved material and method as required to maintain the integrity of the fire separation.

C. The Contractor shall provide all sleeves, hangers, and anchors required for installation of the work in chases and openings.

1.18 WATER SERVICE AND METERS

A. The Contractor shall coordinate water meter requirements in accordance with the local water utility regulations, including required permits, meters, piping, valves, bypasses, supports and other accessories.

1.19 PAINTING

A. Painting shall be in accordance with Division 9.

1.20 RELATED WORK

A. All work related to providing complete plumbing systems and equipment shall be the responsibility of the Contractor. The following related work shall be provided as indicated in other specification divisions, unless noted otherwise, but shall remain the responsibility of the Contractor for workmanship and completeness:

1. General Contractor

a. Installation of access panels.

b. Leaders and gutters.

c. New catch basins and foundation drains. Final connections shall be by the Contractor, as indicated on the drawings and as herein specified.

d. Final painting of existing walls, floors and ceilings where the surfaces are being refinished and remodeled under the general contract. Refer to general construction drawings.

e. Equipment and furnishings including shop equipment and laboratory equipment. The Contractor shall make all final connections to equipment and furnishings. The Contractor shall be responsible for coordination of plumbing services with the equipment and furnishings.

2. Mechanical Contractor

a. Side wall ventilators and air conditioning equipment.

3. Electrical Contractor

a. Verification of the proper rotation of three-phase equipment, and making modifications as required to correct improper rotation.

b. Installation of all combination starters/disconnects and overload protectors.

1.21 MISCELLANEOUS STEEL AND ACCESSORIES

A. The Contractor shall provide all necessary steel angles, channels, pipe, rods, nuts, bolts, etcetera, as shown on plans, as specified, or as may be required for complete and proper installation of plumbing fixtures, systems and equipment. All material and workmanship shall be of the best quality and shall be installed in accordance with the best practices of the trade.

PART 2 PRODUCTS

2.1 GENERAL

A. All materials used on plumbing systems shall comply with the following lead ban requirements:

1. Solders with lead content exceeding 0.2% (two-tenths of a percent) are prohibited. Brass and bronze materials containing 2.0% (two percent) or greater lead are prohibited.

PART 3 EXECUTION

3.1 GENERAL

A. The contract drawings are diagrammatic and are indicative of the work to be performed. It is not intended that they show every pipe, fitting or apparatus required for a complete installation.

B. The contract documents are not intended to indicate every bend, offset, change in direction and appurtenance required to provide a complete and workable system.

C. All materials and equipment used shall be installed in strict accordance with the standards under which the materials are accepted and approved, and in strict accordance with the manufacturer's instructions.

D. Except where otherwise indicated, minimum cover on site shall not be less than the following:

1. Sanitary sewer piping: 3'-0"
2. Storm drain piping: 2'-0"
3. Domestic water piping: 3'-0"
4. Natural gas piping: 2'-0"

END OF SECTION

SECTION 22 05 03 - PLUMBING PIPING

PART 1 GENERAL

1.1 REQUIREMENTS

A. General Conditions of the Contract, Special Conditions, Instructions to Bidders, and other General Requirements contained in Division 1 and 2 are a part of these Specifications.

1.2 SECTION INCLUDES

A. Work in this Section includes the following:

1. Domestic water piping
2. Sanitary waste, vent and storm drain piping
3. Fuel gas piping
4. Sleeves and floor plates
5. Supports, hangers, inserts and fasteners
6. Valves
7. Pipe insulation
8. Pipe identification labels
9. Valve tags
10. Utility marking tape

1.3 RELATED SECTIONS

A. All sections of the Project Manual apply to this section.

1.4 SUBMITTALS

A. Submittals shall be in accordance with Section 22 01 05 – Shop Drawings and Submittals.

B. The Contractor shall submit manufacturer's catalog data for the following:

1. Domestic water piping
2. Sanitary waste, vent and storm drain piping
3. Fuel gas piping
4. Sleeves and floor plates
5. Supports, hangers, inserts and fasteners
6. Valves
7. Pipe insulation
8. Pipe identification labels
9. Valve tags
10. Utility marking tape

B. The Contractor shall submit Certificates of Compliance for the following:

1. Schedule of UL listed through penetration assemblies

C. The Contractor shall submit Operation and Maintenance Data for the following:

1. Valves

1.5 JOB CONDITIONS

A. The Contractor shall verify the requirements for the gas service with the Gas Utility Company before starting work.

The Contractor shall include in his bid price the cost to obtain, furnish and install the gas meter, regulators, associated concrete pads, piping, supports and valves required by the Gas Utility Company as a condition to provide service

PART 2 PRODUCTS

2.1 DOMESTIC WATER PIPING AND TRAP PRIMER PIPING

A. Aboveground:

Piping: Type "L" hard temper copper tubing, ASTM B88

Fittings: Cast bronze or wrought copper solder end fittings, ANSI B16.18, ANSI B16.22

Solder: 95-5 tin-antimony solder, ASTM B32 for sizes up to 1-1/4 -inch

Brazing solder: ASTM B260 for sizes 1-1/2-inch and larger using copper-phosphorus or copper-phosphorus-silver brazing filler material (BCuP series) in accordance with ANSI/AWS standards.

B. Underground (1/2-inch through 2-1/2-inches): (Water piping within the building and below the slab shall have no joints below the slab.)

Piping: Type "K" copper tubing, ASTM B88

Fittings: Cast bronze flared fittings, AWWA

C. Underground (3-inches and larger):

Piping: Ductile Iron pressure pipe Class 52, ANSI A21.51/AWWA C151 with ANSI A21.4/AWWA C104 cement lining

Fittings: Mechanical joint ANSI A21.10/AWWA C110 with gaskets

2.2 SANITARY WASTE, VENT AND STORM DRAIN PIPING

A. Aboveground:

Piping: Cast iron, no-hub, service weight cast iron CISPI 301

Fittings: Heavy duty “No-Hub” drainage pattern type CISPI 301.

Couplings: Type 304 stainless steel Sealing sleeve with a minimum gauge 0.015 clamp assembly with a 3/8 inch worm gear tightened to a torque of 80 inch pounds conforming to ASTM C 1540 and an elastomeric sealing sleeve conforming to ASTM C564.

Clamp width – 3” wide minimum for 1½” to 4”

Clamp width – 4” wide minimum for 5” and larger

B. Fixture Branch

Piping: Type M hard drawn copper tubing, ASTM B306

Fittings: Wrought copper drainage type fittings, ANSI B16.29 or cast copper drainage type

fittings, ANSI B16.23

Solder: 95-5 tin-antimony solder, ASTM B32

Piping: Cast iron, no-hub, service weight cast iron CISPI 301

Fittings: No-hub drainage pattern type CISPI 301.

Couplings: Sealing sleeve with heavy duty ASTM A666, Type 304 stainless steel shield and clamp assembly – 0.016-inch thick minimum and torque to 80 psi.

Clamp width – 3” wide for 1 ½” to 4”

Clamp width – 4” wide for 5” and larger

Piping: Schedule 40 galvanized steel pipe, ASTM A53

Fittings: Threaded, 150 pound, malleable iron fittings, ANSI B16.3.

Do not use copper for urinal waste.

C. Underground

Piping: Service weight, hub and spigot cast iron soil pipe, ASTM A74.

Fittings: Cast iron, hub and spigot, drainage pattern type, ASTM A74 with neoprene compression type gaskets, ASTM C564.

D. Drain Piping (Condensate, Relief Valve, Indirect Waste, and Backflow Preventer Drain Piping):

Piping: Type "M" hard temper copper tubing, ASTM B88

Fittings: Cast bronze or wrought copper solder end fittings, ANSI B16.18, ANSI B16.22 or ANSI B16.24

Solder: 95-5 tin-antimony solder, ASTM B32

E. Sewage Pump and Sump Pump Discharge Piping:

Piping: Schedule 40 black steel, ASTM A53

Fittings: Threaded malleable iron, ASME B16.3 or forged steel butt welded type, ASTM A234

2.3 FUEL GAS PIPING

A. Aboveground (2-inch and smaller):

Piping: Schedule 40 black steel pipe, ASTM A53

Fittings: Threaded, 150 pound malleable iron fittings, ANSI B16.3

2.4 SLEEVES AND FLOOR PLATES

A. Sleeves in finished areas shall be fitted with chrome plated escutcheons sized to fit securely at the pipe or pipe insulation and shall cover the sleeve and penetration opening.

B. Floor sleeves located in areas with automatic sprinkler protection shall have sleeves extending a maximum of 2-inches above the finish floor. Escutcheons shall accommodate the depth of the sleeve.

C. Sleeves in Non-Rated Construction

1. Interior Partitions - New Construction

24-gauge galvanized sheet metal sleeve

Mineral wool insulation packing between sleeve and piping/piping insulation

2. Floor - New Construction

Schedule 40 black steel sleeve with retaining collar welded to sleeve

Mineral wool insulation packing between sleeve and piping/piping insulation

3. Slab on Grade

Schedule 40 black steel sleeve with retaining collar welded to sleeve

Expandable modular seals with molded rubber interlocking sections

Seal Manufacturers:

Thunderline Corporation

Metraflex Company

4. Underground Foundation Wall - New Construction

Schedule 40 black steel sleeve with retaining collar welded to sleeve

Mineral wool insulation packing between sleeve and piping

5. Underground Under Foundation Wall – All Construction

Schedule 40 black steel sleeve coated with bitumastic material

Mineral wool insulation packing between sleeve and piping

D. Sleeves in Rated Construction

1. Piping which penetrates rated construction shall be provided with UL listed through penetration assemblies. Assemblies shall provide protection of the through penetration equal to or greater than the construction rating. Assemblies shall be selected after determining all characteristics of the assembly including piping material and size, construction type, rating (in hours) of the required construction and fill, void or cavity materials.

2.5 SUPPORTS, HANGERS, INSERTS AND FASTENERS

A. Provide all miscellaneous steel required for support of pipes and equipment other than steel shown on Structural Engineer's drawings.

B. Pipe hanger design, materials, and manufacturer shall conform with the requirements defined in MSS SP58-88.

C. The selection and spacing of pipe hangers shall comply with the data included in MSS SP69-91.

D. All hanger materials including clevis hangers, rods, inserts, clamps, stanchions, brackets, shall have a factory applied finish of electro-plated zinc, unless noted otherwise.

E. Hangers, clamps and supports for use on un-insulated copper piping shall be provided with inserts to isolate the copper piping from the hanger. Inserts shall be made of felt or plastic and shall be as manufactured by the hanger manufacturer.

F. Insulated piping shall be provided with insulation shields. Hanger shall be sized to include piping diameter and insulation thickness.

G. Hanger Materials:

1. Horizontal Sanitary, Waste and Vent Piping and Storm water Piping:

a. 3 inch and smaller:

B-Line	B3100
Grinnell	260
PHD	450

b. 4 inch and larger:

B-Line	B3102
Grinnell	590
PHD	420

2. Horizontal Domestic Water Piping:

a. 2 inch and smaller:

B-Line	B3100
Grinnell	260
PHD	450

b. 2-1/2 inch and larger:

B-Line	B3100
Grinnell	260
PHD	450

c. AWWA piping:

B-Line	B3102
Grinnell	590
PHD	420

3. Insulation Shields

a. All Piping:

B-Line	B3155
Grinnell	168
PHD	160

4. Vertical Piping (Riser Clamps):

a. Copper Pipe (copper plated with plastic coated formed portion.):

B-Line	B3373CT
Grinnell	CT-121C
PHD	554

b. Steel Pipe:

B-Line	B3373
Grinnell	261
PHD	550

5. Connectors:

a. Beam Clamps:

B-Line	B3033, B3050, B3291-B3297
Grinnell	88, 133, 134 or 292S.
PHD	360, 620

b. Concrete inserts:

B-Line	B2500, B3014
Grinnell	282, 285
PHD	950

c. Welded beam attachments:

B-Line	B3083
Grinnell	66
PHD	900

d. Piping adjacent to walls or steel columns, brackets:

B-Line	
Grinnell	No. 194, 195, or 199, depending on weight to be supported.
PHD	

e. Base supports:

B-Line	
Grinnell	Figure No. 259, or 264.
PHD	

6. Hanger Rods:

a. Hanger rod:

B-line	
Grinnell	Figure No. 140.
PHD	

b. Continuous threaded rod:

B-line	
Grinnell	Figure No. 146.
PHD	

c. Eye Rods:

B-line	
Grinnell	Figure No. 248.
PHD	

2.6 VALVES

A. All valves shall be products regularly produced for the specified service and rating in accordance with the manufacturer's catalog or engineering data. All valves shall be marked with the manufacturer's name or trademark. The recommended service pressure and the size, by letters and figures, cast or stamped on the body of the valve. Lead content in brass and bronze used in valves for plumbing systems shall not exceed two (2) percent.

B. All valves shall be standard 200 pounds per square inch (psi) WOG minimum. Valve ends shall be compatible with the piping system served.

C. Composition disks shall be as recommended by the valve manufacturer for hot or cold water service.

D. Gate valves for water main service shall be iron body, bronze mounted, tapered seat non-rising stem, O-ring packing. AWWA C500, 200 psi working pressure. Open counterclockwise. Mechanical joint valve ends shall conform to AWWA C111. Valves shall be of a design that requires no more than fifty (50) lbs. pull on the standard valve wrench to provide positive shutoff against rated working pressure.

E. All flanges shall be plain faced, smooth finished and shall conform in dimensions and drilling to the American Cast Iron Flange Standard Class l25 (Bl6.l-48).

F. Ring gaskets 1/16 inch thick shall be used with all flanged valves. Basis of design for gaskets shall be Cranite, Garlock. Paint one (l) side of gasket with graphite and oil, or accepted substitution, thread lubricant before installing.

G. Domestic Hot and Cold Water Valves

1. Ball Valves

a. 2-inch and Smaller - 200 psi WOG, full port, two piece construction, bronze body with chrome plated solid brass ball and stem, threaded or sweat ends.

b. Acceptable Manufacturers:

Apollo

Jamesbury

Milwaukee

Nibco

Powell

Watts

2. Gate Valves

a) 2-inch and Smaller - Bronze gate, union bonnet, rising stem, solid wedge disk, threaded or sweat ends

b) 2-1/2-inch and Larger - Iron body bronze mounted OS&Y, solid wedge disk, flanged ends.

c) Acceptable Manufactures:

Kennedy

Milwaukee

Mueller

Nibco

Powell

Stockham

3. Balancing Cocks (Circuit Setters)

a) Bronze body threaded or sweat connection, brass valve, "O" ring sealed, calibrated nameplate, indicator pointer, dual stage orifice, read out ports equipped with integral composition check valve, 125 psi rated, 20 degrees F to 220 degrees F range.

b) Acceptable Manufacturers:

Bell and Gossett

Illinois

Rockwell

Sarco

Taco

4. Check Valves (Swing Type)

a) 2-inch and Smaller - Bronze body, bronze disk for general service, threaded or sweat ends.

b) 2-1/2-inch and Larger - Cast iron body, bronze disk and seat ring; flanged ends.

c) Acceptable Manufacturers:

Kennedy

Milwaukee

Mueller

Nibco

Powell

Stockham

H. Fuel Gas Valves

1. Gas Shutoff Valve - Gas valves shut off purposes shall be cast iron body eccentric action plug type with resilient plug facings composed of nitrile butadiene.

a) Acceptable Manufacturers:

Crane

Conbraco

Mueller

Powell

Rockwell

DeZurik

Worchester

Walworth

2. Gas Solenoid Valve - Explosion proof, normally closed, with a NEMA 1 enclosure, UL listed gas solenoid valve. Aluminum body, Buna N seat and disc valve shall be rated for 120V operation. All switches, wiring, etc. for valve shall be provided as indicated in Division 16.

2.7 PIPE INSULATION

A. All insulation shall have composite surface burning characteristic ratings as tested by ASTM E 84, UL 723, or NFPA 255 not exceeding:

Flame Spread:	25
Smoked Developed:	50

B. Composite shall include insulation, jacketing and adhesive used to secure jacketing or facing. All accessory items such as PVC Jacketing and Fittings, adhesive, mastic, cement, tape and cloth shall have the same component rating as specified above.

C. Insulation shall be molded one (1) piece with a maximum thermal conductivity not exceeding 0.23 BTU-in./hr-sq. ft.-°F at seventy-five (75) degrees F mean temperature (R = 4.3).

D. Insulation shall be heavy density fiberglass, Basis of design is ASJ/SSL-II as manufactured by Owens-Corning Fiberglass Corp., Johns Manville Co. Basis of design for valve and fitting covers shall be Zeston 2000 PVC fitting covers as manufactured by Johns Manville Co. Basis of design for mastic sealer shall be Foster Tite-Fit Coating 30-35 as manufactured by H.B. Fuller Company, nonflammable, solvent based, UL classified.

1. Approved Manufacturers:

   Certain Teed Corporation

   Johns Manville Co.

   Knauf Fiberglass GmbH

   USG Interiors, Inc. – Thermafiber Division

   Owens-Corning Fiberglass Corporation

E. Insulation jackets:

1. Glass fiber insulated pipes conveying fluids below ambient temperature:

   a. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.

   b. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe and PVC fitting covers.

2. Glass fiber insulated pipes conveying fluids above ambient temperature:

   a. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.

   b. Insulate fittings, joints, and valves with insulation of like material and thickness of adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

3. Pipe Exposed in the Storage Shed: Finish with canvas jacket sized for finish painting.

F. Closed cell foam insulation of 1 inch thickness or less may be substituted for fiberglass type sealed with compatible adhesives. Basis of design for shall be Model AP Armaflex as manufactured by Armstrong.

1. Approved Manufacturers:

   Armstrong World Industries, Inc.

   Halstead Industrial Products

   IMCOA

   Rubatex Corporation

G. Metal shields shall be installed between hangers or supports and the piping insulation. Rigid insulation inserts shall be installed as required between the pipe and the insulation shields.

H. Inserts shall be of equal thickness to the adjacent insulation and shall be vapor sealed.

2.8 PIPE IDENTIFICATION LABELS

A. Labels shall be acrylic faced, wrap-around labels. Labels shall indicate piping contents, direction of flow and shall bear the manufacturer's standard color for the service indicated.

1. Approved Manufacturers:

   Brimar

   MSI

   Seton

2.9 VALVE TAGS

A. Tags shall be brass, 1" in diameter with large stamped numerals and attached by a short link brass chain or brass "S" hook.

2.10 UTILITY MARKING TAPE

A. Minimum 2 inches wide, metalized core plastic foil with the words "Caution - Pipeline Buried Below" printed in bold black letters.

PART 3 EXECUTION

3.1 GENERAL

A. All materials, equipment and accessories specified in this section shall be installed in strict accordance with the manufacturers' recommendations.

3.2 EXCAVATION, COMPACTION, BACKFILL

A. Excavation, compaction and backfill shall be as specified in Section 22 01 00, Plumbing General.

3.3 PIPING INSTALLATION

A. General

1. All piping in finished areas shall be run concealed where possible. The Contractor shall furr in piping or provide soffiting as required and in accordance with the Professional's instructions. All piping shall be installed as required to suit space available in building structure, above suspended ceilings, and other locations found necessary for installation.

2. The Contractor shall not install any piping that will interfere with any lights, openings, doors, windows, ductwork, equipment, and existing or special conditions. Headroom in front of openings, doors, or windows shall not be less than the top of the opening. Provide all piping offsets necessary to avoid interferences with other work. Piping offsets shall include all devices and assemblies necessary to accommodate the change in direction of the piping.

3. All piping shall run straight with no more couplings and joints than necessary, shall be grouped wherever practical and shall be carefully installed to provide for proper alignment slope and expansion

4. Pipes carrying fluids shall not be installed in transformer vaults, electrical equipment rooms, elevator hoistways, elevator equipment rooms, or similar areas having a collection of electrical equipment. Pipes shall not be installed over, around, in front of, in back of, or directly below, electrical controls, panels, switches, terminals, boxes, or similar electrical equipment.

5. All piping shall be installed with a minimum of 2 inches between finish covering of pipe and all other work or piping.

6. All piping shall have shut-off valves at all branch connections to mains.

7. Reduction in sizes of pipes shall be made with reducing fittings. Bushings will not be permitted.

8. The Contractor shall perform excavation of the subgrade where required for the installation of the work, including that for piping and piping enclosures. The backfill shall be stabilized by hand or pneumatic tamping as directed by the Professional and shall be returned to the original subgrade level. Piping shall not be run in cinder fill unless protected by a concrete envelope of 2 inches minimum thickness on all sides of pipe. All steel and copper piping and fittings installed underground shall be protected with two layers of tightly applied spirally wrapped tape. Basis of design shall be 3M number 50.

9. Bullhead connections in any piping service are prohibited.

10. All screwed joints shall be made with a non-corrosive, non-hardening compound or Teflon tape applied on the male thread only. All compounds must be approved for the pipe on which they are used. Pipe ends shall be reamed or filed out to size of bore and all chips and cuttings removed. Ends of pipe must be cut square so as to seat in the bottom of the recess in drainage fittings. In making joints in chromium plated brass pipe no more than one thread shall remain exposed when joint is completed. Caulking of screwed joints is not permitted. Pipe joint cement and paint will be permitted only on external threads.

11. All soldered joints shall be made with fittings specified. Copper tube and brass pipe, valves, unions, flanges, fittings, and connections shall be joined by means of lead free solder. Ends of all pipe and inside surfaces of fittings shall be cleaned, burnished and tinned before solder is applied. All joints in tubing 2 inches and larger shall be tinned and then soldered with a circular type flame torch. Pull joints, saddle type joints, and "T-Drill" type connections are prohibited.

B. Drainage Piping

1. All sewer piping shall be set true to line and even slope using grade boards and targets or grade lines in accordance with ASTM C12, "Recommended Practice for Laying Sewer Pipe". Horizontal sanitary and storm piping shall be installed to pitch towards drain points. Minimum pitch shall be 1/8 inch per foot for piping 4 inch and larger. Pitch for smaller piping shall be 1/4 inch per foot minimum. Minimum pipe size below grade shall be 2 inch. To join screwed pipe to cast iron pipe, provide ring on screwed pipe to form spigot end.

2. All changes in pipe size of soil, waste, and drain lines shall be made with reducing fittings or reducers. Changes in direction, where space permits, shall be made with long sweep bends, Y-fittings, and one-eighth (1/8) or one-sixteenth (1/16) bends, or combination "Y" and 1/8 bends.

3. Cleanouts shall be furnished installed on horizontal runs and at the base of stacks for all soil, waste, drain, and rain conductor lines. A cleanout shall be installed at every change of direction of greater than 45 degrees. Cleanouts shall be installed not more than 50 feet apart for piping 4 inch size and smaller. Cleanouts shall be installed no more than 80 feet apart for piping larger that 4 inch. Cleanouts on horizontal runs above ground, including crawl spaces, shall be cast brass plugs in wye fittings. Cleanouts at the base of each vertical stack shall be cast brass plugs in wye fittings. Cleanouts on buried or concealed lines shall be brought flush with grade or floor level. Cleanouts in walls shall be brought flush with finished face of the wall. Cleanouts on underground lines shall be made with wye and 45 degree fittings. Terminal cleanouts on underground lines shall have a concrete cradle bearing block set against undisturbed earth. 45 degree fittings shall be set against concrete cradle to prevent separation or misalignment of joints. Cleanout plugs shall be full size for pipe up to and including 4 inch diameter and not less than 4 inch diameter for larger size pipe.

4. Cleanouts shall not located in air plenums. Cleanouts shall be extended to the floor or wall in order to locate the cleanout outside of the air plenum.

C. Pressure Piping

1. Branch piping shall be as indicated, but shall be a minimum 3/4 inch in nominal size with the last ten feet to each 1/2 inch outlet fixture a minimum of 1/2 inch in nominal size.

2. Each water piping system within the building shall be properly arranged and graded to low points where the entire system can be emptied through a drain.

3. Drain Valves - Furnish and install a 1/2" rough brass hose bibb with female hose connection at all low points of the domestic water piping systems. The hose bibb shall be located so as to be accessible and easily operable, and so that a hose can be connected to the outlet.

4. Outside water piping shall be so graded and arranged that water can be drained from the underground piping through drains installed in the building served. The drains shall be the same size and type specified for interior piping.

D. Equipment Piping

1. Provide shutoff valves in supply and return to each item of equipment. Valves shall be suitably located to isolate each unit to facilitate maintenance or removal of all equipment and apparatus. Valves shall be flanged or have a union installed between valve and equipment.
2. Provide all piping from backflow preventers to spill over open sight drains, floor drains, or other trapped acceptable discharge points, and terminate with plain end (unthreaded) pipe.
3. Provide thermometer wells and pressure gauge wells for specified thermometers and gauges, and at the inlet and outlet connection of each piece of equipment specified in this contract.

E. Fuel Gas Piping

1. Horizontal fuel gas piping shall slope up in direction of flow not less than 1/4 inch in 15 feet.
2. Provide 6 inch drip leg and cap and shutoff valve at each piece of gas fired equipment, at the ends of horizontal runs and at the base or risers.
3. All fuel gas piping shall be installed in accessible locations. Piping located in or below concrete slabs shall be run in channels in the floor with suitable access panels. Where approved by the local gas utility, gas piping may be embedded in the floor slab. Such piping shall be surrounded by not less than 1-1/2 inches of Portland cement, and piping shall not be permitted to be in physical contact with any other metallic materials.
4. Gas tubing run inside hollow walls or partitions shall be protected with a steel striker barrier at least .0508 inches thick. Striker barriers shall extend 4 inches beyond concealed penetrations or plates, fire stops, etc. Rigidly securing tubing run vertically inside hollow walls or partitions shall be prohibited.
5. Use of polyethylene fuel gas piping is prohibited above ground and under floor slabs. Transition from polyethylene to steel pipe shall be made underground and piping brought Aboveground before entering the building.

3.4 ELECTROLYSIS CONTROL

A. All copper pipe and tubing installed under this Contract shall be installed so that the pipe and tubing will not touch or come in contact with ferrous metals. Where copper tubing or piping for fittings is anchored, guided, supported, secured, or may come in contact with ferrous metal, an insulating nonconductor spacer, similar to rubber or fiber, shall be installed to assure prevention of electrolysis.

B. When copper tubing or piping is connected to ferrous piping or equipment, connections shall be made with dielectric unions, couplings, or isolating flanges.

3.5 SLEEVES AND FLOOR PLATES

A. Sleeves shall be provided for all pipes passing through walls and partitions. Sleeves shall be cut flush with wall, floor or ceiling surfaces except that sleeves through waterproofed roof or floor slabs shall extend one inch (1") above the finished surface. Sleeves shall be sufficient size to allow a sealable annular space between the sleeve and the pipe or between the sleeve and the pipe insulation. All exposed piping passing through floors, walls or ceiling shall be provided with a chrome escutcheon plate securely fastened around the pipe. The annular space around the pipe in non-water-proof sleeves shall be filled with penetration sealant and smoothed out flush with all surface.

B. All pipe, tube, conduit, or similar through-penetrations of all fire rated walls, floor-ceiling, or roof-ceiling assemblies shall be provided with a fire stopping system to achieve a tight seal that will maintain the fire resistant rating of the assembly containing the through-penetration. Fire stopping system may be sealant or mechanical type.

3.6 PROTECTION AGAINST PHYSICAL DAMAGE

A. In concealed locations, where piping, other that cast-iron or galvanized steel, is installed through holes or

notches in studs, joists, rafters or similar members less than 1¼-inches from the nearest edge of the member, the pipe shall be protected by shield plates. Protective shield plates shall be a minimum of 1/16-inch thick steel, shall cover the area of the pipe where the member is notched or bored and shall extend a minimum of 2-inches above sole plates and below top plates.

B. Fuel gas piping shall be protected in accordance with NFPA 54.

3.7 SUPPORTS, HANGERS, INSERTS AND FASTENERS

A. The Contractor shall furnish and install all supports, hangers, inserts and fasteners for the items incidental to the work in the construction of the project. Supports and hangers shall be provided to suit specific conditions for the type of construction. The method adopted shall be subject to the approval of the Professional.

B. Supports shall secure pipes in place, prevent swaying and vibration, maintain required grading, provide free expansion and shall have a neat appearance. Supports shall be selected for strength and service and installed in a manner which will not stress building construction. Supports shall be selected for safety factor of five (5) to one (1) for gross weight of piping system including fluid and installation.

C. Where support is from concrete construction, take care not to weaken concrete or penetrate waterproofing. Only use inserts for suspending hangers from concrete slabs. Use beam clamps for suspending hangers from building steel. Do not hang one pipe from another. Do not use perforated band iron, wire or chain as hangers. Do not use vertical expansion shields. Do not hang from joist bridging.

D. Fastenings required in masonry walls shall be galvanized U-bolts set in the construction during erection.

E. Where several pipes can be installed in parallel at the same elevation, provide trapeze hangers. Trapeze hangers shall be suspended by means of rods or angles. Brace trapeze hangers to prevent motion due to expansion and contraction of pipe. Support individual pipes by hangers or rollers.

F. Where hanger rods are longer than 18 inches, provide lateral bracing at every fourth hanger. Do not support piping by wire, rope, wood or other makeshift device. Provide additional steel supports where building construction does not permit the hanger spacing as specified in the schedules. Location and details shall be submitted to the Professional for review.

G. Where loading exceeds the safe allowable limit for any single insert, then multiple inserts shall be installed spaced no less than 12 inches on centers. The multiple inserts shall be connected with suitable size steel angles and locking bolts.

H. Where inserts in new construction have been omitted or are required in existing construction, the fastening shall be accomplished by means of approved lead sheathed expansion bolts. Wood plugs shall not be used. Expansion shields in precast concrete slabs shall not be loaded more than one-half (1/2) their maximum design capacity and never more than 200 pounds per bolt. Where bolts used with lead expansion bolts are spaced closer than one foot centers, the multiple bolts shall be connected with suitable size steel angles and locking bolts or with single bolts extending through the slab above with a bearing plate. Where finished floors occur, the welded plate and rod shall be recessed in the slab, finished in an approved manner.

I. Where fastenings are required in steel stud, wire lath or other non-masonry construction, a "J" hook and holding lock washer and nut shall be used which shall fasten to the opposite stud edge to which the item will abut. If the location of the fastening is not a steel stud, a structural steel shape shall be fastened to the wall with bolt and holding nut, with the fastening extension through the wall. The use of toggle bolts will not be permitted.

J. Steel frame Construction

1. Where roofing construction is supported by structural steel members or bar joist, support piping systems, devices, and equipment from structural steel members or secondary fabricated supports. No hanging from corrugated metal deck shall be allowed.

K. Reinforced Concrete Construction

1. Inserts in poured concrete slabs shall be iron or fabricated galvanized iron or steel of the type to receive a

machine bolt head or nut after installation. Inserts shall permit adjustment of this bolt in one (1) horizontal direction. Inserts shall be accurately located before the concrete is poured.

2. Piping, tanks and equipment shall be adequately supported either by suspension from the construction above or by means of struts or brackets to the construction below or to the side.

3. Before drilling any concrete for attachments, installer shall carefully check concrete drawings and shop drawings and shall locate drilled holes to avoid reinforcing by at least 1 inch.

HANGER AND ROD SCHEDULE

Nominal Pipe Diameter (Inches)	Steel Pipe Spacing (Feet)	Steel Pipe Rod Size (Inches)	Copper Tubing Spacing (Feet)	Copper Tubing Rod Size (Inches)
1/2	5	3/8	5	3/8
3/4	6	3/8	6	3/8
1	7	3/8	6	3/8
1-1/4	8	3/8	6	3/8
1-1/2	10	3/8	6	3/8
2	10	3/8	10	3/8
2-1/2 & 3	12	1/2	10	1/2
4 & 5	12	5/8	10	5/8
6	12	3/4	10	7/8
8,10,12	12	7/8	10	7/8

HANGER AND ROD SCHEDULE NOTES:

Where unusual concentrated loads of valves and fittings occur, closer spacing shall be required. Submit specific cases for review and comment.

Where piping changes direction, supports shall be placed in each direction adjacent to joints and no more than 12 inches from the joint.

Hanger spacing for copper piping shall conform to the requirements defined in the North Carolina Building Code – Mechanical- 2002.

M. Cast Iron Pipe Supports

1. In accordance with manufacturer's instructions.

2. Vertical piping supported at each stack be and at each floor. Freestanding vertical pipe should be adequately staked or braced during construction to maintain alignment.

3. Horizontal piping supported within 24 in. each side of the coupling joint at 10 ft. intervals for 10 ft. pipe lengths and at 5 ft. intervals for 5 ft. pipe lengths. Supports or hangers placed to maintain alignment and grade with provision made to prevent shear. Greater than 3 in. diameter pipe braced at changes of direction to prevent horizontal movement.

3.8 VALVES

A. Valves shall be installed at each riser, branch to equipment, at each group of fixtures, at each fixture not

equipped with stop valves, and where shown on the drawings. Valves shall be installed with stems at or above the horizontal plane.

B. Where supplies to individual fixtures occur in base cabinets, or in other places where copper tubing supplies are used stops shall be solder end.

3.9 INSULATION

A. Pipe Insulation

1. Piping to be insulated shall include all domestic water piping and above ground horizontal rainwater conductors.

2. All insulation shall be applied by skilled workmen regularly engaged in this type of work. Insulation shall be applied to clean and dry surfaces after tests and approvals required by this specification have been completed.

3. On cold surfaces where a vapor barrier must be maintained, insulation shall be applied with a continuous, unbroken moisture and vapor seal. Insulation and vapor barrier shall be continuous through pipe hangers and supports. Other projections that are secured to cold surfaces shall be insulated and vapor sealed to prevent condensation.

4. All surface finishes shall be extended in such a manner as to protect all raw edges, ends and surfaces of insulation.

5. All pipe insulation shall be continuous through walls, ceiling, floor openings, or sleeves; except where firestop or firesafing materials are required.

6. Metal shields shall be installed between hangers or supports and the piping insulation. Rigid insulation inserts shall be installed as required between the pipe and the insulation shields. Inserts shall be of equal thickness to the adjacent insulation and shall be vapor sealed.

7. Insulation used on piping systems shall be contoured for the pipe size. Duct wrap or batt insulation on piping systems is not acceptable.

B. Insulation thickness shall conform to the "PIPING INSULATION THICKNESS TABLE".

PIPING INSULATION THICKNESS TABLE

SERVICE	PIPE SIZE	INSULATION THICKNESS
Domestic Cold Water	1/2" to 2"	1/2"
Domestic Cold Water	Larger than 2"	1"
Domestic Hot Water (Branches)	1/2" to 1"	1/2"
Domestic Hot Water	1/2" to 2"	1"
Domestic Hot Water	Larger than 2"	1-1/2"
Rain Leaders	All Sizes	1"
Drainage Piping Installed	All Sizes	1/2"

C. Application

1. All ends shall be firmly butted and secured with an all service jacket or self-sealing lap butt strips of a minimum 3 inches wide. All service jacket laps and butt strips shall be secured by use of a suitable lap adhesive. Exposed end of pipe insulation shall be sealed with vapor retardant mastic at all fittings and valves.

2. All fittings and valves shall be insulated with preformed fiberglass fittings. Insulation shall be of equal

thickness to the adjacent pipe insulation.

3. Fitting and valves shall be finished by applying PVC fitting covers. PVC covers shall be secured using solvent type PVC adhesive. All circumferential edges shall be further sealed by an overlap of at least 2 inches onto adjacent pipe insulation using PVC tape or all service jacket/ self-sealing lap butt strip material.

3.10 PAINTING AND IDENTIFICATION

A. Painting

1. All painting shall be done in a careful, neat and workmanlike manner, with particular care being exercised to protect building equipment and finishes. All surfaces shall be thoroughly cleaned or rust, scale, dirt, grease, dust, and like items, and sanded so as to provide a bond for new paint. All painted surfaces under this Contract shall be finished in an acceptable manner.

2. Insulation, galvanized piping, and copper piping in crawl spaces, in sump pits, inaccessible pipe spaces, and above ceilings shall not be painted.

3. All unpainted, uncoated, or non-galvanized steel piping, equipment, supports, hangers and other iron and steel work in crawl spaces, and sump pump pit, installed under this Contract, shall be painted with two (2) coats of Rust-Oleum rust preventative paint, or approved equal. First coat shall be Rust-Oleum No. X-60 red primer, or accepted substitute. The second coat shall be Rust-Oleum No. 634 black gloss, or accepted substitute.

B. Pipe Identification

1. All piping (domestic cold water, de-ionized water, fuel gas, chemical waste, laboratory compressed air and laboratory vacuum piping) shall be provided with identification markers. Markers shall be provided as follows:

   a. On straight runs of piping at intervals not exceeding 20-feet

   b. Within 2-feet of all elbows

   c. Within 2-feet of all piping as it passes through partitions (markers provided on both sides of partitions)

C. Valve Tags

1. The Contractor shall tag each valve for the cold water, hot water, hot water circulating, gas lines, laboratory compressed air, laboratory vacuum and de-ionized water systems furnished under this Contract. The Contractor shall prepare three (3) lists on heavy white paper giving the valve number, its location, and the equipment controlled. One (1) list shall be enclosed in a metal frame under glass and mounted in the building where directed by the Owner. The other two (2) copies shall be delivered to the Architect.

2. In buildings where existing piping systems are modified, the new valve tag numbers and list shall be coordinated with existing valve tag numbers and lists and those supplied under other contracts, if applicable.

D. Utility Marking Tape

1. Install detectable utility marking tape above all outside pipelines, 12 inches to 18 inches below grade.

END OF SECTION

SECTION 22 0504
PLUMBING SPECIALTIES

PART 1 GENERAL

1.1 REQUIREMENTS

A. General Conditions of the Contract, Special Conditions, Instructions to Bidders, and other General Requirements contained in Division 01 are a part of these Specifications.

1.2 SECTION INCLUDES

A. Work in this Section includes the following:

1. Cleanouts
2. Floor Drains
3. Hose Bibbs
4. Wall Hydrants
5. Backflow Prevention Devices
6. Water Hammer Arrestors
7. Pressure Gauges
8. Thermometers
9. Domestic Water Pressure Regulating Valves
10. Ice Maker Outlet Boxes

1.3 RELATED SECTIONS

A. All sections of the Project Manual apply to this section.

1.4 SUBMITTALS

A. Submittals shall be in accordance with Section 01 60 00

B. The Contractor shall submit manufacturer's catalog data for the following:

1. Cleanouts
2. Floor Drains
3. Hose Bibbs
4. Wall Hydrants
5. Backflow Prevention Devices
6. Water Hammer Arrestors
7. Pressure Gauges
8. Thermometers
9. Domestic Water Pressure Regulating Valves

10. Hose Stations

11. Ice Maker Outlet Boxes

C. The Contractor shall submit Operation and Maintenance Data for the following:

1. Backflow Prevention Devices

2. Domestic Water Pressure Regulating Valves

PART 2 PRODUCTS

2.1 CLEANOUTS

A. Finished Floor Cleanouts: Coated cast-iron body, taper thread bronze plug, scoriated secured nickel bronze top. Cleanout shall have adjustable housing.

1. Acceptable Manufacturers:

Josam	56010-22
Jay R. Smith	4023
Wade	W-6000-1
Zurn	ZN-1400-BP

B. Carpeted Area Cleanouts: Coated cast-iron body, taper thread bronze plug, scoriated secured nickel bronze top with carpet marker. Cleanout shall have adjustable housing.

1. Acceptable Manufacturers:

Josam	56010-22-14
Jay R. Smith	4023-Y
Wade	W-6000-CM
Zurn	ZN-1400-BP-CM

C. Tile Floors Cleanouts: Coated cast-iron body, taper thread bronze plug, with square top recessed for tile. Cleanout shall have adjustable housing.

1. Acceptable Manufacturers:

Josam	56010-22-12
Jay R. Smith	4163
Wade	W-6000-TS
Zurn	ZN-1400-BP-TX

D. Terrazzo Floors: Coated cast-iron body, taper thread bronze plug, with nickel bronze round top recessed for terrazzo. Cleanout shall have adjustable housing.

1. Acceptable Manufacturers:

Josam	56010-13-1
Jay R. Smith	4183
Wade	W-6000-U

Zurn	Z-1400-BP-Z

E. Wall Cleanouts: Round stainless steel wall access cover with center screw and recessed bronze tapped plug. Provide cleanout with threaded coated cast iron cleanout tee.

1. Acceptable Manufacturers:

Josam	58790
Jay. R. Smith	4472
Wade	W-8480R-8590E
Zurn	ZANB-1468

F. Exposed Piping Cleanouts: Recessed bronze tapped plug in threaded cast-iron cleanout tee.

1. Acceptable Manufacturers:

Josam	58890
Jay R. Smith	4472
Wade	W- 8480R-8590E
Zurn	ZANB-1468

2.2 FLOOR DRAINS

A. Floor Drains

1. See schedules for types and basis of design model numbers.
2. Coated cast-iron floor drain. Outlet type shall be suitable for the type of piping system provided. Provide floor drain with P-trap
3. Acceptable Manufacturers:
   a. Josam
   b. Jay R. Smith
   c. Wade
   d. Zurn

B. Indirect Waste (Hub Drains)

1. See schedules for types and basis of design model numbers.
2. Acceptable Manufacturers:
   a. Josam
   b. Jay R. Smith
   c. Wade
   d. Zurn

2.3 HOSE BIBBS

A. Hose Bibb

Angle pattern hose bibb consisting of a brass body, vacuum breaker-backflow preventer with 3/4 inch male hose thread nozzle, tee-handle and 3/4 inch copper water tube inlet.

1. Acceptable Manufacturers:

Chicago	387RCF
Wolverine Brass	Encore
Woodford	Model 24C

2.4 WALL HYDRANTS

A. Wall Hydrant (Non-Freeze in Wall Box)

Concealed type, automatic draining wall hydrant consisting of a cast brass wall box and door with chrome finish, vacuum breaker-backflow preventer with 3/4-inch male hose thread nozzle, stainless steel operating stem and 3/4-inch copper water tube inlet. A loose tee key shall be furnished with each wall hydrant.

1. Acceptable Manufacturers:

Josam	71000-96
Jay R. Smith	5509QT
Wade	W-8600-175
Zurn	Z-1300
Woodford	B65

1. Acceptable Manufacturers:

Josam	71200
Jay R. Smith	5609
Wade	W-8600
Zurn	Z-1310
Woodford	65

2.5 BACKFLOW PREVENTION DEVICES

A. Backflow prevention devices shall be installed where shown on the drawings and conform to the type required by the local water authority.

B. Units shall be supported in accordance with manufacturer's recommendations.

C. Reduced Pressure Backflow Prevention Device - ANSI/ASSE 1013; bronze body with bronze and plastic internal parts and stainless steel springs; two (2) independently operating, spring loaded check valves with replaceable seats; diaphragm type differential pressure relief valve located between check valves; non-threaded vent outlet; assembled with two (2) gate valves, strainer, and test cocks.

D. Double Check Valve Assemblies - ANSI/ASSE 1015; corrosion resistant internal parts and stainless steel springs; two independently operating check valves, assembled with two (2) gate valves, strainer, and test cocks.

E. Manufacturer and model number shall be approved by the local utility company.

F. Acceptable Manufacturers:

Conbraco

Febco

Watts

Wilkins.

2.6 WATER HAMMER ARRESTORS

A. Water Hammer Arrestors shall be of Type "L", Type "K" copper or stainless steel bellows or piston type construction conforming to ASME A112.26.1M, ASSE 1010 or PDI WH-201. ASME A112.23.1M sizes A through F and PDI-WH201 sizes A through F. Neoprene bellows not allowed.

B. Acceptable Manufacturers:

PPP, Inc.	Series SWA or SC
Sioux Chief	Series 650
Jay R. Smith	Hydrotrol
Zurn	Shoktrol

2.8 PRESSURE GAUGES

A. 4-1/2-inch dial, liquid filled, stainless steel and phosphor bronze movement, gauge cock and throttling device. Pressure range shall be 0 psi to 150 psi.

B. Acceptable Manufacturers:

H.O. Trerice Co.	450LFB
Weiss Instruments	LF4UGY1
Weksler Instruments	AY14-2

2.9 THERMOMETERS

A. 4-inch mercury type. Temperature range shall be 0°F to 200°F.

B. Acceptable Manufacturers:

H.O. Trerice Co.	M80742
Weiss	
Weksler	

2.10 DOMESTIC WATER PRESSURE REGULATING VALVES (PRV)

A. Pressure regulating valves shall be direct acting piston type, bronze body and bell housing, reinforced neoprene diaphragm, renewable model seats, strainer and union connection.

B. Water service applications - 400 psig rated at 160 degrees F. Each regulator shall have a "Y" type bronze strainer, spring range shall be as required for application. Basis of design shall be Wilkins series 500 YSBR. The Contractor shall field assemble regulating stations including bypass piping with shutoff valve and pressure gauge on discharge side of manifold. Each regulating valve shall be isolated with two full port shutoff valves. Field adjust PRV's to maintain required outlet pressure, (maximum of eighty (80) psi or the minimum booster pump suction pressure if it is greater than eighty (80) psi). Where multiple PRV's are installed the small shall be set for ten (10) psig higher than the larger valves.

C. Flow control or special equipment applications - rated for 300 psig at 180 degrees F, built-in thermal bypass, integral strainer and screen. Spring range shall be as required. Provide isolation value and union tailpiece. Field adjust outlet pressure to equipment manufacturers lowest pressure range requirement. Basis of design shall be Wilkins series 600.

D. AcceptAble Manufacturers:

Spence

Watts

Wilkins

2.11 ICE MAKER OUTLET BOXES

A. General: Recessed-mounting outlet boxes with fittings complying with ASME A112.18.1M. Include box with faceplate, services indicated for equipment connections, and wood-blocking reinforcement.

B. With hose connection and the following:

1. Box and Faceplate: Enamel painted or stainless steel.
2. Supply Fitting: ½-inch NPS globe or ball valve and ½-inch NPS copper water tubing.

C. Reinforcement: 2-by-4-inch or 2-by-6-inch, fire-retardant-treated wood blocking between studs.

D. Acceptable Manufacturers:

Guy Grey

Bradley

Willoughby

PART 3 EXECUTION

3.1 INSTALLATION

A. All materials, equipment and accessories shall be installed in strict accordance with manufacturer's recommendations.

B. Provide isolation valves for all fixtures, equipment, and accessories.

C. Drain piping from all backflow preventors, relief valves and vents, drain down connections, kitchen equipment, etc. shall be extended to within 2 inches of a floor sink or floor drain. Minimum piping size shall be 1-1/4" diameter.

3.2 HOSE BIBBS

A. Install at low points of piping systems and were shown on the drawings.

3.3 WALL HYDRANTS

A. Install minimum 24 inches. above grade.

END OF SECTION

SECTION 22 05 48 - SEISMIC RESTRAINT DESIGN

PART 1 GENERAL

1.1 SCOPE

A. Unless otherwise noted, all NG gas piping shall be restrained for this project.

B. Any components that contain flammable or hazardous material or storage racks in occupancies open to the general public and components needed for the continued operation of the facility or whose failure could impair the continued operation of the facility shall be assigned an Importance Factor, (Ip) = 1.5. All other components shall have an Ip =1.0. All seismic restraints, connections, etc. shall be designed for a Seismic Design Category C.

1.2 REQUIREMENTS

A. Responsibilities

1. Contractor shall restrain all components and systems according to the certified drawings received from the design engineering source. All components shall be either mounted to the structure at the base (i.e. on the floor or on the roof), mounted on grade or suspended from the structure. Base mounted components requiring vibration isolation shall be in accordance with this section.

2. Contractor shall as part of the submittal package identify the seismic design source intended to be used to do the seismic restraint design which shall be submitted for approval. A certified seismic design package showing calculations for anchoring and products to be used for anchoring shall be submitted for review by the Engineer of Record.

B. Source

1. The source selected to do the restraint design shall be an independent engineering group with a minimum of five years experience in restraint design.

C. Special Inspections

1. Special inspections will by performed on this project by a Special Inspector employed by the Owner.

2. The contractor's responsibilities associated with Special Inspections shall include the following:
   a. Timely notification to the Special Inspector for each portion of work requiring inspection.
   b. Submit a written statement of responsibility prior to commencement of work on the system or components requiring special inspections.
   c. Submit copy of approved shop drawings and submittals to the Special Inspector.
   d. Correct deficiencies in the presence of the Special Inspector.
   e. For complex deficiencies identified by the Special Inspector, the contractor shall either stop work until the Engineer of Record has rendered judgment or, f the contractor proceeds regardless, the contractor shall be responsible for complete removal and replacement (and any related forensic costs) of any apparent deficiency that is ultimately judged unacceptable by the Engineer of Record.
   f. Provide access to and means for safe and proper inspection of the work.

1.3 DESCRIPTION

A. Intent

1. It is the intent of the seismic restraint portion of this specification to provide restraint of building system non-structural components irrelevant of fragility levels. Restraint systems are intended to withstand the

stipulated seismic accelerations applied through the component center of gravity.

2. All such systems shall be installed in strict accordance with design building code, component manufacturers' and building construction standards. Whenever a conflict occurs between the manufacturer's standards code requirements, the most stringent shall apply.

B. This section is provided for seismic control for the "equipment" as listed below. This section applied to all equipment, systems and material installed as part of the plumbing contract.

C. The work in this section includes the following:

1. Seismic restraints and attachment to the structure for all equipment base mounted, roof mounted and suspended.
2. Seismic design, restraint and attachment of non-building structures used to support equipment on the roof.
3. Certification of seismic restraint designs and installation supervision.
4. Certification of seismic attachment of housekeeping pads.

D. Definitions

1. The term EQUIPMENT used throughout this specification includes ALL non-structural components. These specifications are applicable to components within the facility and components on grade outside the building servicing the facility. Equipment buried underground is excluded but entry of services through the floor or foundation wall is included.

2. POSITIVE ATTACHMENT:

a) Positive attachment location is defined as a location with a cast-in or expansion anchor, a double sided beam clamp, and a welded or bolted connection to structure.

3. TRANSVERSE BRACING:

a) Restraint(s) applied to limit motion perpendicular or angular to the centerline of the pipe, duct or conduit.

4. LONGITUDINAL BRACING:

a) Restraint(s) applied to limit motion along the centerline of the pipe, duct or conduit.

1.4 ORIGINAL EQUIPMENT MANUFACTURER ISOLATION PACKAGES

A. Internal and/or External Systems

1. Substitution of internally or externally restrained equipment in lieu of the restraints specified in this section is acceptable provided all conditions of this section are met. The equipment manufacturer shall provide a letter of guarantee from their engineering department stamped and certified per section 1.5A stating that the seismic restraints are in full compliance with these specifications. Letters from field offices or representatives are unacceptable.

2. All costs for converting to such restraint systems shall be borne by the Contractor.

1.5 SEISMIC CERTIFICATION

A. Seismic Certification and Analysis:

1. Seismic restraint calculations shall be provided for all connections of equipment to the structure. The most stringent of two shall be used for the restraint design. Calculations shall be stamped by an registered professional engineer with at least five years of seismic design experience.

2. Analysis shall indicate calculated dead loads, derived loads and materials utilized for connections to equipment, to non-building structures and to the structure. Analysis shall detail anchoring methods, bolt diameter, embedment and/or weld length.

3. An insurance certificate shall accompany submittals for record prepared by the licensed independent restraint design engineer.

4. The design of the restraints shall be based on the approved equipment submittal for each project.

5. The restraint engineering design source shall provide anchoring size, depth, edge distances, weld design and support design for roof mounted components.

6. The restraint engineering design source shall provide jobsite training for sway brace size, location and method of attachment.

7. The restraint engineering design source shall provide jobsite inspections and installation instructions. Drawings and field supervision shall be provided to insure proper installation and performance of systems.

8. Training, inspections and documentation shall be provided by the design engineering source or by a qualified engineer under the direct guidance of the design engineering source. Documentation shall be prepared and submitted as part of the close out documents certifying the above conditions have been met.

1.6 CODE AND STANDARDS REQUIREMENTS

A. Applicable Codes

1. North Carolina Building Code 2012.
2. ASCE/SEI 7-05 Minimum Design Loads for Buildings and Other Structures
3. All applicable state and local codes.

B. Where conflicts between these documents exist, the more stringent requirement shall apply.

1.7 RELATED WORK

A. Housekeeping Pads

1. Seismic anchoring of and attachment to pads poured separately shall be detailed, designed and certified according to this section by a licensed professional engineer.

2. Housekeeping pads shall be sized to accommodate a minimum of ten (10) bolt diameters of clearance all around the equipment and its mounting package to allow development of full drill-in anchor ratings. If cast-in anchors are to be used, the housekeeping pads shall be sized to accommodate the ACI requirements for bolt coverage and embedment.

B. Attachments

1. Restraint attachment plates cast into housekeeping pads, concrete inserts, double sided beam clamps, etc. are required to be certified under this section. Single sided, or “C” type beam clamps for support rods of overhead piping or any other equipment are not acceptable on this project.

C. Hangers and Supports

1. Products for the support of piping shall be a catalog standard. Where required, hangers shall be U.L. and/or F.M. (Factory Mutual) approved.

PART 2 PRODUCTS

2.1 DESCRIPTION

A. All seismic restraint design shall be by a single design individual or group.

2.2 PRODUCTS DESCRIPTION

A. Seismic Restraint Products

1. Materials used for seismic restraint design shall be with approved manufacturers of specific seismic restraint products and shall include but not be limited to anchor bolts, concrete anchors, A36 steel, pipe clamps, sway bracing and floor mounted restrained isolators. These devices shall bare a recognized approval agency such as UL, ICBO, ASTM or other recognized approval agencies. Devices shall be as manufactured by Loos & Company, Hilti, B-Line, Grinnell, Rawlplug Co., Inc., welding in accordance with AWS, US Steel, Nucor, Grabber Construction Products, Vibration Eliminator, Mason Industries

PART 3 EXECUTION

3.1 GENERAL

A. All vibration isolators and seismic restraint systems shall be installed in strict accordance with the seismic design sources' written instructions.

B. Installation of seismic restraints shall not cause any change of position of equipment, piping or duct work resulting in stresses or misalignment.

C. No rigid connections between equipment and the building structure shall be made that degrade the noise and vibration control system herein specified.

D. The contractor shall not install any equipment, piping, duct or conduit which makes rigid connections with the building unless isolation is not specified. "Building" includes, but is not limited to, slabs, beams, columns, studs and walls.

E. Coordinate work with other trades to avoid rigid contact with the building.

F. Any conflicts with other trades which shall result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions shall be brought to the architects/engineers attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.

END OF SECTION

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 GENERAL

1.1 REQUIREMENTS

A. General Conditions of the Contract, Special Conditions, Instructions to Bidders, and other General Requirements contained in Division 1 and 2 are a part of these Specifications.

1.2 SECTION INCLUDES

A. Work in this Section includes the following:

1. Sinks
2. Emergency Shower/Eye-Face Water Tempering System

1.3 RELATED SECTIONS

A. All sections of the Project Manual apply to this section.

1.4 SUBMITTALS

A. Submittals shall be in accordance with Section 22 01 05 – Shop Drawings and Submittals.

B. The Contractor shall submit manufacturer's catalog data for the following:

1. Sinks
2. Emergency Shower/Eye-Face Water Tempering System
3. Fixture Carriers
4. Faucets and Mixing Valves

C. The Contractor shall submit Operation and Maintenance Data per section 22 01 05 for the following:

1. Faucets and Mixing Valves

PART 2 PRODUCTS

2.1 GENERAL

A. All fixtures shall be furnished complete with traps, faucets, wastes, supplies with stops, etc., as required. All exposed metal parts shall be chromium plated.

B. Fixtures and equipment shall be those of reputable manufacturers and shall be new and the best of their respective kinds.

C. All fixtures and equipment of similar types shall be of the same manufacturer unless indicated otherwise on the drawings or specified herein.

D. Fixtures shall be mounted at mounting heights as indicated.

E. If fixtures and equipment indicated in the Contract Documents are not currently manufactured, the manufacturer's current equivalent to the indicated fixtures and equipment shall be provided at no additional cost, subject to review and acceptance by the Professional.

2.2 PLUMBING FIXTURES

A. Janitors Sinks

1. Janitors Sink (Single Compartment)

27-inch x 27-inch x 16-inch freestanding single compartment sink, fourteen (14) gauge, Type 304 stainless steel. Faucet shall have a vacuum breaker gooseneck spout outlet with pail hook, upper support rod and lever handles with color indexes. Provide sink complete with rough chrome plated cast brass drain, chrome plated cast brass P-trap with cleanout, chrome plated brass waste to wall, chrome plated brass escutcheon, chrome plated brass tailpiece, stainless steel crumb cup strainer, and rigid supplies.

Approved Manufacturers

Elkay

Moen

Just

T & S Brass

2. EWS: Combination Emergency Shower / Eyewash

Pedestal mounted, hand or foot treadle operated, (both required), stainless steel pull rod with stay open valve for shower, stainless steel receptor; twin eyewash head, anti-surge type, with soft plastic covers; sty open type ball valve; face spray ring; automatic pressure regulating control; floor flange. Unit shall meet ANSI Standard and ADA requirements.

FIXTURE	
Guardian	GBF 1909
Haws	8309 WC
Speakman	SE 690-WCH

PART 3 EXECUTION

3.1 INSTALLATION

A. Fixtures and equipment shall be installed in a neat and workmanlike manner and in accordance with the manufacturer's recommendations. The quality of installation shall be subject to the approval of the Professional.

B. All wall mounted fixture carriers and supports shall be suitable to the type of construction wherein they are located.

C. All fixtures and equipment must be protected against damage during the progress of construction. Upon completion of construction, all fixtures and equipment must be thoroughly cleaned and left in perfect working order. All piping and accessories having polished, plated or finished surfaces shall be protected to prevent scarring or other damage and protect the finish against damage.

D. Provide isolation valves for all fixtures, equipment, and accessories.

1. Exception: Omit stop valves on supplies to emergency equipment, except where permitted by authorities having jurisdiction. When permitted, install valve locked in OPEN position.

E. All fixture supplies and waste lines shall be run to wall unless construction requires they be run to floor. All supplies through walls shall be provided with angle stops. All supplies through floors shall be provided with straight stops. Unions shall be provided adjacent to all equipment or wherever necessary to facilitate the removal

of equipment for repair or replacement. Unions for copper tubing up to and including 2 inch diameter shall be brass ground joint with socket ends for solder. Unions for copper tubing 2-1/2 inches in diameter and over shall be standard brass flanges with socket ends for solder. Flanges to be drilled for ASA Standard 125 pounds flanges and so stamped. No lip type unions or long screws will be permitted. The Contractor shall furnish and install all structural steel angles, channels, etc. necessary to properly support all fixtures and equipment to the satisfaction of the Professional.

F. Drain piping from all backflow preventers, relief valves and vents, drain down connections, etc. shall be extended to within 4 inches of a floor sink or floor drain.

3.2 MOUNTING HEIGHTS

A. Plumbing fixture mounting heights shall be as indicated on the drawings. Mounting heights for barrier free fixtures shall meet the requirements of the ADA Accessibility Guidelines. These guidelines shall apply unless superseded by more stringent State or Local requirements.

END OF SECTION

SECTION 23 11 23
NATURAL GAS SYSTEMS AND SPECIALTIES

PART 1 - GENERAL

1.1 GENERAL

A. General Conditions of the Contract, Special Conditions, Instructions to Bidders, and other General Requirements contained in Division 00 and 01 are a part of these Specifications.

B. The cited examples are used only to denote the quality standard of product desired and that they do not restrict bidders to a specific brand, make, manufacturer or specific name; that they are used only to set forth and convey to bidders the general style, type, character and quality of product desired; and that equivalent products will be acceptable.

1.2 SUMMARY

A. Section Includes:

1. Valves.
2. Strainers.
3. Natural gas pressure regulators.
4. Natural gas pressure relief valves.
5. Fuel gas Piping

B. Related Sections:

1. Division 05 - Structural Steel Framing: Product requirements for touch-up painting of structural steel.
2. Division 05 - Steel Joist Framing: Product requirements for touch-up painting of steel joists.
3. Division 07 – Fire stopping: Product requirements for fire stopping for placement by this section.
4. Division 08 - Access Doors and Frames: Access doors for concealed valves and accessories.
5. Division 09 - Painting and Coating: Product requirements for painting for placement by this section.
6. Section 23 0548 – VIBRATION AND SIESMIC
7. Section 23 0553 – IDENTIFICATION
8. Division 31 - Soils for Earthwork: Soils for backfill in trenches.
9. Division 31 - Aggregates for Earthwork: Aggregate for backfill in trenches.
10. Division 31 - Excavation: Product and execution requirements for excavation and backfill required by this section.

11. Division 31 - Trenching: Execution requirements for trenching required by this section.

12. Division 31 - Fill: Requirements for backfill to be placed by this section.

1.3 REFERENCES

A. Refer to Section 23 05 01 for complete listing of references.

1.4 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.

B. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves, equipment.

1.5 SUBMITTALS

A. Section 01 60 00 Submittal procedures.

B. Product Data:

1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.

2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.

3. Piping Specialties: Submit manufacturers catalog information including capacity, rough-in requirements, and service sizes for the following:

a. Strainers.

b. Natural gas pressure regulators.

c. Natural gas pressure relief valves.

4. Design Data: Indicate pipe size. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

5. Test Reports: Indicate results of Utility Natural Gas Main piping system pressure test.

6. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

7. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12-months.

1.6 CLOSEOUT SUBMITTALS

A. Division 01 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of valves, piping system, and system components.

C. Operation and Maintenance Data: Submit for valves and gas pressure regulators installation instructions, spare parts lists, and exploded assembly views.

1.7 QUALITY ASSURANCE

A. Perform natural gas Work in accordance with NFPA 54.

B. Perform work in accordance with applicable state and federal codes and local gas company requirements.

C. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

D. Perform Work in accordance with applicable codes and AWS D1.1 for welding hanger and support attachments to building structure.

E. Furnish shutoff valves complying with ASME B16.33 or ANSI Z21.15.

F. Maintain one copy of each document on site.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

C. Design piping system hangers and supports under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of North Carolina.

1.9 PRE-INSTALLATION MEETINGS

A. Division 01 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one (1) week prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Division 01 - Product Requirements: Product storage and handling requirements.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain in place until installation. Furnish temporary protective coating on cast iron and steel valves.

1.11 ENVIRONMENTAL REQUIREMENTS

A. Division 01 - Product Requirements.

B. Do not install underground piping when bedding is wet or frozen.

1.12 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.13 COORDINATION

A. Division 01 - Administrative Requirements: Requirements for coordination.

B. Coordinate trenching, excavating, bedding, and backfilling of buried piping systems with requirements of Division 31 sections.

1.14 WARRANTY

A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 - PRODUCTS

2.1 BALL VALVES

A. Manufacturers:

1. Crane Valve, North America
2. Hammond Valve
3. Milwaukee Valve Company
4. NIBCO, Inc.
5. Stockham Valves & Fittings

B. ¼-inch to 1-inch: MSS SP 110, Class 125, two-piece, threaded ends, bronze body, chrome plated bronze ball, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, full port.

C. 1 ¼-inch to 3-inch: MSS SP 110, Class 125, two-piece, threaded ends, bronze body, chrome plated bronze ball, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and NG, conventional port.

2.2 STRAINERS

A. Manufacturers:

1. Mueller Steam Specialty
2. O.C. Keckley Company
3. Spirax Sarco, Inc.

B. 2-inch and Smaller: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32-inch stainless steel perforated screen.

C. 2 ½-inches to 4-inch: Flanged iron body for 175 psig working pressure, Y pattern with 3/64-inch stainless steel perforated screen.

D. 5-inch and Larger: Flanged iron body for 175 psig working pressure, basket pattern with 1/8-inch stainless steel perforated screen.

2.3 NATURAL GAS PRESSURE REGULATORS

A. Manufacturers:

1. Fisher Regulators

2. Norgas Controls, Inc.

3. Sensus Metering

4. Maxitrol Co.

B. Gas pressure regulators shall be diaphragm actuated with cast iron body, aluminum diaphragm chamber, and all internal parts designed for use with natural gas. Regulators shall be adjustable, with automatic loading, automatic low pressure cut-off, and full internal relief. The regulator shall be adjusted for outlet pressure indicated on the drawings. The outlet pressure shall not vary more than 1-inch w.c. from the set point at specified capacity. The regulator shall be capable of complete shut-off in the event the supply pressure is interrupted or the gas demand exceeds the regulator capacity and shall remain off until the regulator is manually reset. The regulator shall have a weatherproof, bug proof, screened vent cap installed in the vent tapping.

1. Temperatures: minus 20 degrees F to 150 degrees F.

2. Body: Cast iron.

3. Spring case, lower diaphragm casing, union ring, seat ring and disk holder: Aluminum.

4. Disk, diaphragm, and O-ring: Nitrile.

5. Maximum inlet pressure: 150 psig.

6. Furnish sizes 2-inches and smaller with threaded ends. Furnish sizes 2 ½-inches and larger with flanged ends.

2.4 NATURAL GAS PRESSURE RELIEF VALVES

A. Manufacturers:

1. Fisher Regulators

2. Norgas Controls, Inc.

3. Sensus Metering

4. Maxitrol Co.

B. Product Description: Spring loaded type relief valve.

1. Body: Aluminum.

2. Diaphragm: Nitrile
3.

4. Orifice: Brass

5. Maximum operating temperature: 150 degrees F.

6. Inlet Connections: Threaded.

7. Outlet or Vent Connection: Same size as inlet connection.

2.5 FUEL GAS PIPING

A. Aboveground (2-inch and smaller):

Piping: Schedule 40 black steel pipe, ASTM A53

Fittings: Threaded, 150 pound malleable iron fittings, ANSI B16.3

B. Aboveground (2½ -inch and larger):

Piping: Schedule 40 black steel pipe, ASTM A53

Fittings: Forged steel butt welding type, ASTM A234

C. Underground (polyethylene)

Piping: SDR11 polyethylene, (PB2306/PE2405), ASTM D2513 The Contractor shall submit a letter from the Gas Company confirming their approval of this material.

Fittings: Heat fusion or mechanical joints

PART 3 - EXECUTION

3.1 EXAMINATION

A. Division 01 - Administrative Requirements: Coordination and project conditions.

B. Verify excavations are to required grade, dry, and not over-excavated.

3.2 COORDINATION

A. Coordinate installation of natural gas service with the local public utility company. Coordinate meter location and installation.

B. Connect to meter and continue on into building.

3.3 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install hangers and supports in accordance with ASME B31.9

B. Support horizontal piping hangers as scheduled.

C. Install hangers to provide minimum ½-inch space between finished covering and adjacent work.

D. Place hangers within 12-inches of each horizontal elbow.

E. Install hangers to allow 1½-inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

F. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.

G. Where installing several pipes in parallel and at same elevation, provide multiple pipe hangers or trapeze hangers.

H. Prime coat exposed steel hangers and supports in accordance with Division 09.

I. Finish paint exposed steel hangers and supports in accordance with Division 09. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

J. Install pipe hangers and supports in accordance with Section 22 11 04.

3.5 INSTALLATION - BURIED PIPING SYSTEMS

A. Install natural gas piping in accordance with NFPA 54.

B. Verify connection size and location of Gas Utility Meter assembly are as indicated on Drawings.

C. Establish elevations of buried piping with not less than 3 FEET of cover.

D. Establish minimum separation of regulator vents from openings and air intakes in accordance with fuel gas code.

E. Remove scale and dirt on inside of piping before assembly.

F. Excavate pipe trench in accordance with Division 31 sections.

G. Install pipe to elevation as indicated on Drawings or as required by utility company.

H. Install pipe on prepared bedding.

I. Route pipe in straight line.

J. Install pipe to allow for expansion and contraction without stressing pipe or joints.

K. Install plastic ribbon tape continuously over top of pipe, buried below finish grade, above pipe line; coordinate with Division 31 sections.

L. Install trace wire or traceable metallic-foil ribbon tape continuously over top of pipe, buried below finish grade, above pipe line; coordinate with Division 31.

M. Pipe Cover and Backfilling:

1. Backfill trench in accordance with Division 31.

2. Maintain optimum moisture content of fill material to attain required compaction density.

3. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in 6-inches compacted layers to 6-inches minimum cover over top of jacket. Compact to 95 percent maximum density.

4. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.

5. Do not use wheeled or tracked vehicles for tamping.

3.6 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

A. Install natural gas piping in accordance with NFPA 54.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient.

D. Install piping to conserve building space and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Sleeve pipe passing through partitions, walls and floors. Refer to Section 23 05 29.

H. Install fire-stopping at fire rated construction perimeters and openings containing penetrating sleeves and piping. Refer to Division 07.

I. Provide clearance for installation of insulation and access to valves and fittings.

J. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Division 08.

K. Where pipe support members are welded to structural building framing, scrape, brush clean, weld, and apply one coat of zinc rich primer. Refer to Division 05.

L. Provide support for utility meters in accordance with requirements of utility company.

M. Install vent piping from gas pressure reducing valves to outdoors and terminate in weatherproof hood.

N. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting. Refer to Division 09.

O. Install identification on piping systems including underground piping. Refer to Section 22 05 53.

P. Install valves with stems upright or horizontal, not inverted.

Q. Shutoff valves for natural gas system shall be plug valves.

R. Protect piping systems from entry of foreign materials by temporary covers, completing sections of

the Work, and isolating parts of completed system.

S. Install 2-psig gas pressure regulator with tee fitting between regulator and upstream shutoff valve. Cap or plug one opening of tee fitting.

T. Install <1-psig gas pressure regulator with tee fitting not less than 10 pipe diameters downstream of regulator. Cap or plug one opening of tee fitting.

U. Install gas pressure regulator with independent vent full size opening on regulator and terminate outdoors.

V. Install gas pressure regulator with independent vent full size of opening on regulator and terminate outdoors.

3.7 FIELD QUALITY CONTROL

A. Division 01 - Quality Requirements; Division 01 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

B. Pressure test natural gas piping in accordance with NFPA 54.

C. Inspect, test and purge gas piping in accordance with NFPA 54 Code and local gas company requirements.

D. When pressure tests do not meet specified requirements, remove defective work, replace and retest.

E. Pipe Hanger Spacing:

PIPE SIZE Inches	STEEL PIPE MAXIMUM HANGER SPACING Feet	STEEL PIPE MINIMUM HANGER ROD DIAMETER Inches
3/4	7	3/8
1	7	3/8
1-1/4	7	3/8
1-1/2	9	3/8
2	10	3/8
2-1/2	10	1/2
3	10	1/2
4	10	5/8
5	10	5/8
6	10	3/4
8	10	3/4

END OF SECTION

DIVISION 23 - MECHANICAL SPECIFICATIONS
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23 52 16	CONDENSING BOILERS
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23 82 39	UNIT HEATERS

SECTION 23 00 03

FIRESTOPPING

PART 1 GENERAL REQUIREMENTS

1.1 SCOPE OF WORK:

A. General

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the patching and repair of building structure, finishes and building assemblies as specified hereinafter.

2. Furnish all labor, materials, tools and equipment and perform all penetrations in connection with the installation of fire stopping systems required to seal all penetrations of required rated partitions, walls or assemblies Division 15 material and equipment.

B. Descriptions:

1. Patch and repair all building finishes, structural components, or other appurtenances that are removed or damaged as a result of the performance of this contract. Patch and repair work shall include finishes, components, substructure and materials required for the installation of such work in accordance with standard practices.

2. All penetrations through exterior walls, floors, and roof systems shall be sealed watertight.

3. Firestop all new openings in walls, roofs, slabs and similar assemblies at pipe, duct, conduits, equipment and appurtenances.

4. Patched and repaired work shall be finished to match existing or adjacent construction and conditions.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

A. In addition to this section, the Contractor shall refer to other Divisions of the specifications and drawings to ascertain the extent of work required for the materials being furnished and installed.

1.3 QUALITY ASSURANCE

A. Materials:

1. Materials shall be new, unused, properly stored and matching existing in colors, texture, finish, appearance and function.
2. Fire stopping and smoke stopping materials shall be delivered to the job site ready to install and require no critical mixing procedures or precise installation time constraints.
3. Materials shall be delivered to the site in sealed containers, fully identified with manufacturer's name, brand, type, grade and U.L. and FM labels. Store materials in a dry space under cover and off the ground.
4. Products shall be applied in strict accordance with their listing and manufacturers' application requirements.

B. Code and Standards: All work shall meet or exceed the standards and procedures (latest editions) of the following:

1. ASTM E814, Fire Tests of Through-Penetration Firestop Systems.

2. UL 1479, Through-Penetration Firestop Systems.
3. UL 8418 Duct Fire Protection

C. Provide UL approved details for firestop systems that will be used by the contractor.

D. Manufacturer: The following fire-stopping sealant manufacturers are acceptable:

1. Nelson
2. Thomas & Betts
3. 3M
4. Hilti
5. GE
6. Fyre Putty

E. The following waterproofing sealant manufacturers are acceptable:

1. TREMCO
2. Sonneborn-Contech
3. W.R. Meadows

F. The following smoke stopping manufacturers are acceptable:

1. Nelson
2. Thomas & Betts
3. 3M

PART 2 PRODUCTS

2.1 FIRESTOPPING:

A. Firestopping material shall maintain its dimension and integrity while preventing the passage of flame, smoke and gases under conditions of installation and use when exposed to the ASTM E119 time-temperature rating of the assembly penetrated.

B. All material shall be listed by U.L. or other agencies recognized by the N.C. Department of Insurance.

2.2 SMOKESTOPPING:

A. Smoke-stop shall provide an effective barrier against the spread of smoke.

B. All material shall be listed by U.L. or other agencies recognized by the N.C. Department of Insurance.

2.3 WATERPROOFING:

A. Sealant materials shall be as follows:

1. Penetrations of Fire Rated assemblies shall meet the requirements of 2.1 FIRESTOPPING specified hereinbefore.
2. Exterior joint sealant shall be Polyurethane base, multi-component; self-leveling type for application in vertical joints; capable of withstanding movement of up to 50% of joint width and satisfactorily handled throughout temperature of 4 to 27 degrees C.; uniform, homogeneous, and free from lumps, skins and coarse particles when mixed; Shore “A” hardness of minimum 15 and maximum 50; non-staining; non-bleeding; colors selected by Architect/Engineer.

PART 3 EXECUTION

3.1 GENERAL

A. Follow requirements in related sections of specifications.

B. Exercise care in the performance of this contract so as not to damage any building components and finishes, outside components, shrubs, or other appurtenances.

C. Clean and prepare joints for sealant application in accordance with manufacturer's recommendations. Ensure that joint forming materials are compatible with sealant.

D. Openings larger than required for proper installation of pipe or duct shall be patched or repaired.

E. Protect the roof at all times. Provide planking, plywood, supports, and other materials and means to ensure damage is not incurred.

3.2 EQUIPMENT PENETRATIONS:

A. Seal all openings into equipment resulting from installation of equipment such as piping and conduit.

B. Repair all insulation damaged during installation of equipment.

END OF SECTION

SECTION 23 00 04

SUBSTITUTION OF EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The general provision of the Contract, including General and Supplementary Conditions, and General Requirements, apply to the work specified in this Section.

1.2 BIDDERS OPTIONS:

A. The Prime Bidders have the following options of providing all items to be used in the Construction of this project.

1. For products specified only by reference standard, select product meeting that standard by any manufacturer.

2. For products specified by naming several brand names or manufacturers, select one which complies with the technical Specifications.

1.3 USE OF ALTERNATIVE BID:

A. If the plans list three (3) acceptable products, and the contractor prefers another brand of material, then such brand may be bid as an alternate to the base bid.

B. Requests for substitutions of products may be made during the bidding period by submitting completed substitution request accompanied by information sufficient for the Engineer to make a determination as to the equivalency of a product.

C. The Engineer will consider requests utilizing this section for substitution of products in place of those specified.

D. Submit 10 calendar days prior to Bid Date. No substitutions will be reviewed or accepted after this date.

E. Substitution requests may be submitted by U.S. Postal Service, e-mail or facsimile machine (FAX).

F. Prime Bidders shall request a substitution on the letterhead stationary of the Prime Bidder submitting the request. Requests from individual manufacturers will not be accepted.

G. Submit separate request for each substitution. Support each request with the following information. All items must be addressed.

H. Complete data substantiating compliance of proposed substitutions with requirements stated in Contract Documents:

1. Product identification, including manufacturer's name and address.

2. Manufacturer's literature, identifying:

a) Product description.
b) Reference standards.
c) Performance and test data.

3. Samples, as applicable.

4. Name and address of similar projects on which product has been used and date of each installation.

5. Itemized comparison of the proposed substitution with product specified, listing significant variations.

6. Data relating to changes in construction schedule, if any.

7. All effects of substitution on separate contracts.

8. List of changes required in other work or products.

9. Designation of availability of maintenance services and sources of replacement parts.

I. Substitutions will not be considered for acceptance when:

1. Acceptance will require substantial revision of Contract Documents.

2. In judgment of Architect, substitution request does not include adequate information for a complete evaluation.

3. Requests for substitutions not submitted by a Prime Bidder.

4. Where the effect on the schedule will be negative.

1.4 BIDDERS REPRESENTATION:

A. In making formal request for substitution, the Prime Bidder represents that:

1. The Prime Bidder has investigated proposed product and has determined that it is equivalent to or superior in all respects to that specified.

2. The Prime Bidder will provide the same warranties or bonds for substitution as for product specified.

3. The Prime Bidder will coordinate installation of accepted substitution into the Work and will make such changes as may be required for the Work to be complete in all respects.

1.5 ARCHITECT'S DUTIES

A. Issue an addendum to identify accepted substitutions.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 23 01 00 - MECHANICAL GENERAL

PART 1 GENERAL REQUIREMENTS

1.1 DEFINITIONS:

A. Piping: Pipe, fittings, flanges, valves, controls, hangers, supports, traps, drains, gauges, insulation, vents and items customarily required in connection with the transfer of fluids.

B. Provide: Furnish and install complete ready for use. Substitutions for specified materials must be approved at least 10 days prior to bidding.

C. Furnish: Purchase and deliver to the project site complete with every necessary appurtenance and fitting for complete installation. Approved shop drawings must be received prior to purchasing any materials.

D. Install: Unload at the delivery point and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project. Coordination with other trades is mandatory.

E. Concealed: Embedded in masonry or other construction, installed behind wall furring, above ceilings, in crawl spaces, in shafts or otherwise not visible.

F. Exposed: Not concealed.

G. By other Trades: Shall mean by persons or parties who are not anticipated to be the Subcontractor for this trade working together with the Prime Contractor. In this context the words “by other trades” shall be interpreted to mean not included in the overall contract.

H. Contractor: As used in this Division of the specification refers to the Mechanical Contractor unless specifically noted otherwise.

1.2 INTERPRETATION OF CONTRACT DOCUMENTS:

A. This section of the specifications and related drawings describe general provisions applicable to every section of Division 23.

B. Attention is directed to, General Conditions, which are binding in their entirely on this portion of the work and in particular to paragraphs concerning materials, workmanship and substitutions.

C. Mention in these specifications, indications and reasonable implications on drawings, whereby articles, materials, operation or methods related to execution of the mechanical work are noted, specified, drawing or described, thereby requires execution of each such item of work and provision of all labor, materials, equipment and appurtenances required for execution thereof.

D. Particular attention is directed to the drawings and other contract documents for information pertaining to required items or work which are related to and usually associated with the work of this Division of the specifications, but which are to be provided as part of the work of other Divisions of the specifications.

E. No exclusions from, or limitations in, the language used in the drawings or specifications shall be interpreted as meaning that the appurtenance or accessories necessary to complete any required system or item of equipment are to be omitted.

F. The drawings of necessity utilize symbols and schematic diagrams to indicate various items of work. Neither of these have any dimensional significance nor do they delineate every item required for the intended installations. The work shall be installed, in accordance with the intent diagrammatically expressed on the drawings, and in conformity with the dimensions indicated on final architectural and structural working drawings and on equipment shop drawings. No interpretation shall be made from the limitations of symbols

and diagrams that any elements necessary for complete work are excluded. When abbreviations appear on the drawings or specification in lower case letter with or without periods, their meanings shall be the same as stated above.

G. Certain details appear on the drawings which are specific with regard to the dimensioning and positioning of the work. These details are intended only for the purpose of establishing general feasibility. They do no obviate field coordination for the indicated work.

H. Information as to the general construction shall be derived from structural and architectural drawings and specifications only.

I. The use of words in the singular shall be considered as limited where other indications denote that more than one item is referred to.

J. Submission of a proposal and ultimate acceptance of an agreement or contract for execution of this section of work will be construed as evidence that the Prime Contractor, Subcontractor and Vendor has carefully read and accepts all conditions set forth in each division, insofar as such conditions may affect both the bidding for and execution of this section of work.

1.3 QUALITY ASSURANCE

A. All equipment and materials required for installation under these specifications shall be new and without blemish or defect. All equipment shall bear labels attesting to Underwriters Laboratories approval where subject to Underwriters Laboratories label service. Where no specific indication as to the type or quality of material or equipment is indicated, a first-class standard article shall be furnished. All manufacturers of equipment and materials pertinent to these items shall have been engaged in the manufacturers of said equipment a minimum of three (3) years and, if so directed by the Designer, be able to furnish proof of their ability to delivery this equipment by submitting affidavits supporting their claim.

B. Each major component of equipment shall have the manufacturer's name, address, model number and rating on a plate securely affixed in a conspicuous place. The nameplate of a distributing agent will not be acceptable. UL or other label, or other data which is die-stamped into the surface of the equipment shall be stamped in a location easily visible. Performance as delineated in schedules and in the specifications shall be interpreted as minimum performance.

C. All equipment of one type (such as fans, valves, etc.) shall be the products of one manufacturer unless specifically stated otherwise.

D. Where the specifications do not list a specific model number for a manufacturer, the construction of a product shall be equal to those models specifically listed.

E. All welders shall be certified by the Welding Bureau of the Mechanical Contractors Association of America for the appropriate service, and shall perform all welding in accordance with Welding Bureau's procedures and the ASA Code for pipe welding. Welding and welder qualifications shall be in accordance with ASME Section IX. All welders certifications shall be submitted to the engineer for approval for all materials to be welded.

1.4 REQUIREMENTS OF REGULATORY AGENCIES:

A. Contractors shall submit to the appropriate Regulatory Agencies all items necessary to obtain all required permits obtain such required permits and pay all required fees.

B. All work shall conform to the following Standards and Codes (applicable edition):

1. North Carolina State Building Code.
2. National Fire Protection Association.

3. Uniform Boiler and Pressure Vessel Act of N.C. (Boiler Code)

C. Where applicable, all fixtures, equipment, and materials shall be as approved or listed by the following:

1. Factory Mutual Laboratories (FM).
2. Underwriters Laboratories, Inc. (UL).
3. CSA
4. ETL
5. AGA
6. AWWA

D. All fuel fired equipment shall meet the requirements of the agencies listed and also meet the Owner's insurer requirements.

1.5 STANDARDS AND PROCEDURES:

1. ADC: Air Diffusion Council.
2. AMCA: Air Moving and Conditioning Association, Inc.
3. ANSI: American National Standards Institute.
4. API: American Petroleum Institute.
5. ARI: American Refrigeration Institute.
6. ASHRAE: American Society of Heating, Refrigeration and Air Conditioning Engineers.
7. ASME: American Society of Mechanical Engineers.
8. ASTM: American Society of Testing and Materials.
9. IBR: Institute of Boiler and Radiator Manufacturers.
10. MSS: Manufacturers Standardization Society.
11. NEMA: National Electrical Manufacturer's Association.
12. OSHA: Occupational Safety and Health Administration.
13. SMACNA: Sheet Metal and Air Conditioning Contractors National Association, Inc.

B. Where reference is made to ASA Standards it shall be understood that this reference is to the standards published by ANSI.

C. Include all items of labor and materials required to comply with such standards and codes. Where quantity, sizes or other requirements indicated on the drawings or herein specified are in excess of the standard or code requirements, the specifications or drawings, respectively, shall govern.

1.6 VERIFICATION OF DIMENSIONS AND LOCATIONS:

A. The Contractor shall visit the premises and thoroughly familiarize himself with all details of the work, working conditions, verify all dimensions in the field, advise the Designer of any discrepancy, and submit shop drawings of any changes he proposes to make, in quadruplicate for approval, before starting the work. Contractor shall install all equipment in a manner to avoid building interference.

B. The location of duct, pipe, fixture, equipment and appurtenances for existing facilities are shown on plans to indicate the extent of work required. Exact condition shall be field verified.

1.7 COORDINATION WITH OTHER TRADES:

A. Each contractor is to review all drawings and documentation of other trades to ensure all construction requirements are understood and will be provided for a complete installation.

B. Coordinate all work of each section with work of other sections to avoid interference. Bidders are cautioned to check their equipment against space available as indicated on drawings, and shall make sure that proposed equipment can be accommodated. If interferences occur and clearances cannot be maintained as recommended by manufacturer and as required for maintenance and inspection of equipment, Contractor shall bring them to the attention of Designer, in writing, prior to signing of contract; or, Contractor shall, at his own

expense, provide proper materials, equipment, and labor to correct any damage due to defects in his work caused by such interferences.

C. Coordination drawings: Contractor shall prepare coordination drawings showing coordination between trades for all above-ceiling areas, sleeves, and mechanical and electrical equipment rooms. Contractor shall conduct a review meeting with the commissioning team of the coordination drawings prior to commencing any rough-in of commissioned systems, and any comments by the commissioning team shall be addressed and incorporated in the coordination drawings prior to rough-in.

1.8 WORKMANSHIP

A. Workmen to be thoroughly experienced and fully capable of installing assigned work. Work to be in accordance with the best standard practice of the trade. Work that is not of good quality will require removal and reinstallation at no additional expense to Owner and as approved.

B. All material and equipment to be installed in accordance with manufacturer's printed recommendations (using recommended accessories) and/or as approved by the Designer. Retain a copy on job site and submit others for approval when required.

PART 2 PRODUCTS

THIS PART NOT USED.

PART 3 EXECUTION

3.1 LEED PROJECT REQUIREMENTS

A. This is not a LEED certified project. Refer to specification section 01 10 10 Sustainable Design Requirements for additional information and contractor responsibilities.

3.2 SURFACE CONDITIONS:

A. Inspection:

1. Prior to any work, the Contractor shall carefully inspect the installed Work of all other Trades and verify that all such Work is complete to the point where his installation may properly commence.

2. Verify that all equipment may be installed in accordance with all pertinent codes and regulations, the original design and the referenced standards.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Designer.
2. Do not proceed with installation in areas of discrepancy until such discrepancies have been fully resolved.

3.3 INSTALLATION

A. Install all equipment and appurtenances in strict accordance with the manufacturer's recommendations.

3.4 PROTECTION AND CLEANING OF SYSTEMS AND EQUIPMENT

A. Protect all materials and equipment from damage during storage at the Site and throughout the construction period. In the event of damage prior to final inspections, the Contractor shall repair or replace damaged items as determined by the Architect/Engineer, at no cost to the Owner.

B. Damage from rain, dirt, sun, and ground water shall be prevented by storing the equipment on elevated supports and covering them on all sides with securely fastened protective rigid or flexible waterproof coverings.

C. Piping shall be protected by storing it on elevated supports and capping the ends with suitable closure material to prevent dirt accumulation in the piping.

D. During construction cap the top of all piping installed vertically.

E. Periodically during construction and prior to Owner acceptance of the building, Contractor shall remove from the premises and dispose of all packing material and debris. All adjacent occupied areas shall be cleaned daily to remove dirt and debris resulting from this work.

3.5 WELDING

A. All welded piping shall be installed by Contractor using NCPWB or ASME Certified Welding Procedures. Welding shall comply with ANSI/ASME B31.1 and Section IX of the ASME Boiler and Pressure Code.

B. All welded piping shall be hydrostatically tested for pressure of 1-1/2 times the working pressure of the line, but not less than 200 psig. This hydrostatic test shall be witnessed by the Designer.

C. Ten days before any welded work is to start, the Contractor shall furnish the Designer copies of the welding procedures approved for the Contractor.

D. Before any welder is put to work in welding any piping for this job, the Designer shall be furnished with duplicate copies of the certification of each welder. If, in the opinion of the Designer, the welding is not done properly, a coupon shall be cut from field welds for inspection and/or the welder may be required to pass a recertification test. Costs of cutting the coupon shall be the responsibility of the Contractor. Also all welds shall be subject to non-destructive x-ray examination by Owner. Contractor will be responsible for all costs of non-destructive x-ray examination, including all remedial repair work and retesting of welding that is determined to be unsatisfactory.

E. No welding is to be covered with insulation or concealed until the welding has been approved by the Designer as outlined above.

F. All welding operations shall be approved by the Designer prior to beginning work. Extreme care shall be exercised to prevent damage to the existing buildings or building or surrounding contents during welding operations.

G. During welding of all piping, contractor shall use fire resistant or equal pad protection to prevent scorching or burning of existing floor and wall finishes, etc. Also, care shall be taken to eliminate sparks from dropping on existing furniture, equipment and flooring material. All damages created by welding flame or sparks shall be repaired to owner's satisfaction at contractor's expense.

3.6 SUBSTITUTION OF EQUIPMENT

A. Requests for substitutions of products may be made during the bidding period by submitting completed substitution request accompanied by information sufficient for the Engineer to make a determination as to the equivalency of a product.

B. The Engineer will consider requests utilizing this section for substitution of products in place of those specified.

C. Submit 14 calendar days prior to Bid Date. No substitutions will be reviewed or accepted after this date unless there is an obvious advantage to the Owner.

D. Substitution requests may be submitted by U.S. Postal Service or electronic mail (email).

E. Prime Bidders shall request a substitution on the letterhead stationary of the Prime Bidder submitting the request. Requests from individual manufacturers will not be accepted.

F. Submit separate request for each substitution. Support each request with the following information. All items must be addressed.

G. Complete data substantiating compliance of proposed substitutions with requirements stated in Contract Documents:

1. Product identification, including manufacturer's name and address.

2. Manufacturer's literature, identifying:

a) Product description.
b) Reference standards.
c) Performance and test data.

3. Name and address of similar projects on which product has been used and date of each installation.

4. Itemized comparison of the proposed substitution with product specified, listing significant variations.

5. Data relating to changes in construction schedule, if any.

6. All effects of substitution on separate contracts.

7. List of changes required in other work or products.

8. Designation of availability of maintenance services and sources of replacement parts.

H. Substitutions will not be considered for acceptance when:

1. Acceptance will require substantial revision of Contract Documents.

2. In judgment of Engineer, substitution request does not include adequate information for a complete evaluation.

3. Requests for substitutions not submitted by a Prime Bidder.

4. Where the effect on the schedule will be negative.

I. In making formal request for substitution, the Prime Bidder represents that:

1. The Prime Bidder has investigated proposed product and has determined that it is equivalent to or superior in all respects to that specified.

2. The Prime Bidder will provide the same warranties or bonds for substitution as for product specified.

3. The Prime Bidder will coordinate installation of accepted substitution into the Work and will make such changes as may be required for the Work to be complete in all respects.

3.7 SUBMITTALS

A. Refer to Division 1 for information on submittal requirements. When conflicts exist, Division 1 shall apply.

B. The terms "Submittals" can generally be used to indicate any information which is required to be reviewed by the A/E before further action on that product can be taken by the Contractor. This may include product data sheets, shop drawings, and schedules.

C. Submittals generally not required when equipment is purchased exactly as specified and scheduled. Submit list of such equipment only. Equipment data sheets must be included in project manual prepared for Owner.

D. PRODUCT SUBMITTALS

The following product data information shall be submitted:

PRODUCT	SUBMITTED	APPROVED
Dielectric Fittings	_____	_____
Fans (Includes Exhaust & HRU)	_____	_____
Fire Stop Material	_____	_____
Flexible Pipe Connections	_____	_____
Flow Control Fittings/Valves	_____	_____
Temperature Controls/BAS	_____	_____
Terminal Heat Transfer Units	_____	_____
Test Wells, Thermometers	_____	_____
Welder Qualifications	_____	_____

E. TEST AND REPORT SUBMITTALS:

The following list may be used as a checklist for the Contractor and A/E. All tests may not be listed.

1. <u>TEST</u>

   a) System start-up
   b) Test and Balance Agency Construction report.
   c) Gas piping pressure test
   d) Required Pressurization Systems

F. CONTROL SUBMITTAL:

Submit drawings on control systems including the following.

1. All control components
2. All information necessary for a clear representative of the system to be provided.

G. FIRE PENETRATION SYSTEMS SUBMITTAL:

1. Each type system penetrating a fire rated assembly shall be identified by the Contractor. The Contractor shall demonstrate his understanding of fire stop systems by the following:

2. Submit 3/4 inch scale drawings of each assembly indicating type penetrations, slab, floor, wall or roof system, fire stop materials used, thickness and all other pertinent details. Submittal shall be neatly and accurately drafted.

3. Each type system penetrating a fire rated assembly shall be identified by the Contractor. Provide approved installation details with agency approval indicated thereon.

3.8 RECORD DRAWINGS:

A. The Contractor shall keep a record set of drawings on the job and, as construction progresses, shall show the actual installed location of all items, material and equipment of these job drawings.

B. At the time of final inspection, two corrected sets of prints and sepias shall be delivered to the Designer. All drawing costs to be paid by the Contractor.

C. Sepias shall be corrected deleting incorrect locations and showing installed locations in accordance with information transferred from job drawing.

D. Qualified draftsmen shall perform this task.

3.9 OPERATION AND MAINTENANCE MANUALS:

A. The Contractor shall compile and bind three (3) sets of all manufacturer's instructions and descriptive literature on all items of equipment furnished under this work.

B. Binder shall be hard cover, three-ring notebook, 11" x 8-1/2" with heavy duty rings. Maximum binder size shall be 2-1/2".

C. The front of the binder shall be titled "Mechanical Operating and Maintenance Instructions," with the name of the job and documents date under the title.

D. Operating and Maintenance Instructions shall include the following:

1. A sheet in each binder listing the architect, engineer, and all contractors. List addresses and phone numbers.
2. List name, address and phone number of organization responsible for warranty work if other than contractor and the specific work for which he is responsible.
3. List name, address and phone number of the nearest sales and the nearest service organization for each product.
4. Schedules of all equipment indicating identification number shown on plans cross referenced to field applied identification tag number.
5. Performance Curves: For pumps, balance valves and similar equipment at the operating conditions.
6. Lubrication Schedule: Indicating type and frequency of lubrication required.
7. List of Spare Parts: Recommended for normal service requirements. Each piece of equipment shall have this list clearly marked or attached to this submittal.
8. Parts List: Identifying the various parts of the equipment for repair and replacement purposes.
9. Instruction Books: May be standard booklets but shall be clearly marked to indicate applicable equipment and characteristics.
10. Wiring Diagrams: Generalized diagrams are not acceptable, submittal shall be specifically prepared for this Project.
11. Automatic Controls: Diagrams and functional descriptions.
12. Test and Balance Reports.
13. Valve tag list: Identifying valve type, size, service and general location.
14. Filter schedule: Identifying filter type, size efficiency, manufacturer and equipment number.
15. Ceiling marker schedule.

E. The following diagrams, schematics and lists shall be framed under glass and hung adjacent to equipment, in mechanical rooms, or where directed by Owner.

1. Automatic control diagrams.
2. Valve Tag List

3.10 OPERATIONAL AND MAINTENANCE INSTRUCTION:

A. After all final tests and adjustments have been complete, a competent employee of the Contractor shall be provided to instruct the Owner's Representative in all details of operation and maintenance for equipment installed. Supply qualified personnel to operate equipment for sufficient length of time after instructions to assure that Owner's Representative is qualified to take over operation and maintenance procedures. Instruction periods shall be as designated by the Owner and shall not necessarily be consecutive. Minimum instruction periods shall be a follows:

1. Air distribution system and Exhaust Systems (1/2 working day)

B. Instruction period shall be performed during the forty-five (45) days following final acceptance at time periods as approved by Owner.

3.11 CONTROLS OPERATION AND MAINTENANCE INSTRUCTION:

A. Upon completion of Operation and Maintenance instructions, competent employees of the Control Contractor shall be provided to instruct the Owner's representative in all details of operation and maintenance for the controls installed. Supply qualified personnel to operate system for sufficient length of time after instructions to assure the Owner's Representative is qualified to take over operation and maintenance procedures.

B. Instruction periods shall be as designated by the Owner and shall not necessarily be consecutive. Minimum instruction periods shall be one (1) working day for on-site training.

C. Instructional period shall be performed during the forty-five (45) days following final aceptance at time periods as approved by Owner. One (1) day of instructions shall be in a formal classroom setting as determined by the owner.

3.12 GENERAL COMPLETION AND DEMONSTRATION:

A. RESULTS EXPECTED:

1. All systems and controls shall be complete, tested and operational.

2. All start-up and testing and balancing shall be complete.

3. All equipment shall be thoroughly cleaned. All excess materials and all debris shall be removed from the site.

4. All walls, floors, ceilings and other surfaces marred or otherwise damaged as a result of execution of this contract shall be cleaned and repaired to the satisfaction of the Designer and Owner.

END OF SECTION

SECTION 23 05 18

METERS AND GAGES FOR HVAC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Flow meters.

B. Pressure gages and pressure gage taps.

C. Thermometers and thermometer wells.

D. Static pressure gages.

E. Filter gages.

1.2 ENVIRONMENTAL REQUIREMENTS

A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.1 TURBINE FLOW METER

A. Flow meter shall be dual turbine insertion flow sensor complete with all installation hardware necessary to enable insertion and removal of the flow meter without system shutdown. The dual turbine element shall have contra-rotating axial turbine elements, each with its own rotational sensing system, and an averaging circuit to measurement errors due to swirl and flow profile distortion. Paddle type rotors will not be acceptable. Rotational sensing of each turbine shall be accomplished electronically by sensing impedance change and not with magnetic or photo-electric means. Each sensor shall be individually calibrated and tagged accordingly against the manufacturers primary standards which must be accurate to within 0.1% and traceable to the U.S. National Institute of Standards and Technology (NIST). The flow meters shall be Onicon Model F-1210 or approved equal.

B. The sensor shall have a maximum operating pressure of 400 PSI, maximum operating temperature of 200ºF (optional 300ºF peak) and a pressure drop of less than 1 PSI at 17 feet per second flow velocity. Flow sensor shall have 100:1 turndown ratio. Accuracy shall be within ± 0.5% of actual reading at the calibrated typical velocity, and within ± 2% of reading over a 50:1 turndown (from 0.4 to 20 ft/s).

C. The sensor shall have integral analog outputs of 0-10 VDC and 4-20 mA current output for connection to the Central Control System. The sensor shall also include three integral frequency outputs, (top turbine, bottom turbine, average frequency) for diagnostic purposes and for connection to peripheral equipment (local display, BTU meter, etc.). All outputs shall be linear with flow rate.

D. The turbine elements shall be made of polypropylene (optional polysulfone) with sapphire jewel bearings and tungsten carbide shafts. The flow sensor shall be constructed of plated brass (optional 316 stainless steel) with an aluminum electronics enclosure and gasketed cover (optional weathertight enclosure

2.2 PRESSURE GAGES

A. Manufacturer: Trerice No. 500X

B. Other acceptable manufacturers offering equivalent products.
   1. Dwyer
   2. Miljoco
   3. Weiss
   4. Weksler

C. Gage: Shall be 4-1/2" dial with stainless steel or cast aluminum case. Movement stainless steel and bourdon tube phosphor bronze. Accuracy, .5% of dial range with zero adjustment. Provide snubber or throttling screw, inculated socket (.20" orifice). Trerice No. 500X or equal.

D. All gauges shall have brass valve. Graduation in feet.

2.3 PRESSURE GAGE TAPPINGS

A. Gage Valve: Brass 1/4" ball valve.

B. 1/4 inch NPT for minimum 150 psig,

2.4 STEM TYPE THERMOMETERS

A. Acceptable manufacturers
   1. Trerice
   2. Miljoco
   3. Weksler
   4. Weiss

B. Thermometer: ASTM E1, adjustable angle, red appearing mercury, lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device

   1. Size: 9 inch scale.
   2. Window: Clear glass.
   3. Stem: 3/4 inch NPT brass.
   4. Accuracy: 2 percent.
   5. Calibration: Degrees F., 2 degrees per graduation.

2.5 THERMOMETER SUPPORTS

A. Pipe Socket: Brass separable sockets with insulation extensions as required.

2.6 TEST PLUGS

A. Test Plug: 1/4 inch or 1/2 inch brass or stainless steel fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F.

2.7 PORTABLE FLOW METERS:

A. Provide for the Owner a portable indicating flow meter with 152 mm (6") round dial, 4.71 rad (270 degrees) indication and of the dual rupture proof liquid filled bellows type with integral temperature compensation. The meter shall have overrange protection in either direction equal to the working pressure equivalent of the instrument which shall be 1724 kPa (250 psig) at 121 degrees C (250 degrees F). The accuracy of the meter shall be plus or minus 2 percent of full scale. The meter shall be waterproof and coated with appropriate paint. It shall have external zero and range adjusting screws. Scale shall indicate differential pressure and a

range of 0 kPa – 24.9 kPa (0”-100” W.G.)

B. Provide two 3657 m (12’) hoses in carrying case with handle.

C. Include complete operating instructions with each meter.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide one pressure gage per pump, installing taps on suction and discharge of pump. Pipe to gage.

C. Install pressure gages with pulsation dampers. Provide valves to isolate each gage. Extend nipples to allow clearance from insulation.

D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation. Dip thermometer stems in heat conducting paste before installing in wells.

E. Install thermometer sockets adjacent to controls systems transmitter.

F. Provide instruments with scale ranges selected according to service.

G. Install gages and thermometers in locations where they are easily read from normal operating level. Install gages and thermometers in mechanical room at eye level.

H. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

I. Locate test plugs adjacent thermometers and thermometer sockets adjacent to pressure gages and pressure gage taps adjacent to control device sockets.

J. Provide pressure gages and thermometers at inlet and outlet of each air handler coil, pump, duct heating coil, boilers, and where shown on the drawings.

K. Provide thermometer in each air handler main supply and return duct.

L. Provide filter manometer for each air handler.

END OF SECTION

SECTION 23 05 29 - SUPPORTS AND ANCHORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe and equipment hangers and supports.

B. Sleeves and seals.

C. Flashing and sealing equipment and pipe stacks.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Placement of inserts sleeves in walls and slabs.

B. Placement of roof sleeves, vents, and curbs.

1.3 REFERENCES

A. ASME B31.2 - Fuel Gas Piping

B. ASME B31.9 - Building Services Piping

C. ASTM F708 - Design and Installation of Rigid Pipe Hangers.

D. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.

E. MSS SP69 - Pipe Hangers and Supports - Selection and Application.

F. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

1.4 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: Provide manufacturers catalog data including load capacity.

C. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

D. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

1.5 REGULATORY REQUIREMENTS

A. Conform to applicable code for support of hydronic piping.

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Pipe hangers for insulated piping shall be sized to fit around the pipe covering. Contractor shall provide at each hanger a galvanized insulation protection shield formed to fit the outside of the covering. Shield shall extend above center line on both sides. Shield to be #18 gauge up to 3” pipe, #16 gauge up to 6” pipe and #14 gauge for 8” and larger. Provide rigid insulation under all hangers. See Section 23 07 00, Insulation.

B. Hydronic Piping:
1. Conform to MSS SP58.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch (13 to 38 mm): Carbon steel, adjustable swivel, split ring.
3. Wall Support for Pipe Sizes to 3 Inches (76 mm): Cast iron hook.
4. Wall Support for Pipe Sizes 4 Inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
5. Vertical Support: Steel riser clamp.
6. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.2 ACCESSORIES

A. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

2.3 FLASHING

A. Metal Flashing: 26 gage galvanized steel.

B. Metal Counter-flashing: 22 gage galvanized steel.

C. Lead Flashing:
1. Waterproofing: 5 lb/sq ft (24.5 kg/sq m) sheet lead
2. Soundproofing: 1 lb/sq ft (5 kg/sq m) sheet lead.

D. Flexible Flashing: 47mil thick sheet compatible with roofing.

E. Caps: Steel, 22 gage (0.8 mm) minimum; 16 gage (1.5 mm) at fire resistant elements.

2.4 EQUIPMENT CURBS Not Applicable

2.5 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage (1.2 mm thick) galvanized steel.

B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage galvanized steel.

C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.2 INSERTS

A. Provide inserts for placement in concrete walls and slabs as noted on plans.

B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

3.3 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping as scheduled.

B. Install hangers to provide minimum 1/2 inch (13 mm) space between finished covering and adjacent work.

C. Place hangers within 12 inches (300 mm) of each horizontal elbow.

D. Use hangers with 1-1/2 inch (38 mm) minimum vertical adjustment.

E. Support riser piping independently of connected horizontal piping.

F. Provide copper plated hangers and supports for copper piping.

G. Design hangers for pipe movement without disengagement of supported pipe.

H. Prime coat exposed steel hangers and supports. Refer to Division 9. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.4 EQUIPMENT BASES AND SUPPORTS Not Applicable

3.5 FLASHING

A. Provide flexible flashing and metal counterflashing where piping penetrate weather or waterproofed walls and roofs.

B. Adjust storm collars tight to pipe with bolts; calk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.6 SLEEVES

A. Set sleeves in position in formwork. Provide reinforcing around sleeves.

B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

C. Where piping penetrates floor or wall, close off space between pipe and adjacent work with fire stopping material and calk as per UL approved detail. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

D. Install chrome plated steel escutcheons at finished surfaces.

3.7 SCHEDULES

	PIPE SIZE Inches	MAX. HANGER SPACING Feet (m)	HANGER ROD DIAMETER Inches (mm)
1.	1/2 to 1-1/4	6.5 (2)	3/8 (9)
2.	1-1/2 to 2	10 (3)	3/8 (9)
3.	2-1/2 to 3	10 (3)	1/2 (13)
4.	4 to 6	10 (3)	5/8 (15)
5.	8 to 12	12 (3.7)	7/8 (22)

END OF SECTION

SECTION 23 05 48 - SEISMIC AND WIND RESTRAINT DESIGN

PART 1 GENERAL

1.1 SCOPE

A. Unless otherwise noted, all life safety components and gas piping shall be under consideration to be restrained for this project.

B. Any life safety components, components that contain flammable or hazardous material or storage racks in occupancies open to the general public and components needed for the continued operation of the facility or whose failure could impair the continued operation of the facility shall be assigned an Importance Factor, (Ip) = 1.5. All other components shall have an Ip =1.0.

1.2 REQUIREMENTS

A. Responsibilities

1. Contractor shall restrain all components and systems according to the certified drawings received from the design engineering source. Components shall be isolated in accordance with manufacturers recommendations and accepted industry standards. All components will be either mounted to the structure at the base (i.e. on the floor or on the roof), mounted on grade or suspended from the structure. Base mounted components requiring vibration isolation shall be in accordance with this section.

2. Contractor shall, as part of the submittal package, identify the seismic design source intended to be used to do the seismic restraint design which will be submitted for approval. A certified seismic design package showing calculations for anchoring and products to be used for anchoring shall be submitted for record.

B. Source

1. The source selected to do the restraint design will be an independent structural or civil engineer or engineering group with a minimum of five years experience in restraint design and who is not affiliated with or a representative of any manufacturer of restraint devices.

1.3 DESCRIPTION

A. Intent

1. It is the intent of the seismic restraint portion of this specification to provide restraint of building system non-structural components irrelevant of fragility levels. Restraint systems are intended to withstand the stipulated seismic accelerations applied through the component center of gravity.

2. All such systems must be installed in strict accordance with design building code, component manufacturers and building construction standards. Whenever a conflict occurs between the manufacturer's standards code requirements, the most stringent shall apply.

B. This section is provided for seismic control for the "equipment" as listed below. This section applies to all equipment, systems and material installed as part of the HVAC, plumbing, electrical and fire protection contracts.

C. The work in this section includes the following:

1. Seismic restraints and attachment to the structure for all equipment base mounted, roof mounted and suspended.

2. Seismic design, restraint and attachment of non-building structures used to support equipment on the roof.
3. Certification of seismic restraint designs and installation supervision.
4. Certification of seismic attachment of housekeeping pads.

D. Definitions

1. The term EQUIPMENT used throughout this specification includes ALL non-structural components. These specifications are applicable to components within the facility and components on grade outside the building servicing the facility. Equipment buried underground is excluded but entry of services through the floor or foundation wall is included.

2. LIFE SAFETY SYSTEMS Defined:

a) All systems involved with fire protection including sprinkler piping, service water supply piping, water tanks, fire dampers and smoke exhaust systems.

b) All systems involved with and/or connected to emergency power supply including all flow paths to fire protection systems.

c) Fresh air relief systems on emergency control sequence including air handlers, conduit, duct, dampers, etc.

3. POSITIVE ATTACHMENT:

a) Positive attachment location is defined as a location with a cast-in or expansion anchor, a double sided beam clamp, and a welded or bolted connection to structure.

4. TRANSVERSE BRACING:

a) Restraint(s) applied to limit motion perpendicular or angular to the centerline of the pipe, duct or conduit.

5. LONGITUDINAL BRACING:

a) Restraint(s) applied to limit motion along the centerline of the pipe, duct or conduit.

1.4 SEISMIC CERTIFICATION

A. Seismic Certification and Analysis:

1. Seismic restraint and wind load calculations will be provided for all connections of equipment to the structure. The most stringent of two will be used for the restraint design. Calculations will be stamped by an independent registered professional engineer with at least five years of seismic design experience.

2. Analysis must indicate calculated dead loads, derived loads and materials utilized for connections to equipment, to non-building structures and to the structure. Analysis will detail anchoring methods, bolt diameter, embedment and/or weld length.

3. An insurance certificate must accompany submittals for record prepared by the licensed independent restraint design engineer.

4. The design of the restraints will be based on the approved equipment submittal for each project.

5. The restraint engineering design source will provide anchoring size, depth, edge distances, weld design and support design for roof mounted components.

6. The restraint engineering design source will provide jobsite training for sway brace size, location and method of attachment.

7. The restraint engineering design source will provide jobsite inspections and installation instructions. Drawings and field supervision will be provided to insure proper installation and performance of systems.

8. Training, inspections and documentation will be provided by the design engineering source or by a qualified engineer under the direct guidance of the design engineering source. Documentation will be prepared and submitted as part of the close out documents certifying the above conditions have been met.

1.5 CODE AND STANDARDS REQUIREMENTS

A. Applicable Codes

1. North Carolina Building Code 2012.
2. SMACNA Guidelines for seismic restraint of HVAC systems
3. All applicable state and local codes.
4. NFPA-13 & 14 for fire protection systems.
5. ASCE/SEI-7-05 Minimum Design Loads for Buildings and Other Structures

B. Where conflicts between these documents exist, the more stringent requirement shall apply.

1.6 RELATED WORK

A. Housekeeping Pads

1. Seismic anchoring of and attachment to pads poured separately shall be detailed, designed and certified according to this section by a licensed professional engineer.

2. Housekeeping pads shall be sized to accommodate a minimum of ten (10) bolt diameters of clearance all around the equipment and its mounting package to allow development of full drill-in anchor ratings. If cast-in anchors are to be used, the housekeeping pads shall be sized to accommodate the ACI requirements for bolt coverage and embedment.

B. Attachments

1. Restraint attachment plates cast into housekeeping pads, concrete inserts, double sided beam clamps, etc. are required to be certified under this section. Single sided, or “C” type beam clamps for support rods of overhead piping, ductwork, fire protection, or any other equipment are not acceptable on this project.

C. Hangers and Supports

1. Products for the support of piping shall be a catalog standard as manufactured by National Pipe Hanger, or approved equal. (Where required, hangers must be U.L. and/or F.M. (Factory Mutual) approved (i.e. Fire Sprinkler Hangers).

PART 2 PRODUCTS

2.1 DESCRIPTION

A. All seismic and/or wind restraint design shall be by a single design individual or group.

2.2 PRODUCTS DESCRIPTION

A. Seismic and Wind Restraint Products

1. Materials used for seismic or wind restraint design will be with approved manufacturers of specific seismic restraint products and will include but not be limited to anchor bolts, concrete anchors, A36 steel, pipe clamps, sway bracing and floor mounted restrained isolators. These devices will bare a recognized approval agency such as UL, ICBO, ASTM or other recognized approval agencies. Devices shall be as manufactured by Loos & Company, Hilti, B-Line, Grinnell, Rawlplug Co., Inc., welding in accordance with AWS, US Steel, Nucor, Grabber Construction Products, Vibration Eliminator, Mason Industries

PART 3 EXECUTION

3.1 GENERAL

A. All vibration isolators and seismic restraint systems must be installed in strict accordance with the seismic design sources' written instructions.

B. Installation of seismic restraints must not cause any change of position of equipment, piping or duct work resulting in stresses or misalignment.

C. No rigid connections between equipment and the building structure shall be made that degrade the noise and vibration control system herein specified.

D. The contractor shall not install any equipment, piping, duct or conduit which makes rigid connections with the building unless isolation is not specified. "Building" includes, but is not limited to, slabs, beams, columns, studs and walls.

E. Coordinate work with other trades to avoid rigid contact with the building.

F. Any conflicts with other trades which shall result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions should be brought to the architects/engineers attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.

G. The hot water boiler and associated flues shall be restrained in accordance with the manufacturer's recommendations.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Stencils.

D. Pipe Markers.

1.2 REFERENCES

A. ASME A13.1 - Scheme for the Identification of Piping Systems.

PART 2 PRODUCTS

2.1 NAMEPLATES

A. Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.2 TAGS

A. Metal Tags: Brass Aluminum Stainless Steel with stamped letters; tag size minimum 1-1/2 inch diameter.

B. Chart: Typewritten letter size list in 3-ring notebook. Chart shall be included in the O & M Manuals.

2.3 STENCILS

A. Stencils: With clean cut symbols and letters of following size:
1. ¾" to 1¼ " Outside Diameter of Insulation or Pipe: 8" long color field, ½" high letters.
2. 1½" to 2" Outside Diameter of Insulation or Pipe: 8" long color field, ¾" high letters.
3. 2 ½" to 6" Outside Diameter of Insulation or Pipe: 12" long color field, 1¼" high letters.
4. 8" to 10" Outside Diameter of Insulation or Pipe: 24" long color field, 2½" high letters.
5. Over 10" Outside Diameter of Insulation or Pipe: 32" long color field, 3½" high letters.
6. Ductwork and Equipment: 2½" high letters.

B. Stencil Paint: As specified in Division 9, semi-gloss enamel, colors conforming to ASME A13.1.

2.4 PIPE MARKERS

A. Color: Conform to ASME A13.1.

B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

2.5 EQUIPMENT NAMEPLATES

A. Provide engraved plastic laminated (5 in x 4 in) labels on all equipment. Labels shall include equipment number, area(s) or equipment served (use actual room numbers used at the facility-not architectural room numbers), final acceptance date (S.C.D.), extended warranty period, number and size of filters and capacity. The following are examples of labeling to be used. Provide correct data:

1	Air Handling Units:	AHU-1	(Classrooms # 212, 213, 214 &215)
		S.C.D.:	08/01/2008
		Filters:	8(24”x24”x2”) & 6(24”x12”x2”)
		Capacity:	14000 CFM @ 1.0” ESP
2	Condensing Units:	CU-1	(Office # 202 & 203)
		S.C.D.:	08/01/2008 (5 years Comp. Warranty)
		Capacity:	3 Tons
3	Terminal Units:	TU-2	(Office # 122 & Storage # 122A)
		S.C.D.:	08/01/2008
		Filters:	1(60”x10”x1”)
		Capacity:	1200 CFM
4	Boilers:	B-1	(Buildings # 100 & 200)
		S.C.D.:	08/01/2008
		Input:	1000 MBH
		Output:	900 MBH
5	Pumps:	HWP-1	(P-3)
		S.C.D.:	08/01/2008
		Capacity:	250 GPM @ 55 FT
6	Fans:	EF-1	(Toilets # Boys & Girls)
		S.C.D.:	08/01/2008
		Capacity:	1000 CFM @ 0.5” ESP
7	VFDs:	VFD-1	(AUH-1, Supply Fan)
		VFD-2	(AUH-1, Return Fan)

2.6 CEILING MARKER TAGS FOR ISOLATION VALVES

A. Description: Phenolic, 3" x 2", with the valve number engraved on it.

B. Tags shall be permanently attached by screws to the ceiling grid directly under the valves.

C. Color code as follows:
1. Red – Hot water valves
2. Green – Domestic water valves

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Section 09900 for stencil painting.

3.2 INSTALLATION

A. Install plastic nameplates with corrosive resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Apply stencil painting in accordance with Division 9.

D. Install plastic pipe markers in accordance with manufacturer's instructions.

E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

G. Identify air handling units, pumps, heat transfer equipment, terminal units, tanks, and water treatment devices with equipment nameplate and stencil painting. Small devices, such as in-line pumps, may be identified with tags.

H. Identify control panels and major control components outside panels with plastic nameplates.

I. Identify thermostats relating to terminal boxes or valves with nameplates.

J. Identify valves in main and branch piping with tags.

K. Tag automatic controls, instruments, and relays. Key to control schematic.

L. Identify piping, concealed or exposed, with plastic pipe markers. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

M. Identify ductwork with stenciled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

N. Provide ceiling tags to locate valves or dampers above T-bar type panel ceilings. Tags shall be permanently attached by screws to the ceiling grid as close as possible to directly under the valves.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 COORDINATION AND RESPONSIBILITY

A. The work of this Section shall be provided as indicated and specified.

B. The Contractor shall engage the services of an independent Test and Balance Contractor (TAB) whose sole business is systems air and hydronic balancing to balance and test all of the installed systems. The HVAC Contractor shall be prepared to fully assist the Test and Balance Contractor in order that all work is accomplished with minimum conflict and delay.

C. All Test and Balance Work shall be coordinated with HVAC commissioning. See the Commissioning Specification Section for an outline of the special requirements of the TAB Contractor to meet Commissioning Specifications.

1.2 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

B. Testing, adjustment, and balancing of hydronic systems.

C. Measurement of final operating condition of HVAC systems.

D. Recording of measured data in a final report.

1.3 REFERENCES

A. AABC - National Standards for Total System Balance.

B. ADC - Test Code for Grilles, Registers, and Diffusers.

C. ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.

D. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

E. SMACNA - HVAC Systems Testing, Adjusting, and Balancing.

1.4 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division-1.

B. Record actual locations of flow and pressure measuring stations, balancing valves.

1.5 QUALIFICATIONS

A. Agency: Company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum three years experience, certified by AABC or NEBB.

B. Perform Work under supervision of AABC Certified Test and Balance registered Professional Engineer experienced in performance of this work and licensed in the State of North Carolina.

1.6 PRE-BALANCING CONFERENCE

A. Convene one week prior to commencing work. Include all pertinent contractors.

1.7 SEQUENCING

A. Sequence work to commence after completion of systems and schedule completion of work before Final Acceptance of Project.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

3.1 PRE-BALANCE COORDINATON

A. The HVAC Contractor shall complete all work under the mechanical contract and shall fully coordinate with the Test and Balance Contractor to ensure the following conditions:
1. Systems are started and operating in a safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Control and adjustment devices on equipment are accessible.
4. Proper thermal overload protection is in place for electrical equipment.
5. Filters are clean and in place.
6. Duct systems are clean of debris.
7. Fans are rotating correctly.
8. Fire and volume dampers are in place and open.
9. Air coil fins are cleaned and combed.
10. Access doors are closed and duct end caps are in place.
11. Air outlets are installed and connected.
12. Duct system leakage is minimized.
13. Hydronic systems are flushed, filled, and vented.
14. Pumps are rotating correctly.
15. Proper strainer baskets are clean and in place.
16. Service and balance valves are open.

B. Submit field reports.

C. Beginning of work means acceptance of existing conditions.

3.2 SYSTEM VERIFICATION

A. The Test and Balance Contractor shall verify that all systems are complete and operable prior to commencing work. The Mechanical Contractor shall fully cooperate with the Test and Balance Contractor (TAB) to insure that the mechanical work is complete to the point where the TBC can accomplish the balancing in accordance with the specifications.

3.3 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make technician and instruments available to Engineer to facilitate spot checks during testing.

B. Provide additional balancing devices as required.

3.4 INSTALLATION TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for air conditioning systems and plus or minus 10 percent of design for exhaust systems.

B. Hydronic Systems: Adjust to within plus or minus 2 percent of design.

3.5 ADJUSTING

A. Ensure recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Engineer.

3.6 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required air quantities.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures control.

E. Use volume control devices to regulate air quantities only to the extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct mounted devices.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet. Provide summary report with all tests and equipment data included.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

I. Adjust automatic, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. Where modulating dampers are provided, take measurements and balance at extreme conditions.

L. Measure building and/or system static pressure and adjust supply, return, and relief air systems to provide required relationship between each to maintain approximate positive static pressure called for.

M. Check all motorized dampers for leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.

3.7 WATER SYSTEM PROCEDURE

A. Adjust water systems to provide required or design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gages to determine flow rates for system balance. Where flow-metering devices are not installed, base flow balance on suitable temperature difference.

C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.8 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing

1. Fans
2. Packaged DX Air Handling Units
3. Split System Air Handling Units
4. Air Filters
5. Air Inlets and Outlets
6. Pumps
7. Boilers
8. Terminal Heat Transfer Units (All types)

B. Report Forms: **Note that all reports shall be made on NEBB forms.**

1. Title Page:
   a) Name of Testing, Adjusting, and Balancing Agency
   b) Address of Testing, Adjusting, and Balancing Agency
   c) Telephone number of Testing, Adjusting, and Balancing Agency
   d) Project name
   e) Project location
   f) Project Architect
   g) Project Engineer
   h) Project Contractor
   i) Project altitude
   j) Report date

2. Summary Comments:

a) Design versus final performance
b) Notable characteristics of system
c) Description of systems operation sequence
d) Summary of outdoor and exhaust flows to indicate amount of building pressurization
e) Nomenclature used throughout report
f) Test conditions

3. Instrument List:
   a) Instrument
   b) Manufacturer
   c) Model number
   d) Serial number
   e) Range
   f) Calibration date

4. Electric Motors:
   a) Manufacturer
   b) Model/Frame
   c) HP/BHP
   d) Phase, voltage, amperage; nameplate, actual, no load
   e) RPM
   f) Service factor
   g) Starter size, rating, heater elements
   h) Sheave Make/Size/Bore

5. V-Belt Drive:
   a) Identification/location
   b) Required driven RPM
   c) Driven sheave, diameter and RPM
   d) Belt, size and quantity
   e) Motor sheave diameter and RPM
   f) Center to center distance, maximum, minimum, and actual

6. Cooling Coil Data:
   a) Identification/number
   b) Location
   c) Service
   d) Manufacturer
   e) Air flow, design and actual
   f) Entering air DB temperature, design and actual
   g) Entering air WB temperature, design and actual
   h) Leaving air DB temperature, design and actual
   i) Leaving air WB temperature, design and actual
   j) Air pressure drop, design and actual

7. Heating Coil Data:
   a) Identification/number
   b) Location
   c) Service
   d) Manufacturer
   e) Air flow, design and actual
   f) Water flow, design and actual
   g) Water pressure drop, design and actual
   h) Entering water temperature, design and actual

i) Leaving water temperature, design and actual
j) Entering air temperature, design and actual
k) Leaving air temperature, design and actual
l) Air pressure drop, design and actual

8. Pump Data:
   a) Identification Number
   b) Manufacturer
   c) Size/Model
   d) Impeller
   e) Service
   f) Design flow rate, pressure drop, BHP
   g) Actual flow rate, pressure drop, BHP
   h) Discharge pressure
   i) Suction pressure
   j) Total operating head pressure
   k) Shut off, discharge suction pressures
   l) Shut off, total head pressure

9. Combustion Test:
   a) Boiler Manufacturer
   b) Model number
   c) Serial number
   d) Firing rate
   e) Overfire draft
   f) Gas meter timing dial size
   g) Gas meter time per revolution
   h) Gas pressure at meter outlet
   i) Gas flow rate
   j) Heat input
   k) Burner manifold gas pressure
   l) Percent carbon monoxide (CO)
   m) Percent carbon dioxide (CO2)
   n) Percent oxygen (O2)
   o) Percent excess air
   p) Flue gas temperature at outlet
   q) Ambient temperature
   r) Net stack temperature
   s) Percent stack loss
   t) Percent combustion efficiency
   u) Heat output

10. Air Moving Equipment
    a) Location
    b) Manufacturer
    c) Model number
    d) Serial number
    e) Arrangement/Class/Discharge
    f) Air flow, specified and actual
    g) Return air flow, specified and actual
    h) Outside air flow, specified and actual
    i) Total static pressure (total external), specified and actual
    j) Inlet pressure
    k) Discharge pressure

l) Sheave Make/Size/Bore
m) Number of Belts/Make/Size
n) Fan RPM

11. Return Air/Outside Air Data:
    a) Identification/location
    b) Design air flow
    c) Actual air flow
    d) Design return air flow
    e) Actual return air flow
    f) Design outside air flow
    g) Actual outside air flow
    h) Return air temperature
    i) Outside air temperature
    j) Required mixed air temperature
    k) Actual mixed air temperature
    l) Design outside/return air ratio
    m) Actual outside/return air ratio

12. Exhaust/Makeup Air Fan Data:
    a) Location
    b) Manufacturer
    c) Model number
    d) Serial number
    e) Air flow, specified and actual
    f) Total static pressure (total external), specified and actual
    g) Inlet pressure
    h) Discharge pressure
    i) Sheave Make/Size/Bore
    j) Number of Belts/Make/Size
    k) Fan RPM

13. Duct Traverse:
    a) System zone/branch
    b) Duct size
    c) Area
    d) Design velocity
    e) Design air flow
    f) Test velocity
    g) Test air flow
    h) Duct static pressure
    i) Air temperature
    j) Air correction factor

14. Duct Leak Test:
    a) Description of ductwork under test
    b) Duct design operating pressure
    c) Duct design test static pressure
    d) Duct capacity, air flow
    e) Maximum allowable leakage duct capacity times leak factor
    f) Test apparatus
        1) Blower
        2) Orifice, tube size
        3) Orifice size

4) Calibrated

g) Test static pressure

h) Test orifice differential pressure

i) Leakage

15. Air Distribution Test Sheet:

a) Air terminal number

b) Room number/location

c) Terminal type

d) Terminal size

e) Area factor

f) Design velocity

g) Design air flow

h) Test (final) velocity

i) Test (final) air flow

j) Percent of design air flow

C. Reports:

1. All of the above required data shall be neatly compiled into a typed brochure. Each copy of the final report shall bear the signatures of the persons who recorded the data and the signature of the balance supervisor of the performing firm and shall have his Professional Engineer's seal affixed to the report.

2. The TAB Contractor shall "flag" or otherwise clearly indicate all airflow readings, water flow readings, etc., that do not meet specifications, including possible causes for the deficiencies. The "flagged defects and deficiencies shall be noted and brought to the attention of the HVAC Contractor, Owner and Architect. All final reports shall be submitted directly to the Owner, or his representative, for review and approval.

END OF SECTION

SECTION 23 07 00

HVAC INSULATION

PART 1 GENERAL

1.1 WORK INCLUDED

A. Work required under this section consists of insulation for piping and duct system and equipment specified in Division 23.

B. Provide all necessary labor, materials, tools and equipment to perform work required on the drawings and specified herein.

C. All pipe fittings, valves, and strainers to be insulated.

D. Certain equipment and/or systems to be factory insulated by manufacturer. Factory insulation materials to be as specified in applicable sections of the specifications.

1.2 DEFINITIONS

A. Thermal resistance “R” values are expressed in units of “Hour-Degrees F-sq. ft./Btu per inch of Thickness” on a flat surface at a mean temperature of 75 degrees F unless noted otherwise.

B. Thermal conductivity (K), the reciprocal of "R", btu/hr/ft^2/degree.

C. Insulation to consist of insulating material, jacket, mastic, and adhesive, either as a “system” or as an individual component when used separately.

1.3 QUALITY ASSURANCE / CERTIFICATION

A. Unless noted otherwise, all insulation, adhesives, coatings, sealers, and tapes to have a flamespread rating of 25 or less and smoke development of 50 or less when tested in accordance with ASTM E-84, NFPA 225 AND UL 723.

B. Apply insulation in a workmanlike manner using experienced, qualified tradesmen.

C. Do not apply insulation until all pressure testing has been completed, inspected and released or insulation application.

D. Clean and dry surfaces prior to insulation application.

E. Butt insulation joints firmly together; smoothly and securely install all jackets and tapes.

F. Insulation jacket for duct, pipe, and equipment exposed to weather to be certified as self-extinguishing in less than 53 seconds when tested in accordance with ASTM D1692.

G. Certify that all duct and piping insulation meets the minimum requirements of the current State Energy Code for New Building Construction.

1.4 APPLICABLE CODES AND STANDARDS

A. ASTM E-84

B. NFPA 255

C. UL 723

D. NFPA 90A

E. MICA, Midwest Insulation Contractors Association – National Commercial and Industrial Insulation Standards

F. NAIMA Insulation Standards

G. North Carolina State Energy Code

PART 2 PRODUCTS

2.1 MATERIALS FOR PIPE AND EQUIPMENT

A. Provide factory premolded or shop mitered segment type insulation for pipe, fittings, and valves, unless otherwise noted.

B. Fitting insulation to be of same thickness and material as adjoining pipe insulation.

C. Flexible Elastomeric

1. Provide AP Armaflex manufactured by Armstrong or equivalent.

2. Provide 2-pound density, fire-retardant polyolefin, flexible type insulation, pre-formed tubular for piping and sheet for equipment, such as hot water tanks.

3. Maximum water vapor transmission rate of 0.03 perms per inch and UV stabilized with a guaranteed outdoor life of 10 years.

4. Product to have continuous operational temperature limit of not less than 210 degrees F and a minimum “R” value of 3.57.

5. Provide white, self-seal Armaflex 2000 manufactured by Armstrong for 1/2 inch application thickness.

6. For flexible tubular elastomeric pipe and fitting insulation when exposed-to-view inside building or exposed to the weather, finish with two coats of fire retardant self-extinguishing vinyl lacquer type flexible coating equivalent to Armstrong “Armaflex Finish”.

7. Provide insulation for the following services:

a) Copper or steel condensate drains: 1/2-inch thick.

b) AC refrigerant suction piping: 3/4- inch thick.

c) Large vessels below 60° F service.

d) Run-outs to terminal units: 3/4" thick.

D. Glass Fiber

1. Provide factory-formed, factory-jacketed “system” type fiberglass insulation.

2. Jacket to be fiberglass reinforced, white kraft bonded to aluminum foil vapor barrier reinforced with fiber glass yarn.

3. Insulation density to be not less than 3.5 pounds per cubic foot.

4. Product to have continuous operational temperature limit of no less than 650 degrees F and a minimum “R” value of 4.00.

5. Product to be equivalent to Manville “Micro-Lok 650” with Type AP jacketing. Applicable products manufactured by Certainteed, Knauf, or Owens Corning are acceptable

6. Provide insulation for following services:

   a) Heating hot water piping:
      1) Up to 2-inch diameter piping: 1" thick.
      2) 2-1/2 inch diameter and larger: 1-1/2" thick.

2.2 MATERIALS FOR DUCTS

A. Blanket Type Insulation

1. Provide minimum 1 pound per cubic foot density, flexible, factory reinforced glass fiber blanket with foil-faced, glass-fiber reinforced kraft vapor barrier jacket.

2. Insulation to have a minimum installed “R” value of 3.92.

3. Product to be manufactured by Manville, Certainteed, Knauf, or Owens-Corning.

4. Provide glass fiber blanket insulation for the following:

   a) Unlined hot air or cold air supply ducts concealed from view: 2 inch thick.
   b) Unlined return air ducts concealed from view: 2 inch thick.

B. Glass fiber Board Type Insulation

1. Provide minimum 3 pound per cubic foot density semi-rigid insulation with factory applied reinforced foil faced kraft vapor barrier glass fiber board “system” type insulation.

2. Insulating board to have a minimum “R” value of 4.34.

3. Product to be manufactured by Manville, or equivalent by Certainteed, Knauf, or Owens Corning.

4. Provide glass fiber board insulation for the following:

   a) Supply, return ducts not having acoustic liner within equipment rooms: 1-inch thick.
   b) Outdoor air intake plenum and duct: 1-inch thick.

2.3 MATERIALS FOR PIPE FITTINGS AND VALVES

A. Premolded or mitered and fitted insulation and one-piece PVC insulated fitting covers.

B. Provide factory pre-molded one-piece PVC insulated fitting covers, precut insulation inserts and installation materials for the following services:

1. All pipe fittings and valves.

C. Materials to be equal to be Foster Seaglass PVC fitting cover, UNI-Fit, Molded Acoustical Products Inc., Hamfab, Zeston division of Mansfield; or Armstrong Products.

2.4 COATINGS, FINISHES AND JACKETS

A. Piping and Equipment:

1. For pipe, fittings and valves not exposed-to-view inside building finish to be all service factory jacket.

2. For tanks, heat exchangers, insulated equipment and pipes in systems exposed inside in equipment rooms, cover insulation with one layer of 8 oz. canvas and finish with fire retardant lagging adhesive ready for painting.

3. Fitting Jackets: For insulated piping inside building use PVC molded one-piece or matching 2-piece jacket.
   a) Hot surfaces; apply with stainless steel tacks or staples.
   b) Cold surface; use 2" wide, 10 mil vinyl tape furnished by manufacturer of jacket.

4. For any service when above grade and exposed to the weather outside building, cover straight pipe insulation with 0.016-inch thick aluminum jacket.

5. Do not insulate valves in systems operating above 60 degrees F and where installed in valve boxes outdoors. Paint valves with a rust-resistant product equivalent to Rustoleum.

6. For flexible tubular elastomeric pipe and fitting insulation when exposed-to-view inside building or exposed to the weather, finish with two coats of fire retardant self-extinguishing vinyl lacquer type flexible coating equivalent to Armstrong "Armaflex Finish".

B. Ducts & Casings:

1. In Equipment Rooms: 6 oz canvas treated with fire retardant lagging adhesive. Seal joints and seams with 3" aluminum tape. Reinforce corners.

2. Exposed to Weather: Seal joints and seams of vapor barrier facing and apply jacket of single ply roofing membrane. Seal weather tight with adhesive furnished by membrane manufacturer.

PART 3 EXECUTION

3.1 GENERAL

A. Refer to Manufacturer's Installation Specification for complete installation procedure.

B. Prior to delivery of pipe and vessel insulation to the project, the insulation contractor shall submit a certification from the manufacturer that all insulation material to be provided will meet all the specified performance and property requirements.

C. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

D. Store insulation in original wrapping, and protect from weather and construction traffic.

E. All surfaces to be insulated shall be kept clean and dry and free from any type of moisture prior to and during the application of insulation and vapor barrier. Covering to be dry when installed and during application of any finish. All wet insulation and wet vapor barrier jacketing, tapes, joint sealers and mastics will be removed from the job site at the insulation contractor's expense.

F. Before applying insulation, M.C. shall verify that piping has been inspected, tested and approved. Verify that brass thermowells with proper length lagging extensions have been installed. Verify that brass nipples for gage cocks have been installed.

G. All adhesives, cements and mastics to be compatible with materials applied without attacking materials in either wet or dry state.

H. Insulation Exposed to view to have a well tailored appearance.

I. Do not insulate expansion tanks or heads of hot water.

3.2 PENETRATION OF RATED WALLS, PARTITIONS & FLOODS

A. Insulated pipe will pass through the rated wall as per UL approved detail.

B. Stop all duct coverings, including jacket and insulation, at fire damper penetrations of walls, floors above grade and roofs.

C. Stop all duct coverings including jacket and insulation at all penetrations of rated walls and smoke partitions. Flare-out or extend insulation jacket at least 2-inches beyond angle frames of fire dampers and seal to structure.

D. Maintain vapor barrier.

E. Install covering over damper and smoke detector access doors readily removable and identifiable.

3.3 INSTALLATION OF DUCT AND AIR HANDLING EQUIPMENT COVERING

A. Install in accordance with NAIMA National Insulation Standards.

B. Insulated ductwork conveying air below ambient temperature:
   1. Provide insulation with vapor barrier jacket.
   2. Finish with tape and vapor barrier jacket.
   3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
   4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

C. Insulated ductwork conveying air above ambient temperature:
   1. Provide with standard vapor barrier jacket.
   2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

D. All exterior duct is to be insulated as indicated and covered with aluminum jacket rated for exterior applications.

E. Blanket type insulation

   1. Apply jacketed blanket type glass fiber pulled snug to ducts but not more than 1/2-inch compression at corners.

   2. Use insulation having 2-inch tab, or cut insulation long enough to allow for “peel-off” of insulation form jacket to effect a minimum overlap tab of 2-inch.

   3. Staple lap with flare type staples on 1-inch centers.

4. Cover standing seams, stiffeners, and braces with an insulation blanket, using 2-inch jacket lap and staple lap.

5. Cover and seal all staples and attachment pins with Foster 30-35 reinforced with glass cloth or FSK tape.

6. Apply insulation with approved adhesive and weld pins used 18" o.c. on the bottom of ducts 16" or wider on sides of ducts 20" or more. Vertical ducts that are larger than 16" shall have weld pins on all sides. Overlap facing 3" and seal with approved adhesive or apply reinforced aluminum tape. Seal punctures and breaks with aluminum tape.

F. Jacketed Board Type Insulation:

1. Apply jacketed board type insulation to ducts using adhesive and weld pins or nylon "Stick-clip" plates having self-locking, coated metal or nylon discs.

2. If insulation is grooved for corners, pin as required to hold insulation tight to duct.

3. Seal pins and joints with Foster 30-35 reinforced with glass cloth or FSK tape.

4. Insulation shall be applied to the ductwork using approved adhesive and mechanical fasteners such as weld pins or stick clips located not less than 3" from each edge or corner of the board. Pin spacing along the duct not greater than 12" o.c. Additional fasteners used on the sides and bottom of all ducts at a maximum spacing of approximately 18" o.c. All edges and joints sealed with 5" wide aluminum vapor barrier tape applied with Foster 85-20 adhesive. All punctures in the vapor barrier facing likewise sealed.

5. Cover all joints, rips, tears, punctures, disc heads, staples, or breaks in vapor barrier jacket with 4-inch wide woven glass fabric tape embedded in equivalent of Childers CP-82 or Benjamin-Foster No. 85-20 "Sparkfast" vapor barrier fire resistant adhesive. Pressure sensitive tape permitted if recommended by manufacturer.

6. In Equipment Rooms: Cover insulation with 8 oz. Canvas jacket applied with adhesive.

3.4 INSTALLATION OF PIPE COVERING

A. Install in accordance with NAIMA National Insulation Standards.

B. Exposed Piping: Locate insulation and cover seams in least visible locations.

C. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies and expansion joints.

D. Glass fiber insulated pipes conveying fluids below ambient temperature:
1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe and PVC fitting covers.

E. Insulation above furred ceiling and in chases requires no finish beyond factory jacket.

F. Inserts and Shields:
1. Shields: Galvanized steel between pipe hangers or hanger rolls and insulation.
2. Insert location: Between support shield and piping and under the finish jacket.

3. Insert configuration: Minimum 12" inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
4. Insert material: Hydrous calcium silicate or foamglas insulation material suitable for the planned temperature range.

G. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions.

H. Pipe Exposed in Mechanical Equipment Rooms Spaces: Finish with canvas jacket.

I. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket rated for exterior applications.

J. Provide “no-drip” tape on valves, valve stems, fittings, etc. where insulation cannot be fitted and sealed.

3.5 INSTALLATION OF EQUIPMENT COVERING

A. Factory Insulated Equipment: Do not insulate.

B. Exposed Equipment: Locate insulation and cover seams in least visible locations.

C. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands as appropriate.

D. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.

E. Insulated equipment containing fluids below ambient temperature: Insulate entire system.

F. Fiber glass insulated equipment containing fluids below ambient temperature: Provide vapor barrier jackets, factory-applied or field-applied. Finish with glass cloth and vapor barrier adhesive.

G. Fiber glass insulated equipment containing fluids above ambient temperature: Provide standard jackets, with vapor barrier, factory-applied or field-applied.

H. Finish insulation at supports, protrusions, and interruptions.

I. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting.

J. Exterior Applications: Provide vapor barrier jacket.

K. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.

L. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed for inspection.

3.6 INSTALLATION OF ONE-PIECE PVC INSULATED FITTING COVERS

A. Premolded fitting covers to be precisely cut or mitered to fit or be tucked snugly into the throat of fitting and edges adjacent to pipe covering and taped to form a fully insulated pipe covering.

B. Use adhesive and/or tape specified for type of insulation to insure a thorough vapor barrier.

C. Tape ends securely to adjacent pipe covering. Tape to extend over adjacent pipe insulation with an overlap of at least 2-inch on both sides.

END OF SECTION

SECTION 23 2113
HYDRONIC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe and pipe fittings for:

1. Heating water piping system
2. Equipment drains and overflows.

B. Valves:

1. Gate valves.
2. Globe or angle valves.
3. Ball valves.
4. Butterfly valves.
5. Check valves.

1.2 RELATED SECTIONS

A. Section 23 05 29 – Supports and Anchors

B. Section 23 05 53 - Mechanical Identification.

C. Section 23 05 48 - Vibration Isolation.

D. Section 23 07 08 - Insulation.

E. Section 23 21 16 - Hydronic Specialties.

1.3 REFERENCES

A. ASME - Boiler and Pressure Vessel Codes, SEC 9 - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brasing Operators.

B. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

C. ASME B31.5 - Refrigeration Piping.

D. ASME B31.9 - Building Services Piping.

E. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc coated Welded and Seamless.

F. ASTM A234 - Piping Fitting of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

G. ASTM B32 - Solder Metal.

H. ASTM B88 - Seamless Copper Water Tube.

1.4 GENERAL REQUIREMENTS

A. Where more than one piping system material is utilized, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

B. Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems.

C. Use grooved mechanical couplings and fasteners in accessible locations only.

D. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded connections to valve bodies, equipment or other apparatus.

E. Except where shown otherwise, use ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.

F. Use ball or butterfly valves for throttling, bypass, or manual flow control requirements for water systems if special valves or fittings are not indicated.

G. Use spring loaded check valves on discharge of pumps when piped in parallel.

H. Use lug type butterfly valves to isolate equipment.

I. Use 3/4 inch ball valve with cap for drains at low points of piping, bases of vertical risers, and at equipment.

1.5 QUALIFICATIONS

A. All pipe and fittings shall be manufactured in the United States.
B. All valves shall be manufactured in the United States.

C. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum ten years documented experience.

D. Installer: Company specializing in performing the work of this section with minimum five years documented experience.

E. Welders: Certify in accordance with ASTM 31.1 and ASME SEC 9. Submit copy of certificate prior to beginning work.

1.6 REGULATORY REQUIREMENTS

A. Conform to ASME B31.9 Code for Installation of Piping Systems.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery, store, protect and handle products to site under provision of Division 01

B. Accept valves on site in shipping containers. Protect machined surfaces.

C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.1 All piping material shall be manufactured in the USA.

2.2 HEATING WATER ABOVE GROUND

A. Copper Tubing: ASTM B88, Type L hard drawn.

1. Fittings: ASME B16.18, cast brass, or ASME B16.22, solder, wrought copper.
2. Joints: Solder, lead free 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.

2.3 EQUIPMENT DRAINS AND OVERFLOWS

A. Hot drains
1. Copper tubing, ASTM B-88, Type L, hard drawn.
a) Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper.
b) Joints: Solder, lead free 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.

B. Condensate (cold) drains:
1. Interior and exterior
a) Copper tubing, ASTM B-88, Type L, hard drawn.
b) Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper.
c) Joints: Solder, lead free 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.
2. Optional Exterior (exposed to freezing)
a) PVC – schedule 40 with DWV glued fittings.

2.4 UNIONS, FLANGES, AND COUPLING

A. Union for Pipe 2 inches and Under:

1. Ferrous Piping: 150 psig malleable iron, threaded.
2. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe Over 2 inches

1. Ferrous Piping: 150 psig forged steel, slip-on.
2. Copper Piping: Bronze.
3. Gaskets: 1/16 inch thick performed neoprene.

2.5 VALVES:

A. Furnish and install all valves as called for, shown on drawings or as required for proper operation and servicing of the equipment. Valves shall be of manufacturer as noted or equivalent.

B. Butterfly valves; “bubble tight” at 150 psi and 200 degrees. Construction shall be:

1. Body - Ductile Iron
2. Seat - E.P.D.M.
3. Valves shall be lugged type for bolting to a standard flange.
4. Disc - Ductile iron or aluminum-bronze
5. Stem - 304, 316 or 17-4PH S.S.
6. Hammond 6000 Series, Victaulic, Nibco LD-2001 or equivalent

7. Valves up to 6” provide provided with a 9” lever handle with infinitely adjustable throttling plate with lock nut and memory stop.
8. VALVES 6” and larger provide with a gear operator and hand wheel.
9. Valves in insulated piping shall have 2” extended neck.

C. Ball Valves - 600# W.O.G., 3-piece, full port

1. Body - Bronze
2. Seat - Teflon
3. Ball - 304 or 316 stainless steel
4. Stem - 304 or 316 stainless steel
5. O-Ring - Viton or Teflon
6. Hammond 8303, Victaulic, Nibco 590-Y or equivalent
7. Valves in insulated piping; 2” extended neck.
8. Valves 2” and smaller shall be MPT
9. Valves 2-1/2” and larger shall be flanged.

D. Gate valves 0-2” - 150 # bronze rising stem, threaded bonnet, solid wedge

1. Body - Bronze
2. Stem - Silicon Brass
3. Wedge - Bronze
4. Handwheel - Malleable iron
5. Packing - Teflon impregnated, asbestos-free
6. Hammond IB641, Nibco T-131,

E. Gate Valves over 2” 125# O.S. &Y. Rising stem

1. Body - Iron
2. Handwheel - Iron
3. Stem - Brass or Bronze
4. Wedge - Iron
5. Seat - Bronze
6. Packing - Graphite impregnated, asbestos-free
7. Hammond IR-1140 Nibco T-275 or equivalent

F. Globe valves 0-2” - 300# Bronze, Rising Stem

1. Body - Bronze
2. Stem - Silicon Bronze
3. Disc - Bronze
4. Handwheel - Malleable iron
5. Packing - Teflon impregnated, asbestos-free
6. Hammond IB412, Nibco T-275 or equivalent

G. Globe valves over 2” - 125# O.S.&Y, Rising Stem

1. Body - Iron
2. Stem - Brass or Bronze
3. Disc - Bronze
4. Seat Ring - Bronze
5. Yoke Bushing - Bronze
6. Packing - Teflon impregnated, asbestos-free
7. Hammond IR116, Nibco F-718-B or equivalent

H. Swing Check Valves 0 - 2” - 150# bronze

1. Body - Bronze
2. Disc - Bronze
3. Hammond IB 904, Nibco T-433 or Victaulic equivalent

I. Swing Check Valves 2” - 125# iron

1. Body - Iron
2. Disc - Bronze
3. Seat ring - Bronze
4. Hammond IR1124, Nibco F-918 or Victaulic equivalent

J. Non-slam check valves

1. Body - Iron
2. Disc - Bronze
3. Seat - Bronze
4. Spring - Stainless Steel
5. Mueller No. 105, Williams-Hagen, Victaulic or equivalent

K. S.C.V. used as vacuum breaker - 15 degrees, composition disc, 150# wsp.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

C. Make piping connections to equipment with flanges or unions.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

E. After completion, fill, clean, and treat systems. Refer to Section 23 21 00.

3.2 INSTALLATION

A. Install in accordance with manufacturer’s instructions.

B. Route piping in orderly manner, parallel to building structure, and maintain gradient.

C. Install piping to conserve building space, and not interfere with use of space.

D. Group piping at common elevations

E. Sleeve pipe passing through masonry partitions, walls and floors.

F. Slope piping and arrange to drain at low points.

G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

H. Inserts:

1. Provide inserts for placement in concrete formwork.
2. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
3. Where inserts are omitted, drill concrete slab from below and provide expansion anchor or use an appropriate powder driven stud where permitted.

I. Pipe Hangers and Supports:

1. Install in accordance with ASTM B31.9.
2. Support horizontal piping as scheduled.
3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers within 30 inches of each horizontal elbow or tee.
5. Use hangers with 1-1/2 inch minimum vertical adjustment. Arrange hangers for pipe movement without disengagement of supported pipe.
6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
7. Where several pipes can be installed insulated parallel and at same elevation, provide trapeze hangers.
8. Prime coat exposed steel hangers and supports and prepare for finish painting. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

J. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

K. Provide access where valves and fittings are not exposed.

L. Slope piping and arrange system to drain at low points. Use eccentric reducers to maintain proper grade.

M. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

N. Install valves with stems upright or horizontal, not inverted.

O. Special Materials: All exposed piping to sterilizers and kitchen equipment shall be chrome plated. Gas piping underground shall be coated and wrapped to meet the local gas company specification.

P. Pipe Joints: Unless otherwise specified, join pipes as follows:
1. Steel pipe 2" and smaller, screwed joints or Victaulic pressfit
2. Steel pipe 2-1/2" to 4", screwed, welded joints of grooved.
3. Steel pipe 4" and larger, welded or flanged joints, or grooved.
4. For welded joints, use only welding type fittings and welding neck flanges with the following exception:
   a) "Weldolet" or "Threadolet" type of welding fittings for intersection welding of small branches to mains may be used where branch is two-pipe sizes smaller than the main.

Q. Do not make direct welded connections to valves, expansion joints, strainers, apparatus, or any other units which are intended to be removable.

R. Copper tube, Type "K" and "L" shall have soldered or Victaulic grooved copper joints with sweat joint type bronze or copper fittings. Flared joints with flare type bronze fittings may be used where approved for specific service.

S. For screwed joints, use Teflon tape or approved pipe joint compound; apply only on male threads.

END OF SECTION

SECTION 23 21 16

HYDRONIC SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Expansion tanks.

B. Air vents.

C. Air separators.

D. Strainers.

E. Balance valves.

F. Pressure reducing valves

G. Relief valves.

H. Flexible coupling.

1.2 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years' experience.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place; until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 EXPANSION TANKS

A. Acceptable Manufacturers:
   1. Bell & Gossett
   2. Taco
   3. Armstrong

B. Construction: Closed, welded steel, galvanized, tested and stamped in accordance with ASME SEC 8-D; cleaned, and supplied with steel support saddles; with tappings for installation of accessories. Pressure rating: 125 psi.

C. Gage Glass Set: Brass compression stops, guard, 3/4 inch sight glass and 1/4 inch ball valve.

D. Manual air control; tank drain valve.

2.2 AIR VENTS

A. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with one-piece, 1/4" ball valve at top of chamber.

B. Float Type: Cast iron body and cover, float, bronze pilot valve mechanism suitable for system operating temperature and pressure; with isolating valve.

2.3 AIR SEPARATORS

A. Manufacturers:
1. Bell & Gossett
2. Taco
3. Armstrong

B. Furnish and install, as shown on plans, a centrifugal type air separator. The unit shall have (NPT/flanged/grooved) inlet and outlet connections tangential to the vessel shell. The unit shall have an internal stainless steel air collector tube with 5/32" (4mm) diameter perforations and 63% open area designed to direct accumulated air to the compression tank on an air control system or an air vent on an air elimination system via an NPT vent connection at top of unit.

C. The unit shall have a removable galvanized system strainer with 3/16" (4.8mm) diameter perforations and a free area of not less than five (5) times the cross-sectional area of the connecting pipe. The strainer shall be located at the bottom of the vessel to reduce floor space required for strainer removal.

D. A blowdown connection shall be provided to facilitate routine cleaning of the strainer and the separator. Manufacturer to furnish data sheet specifying air collection efficiency and pressure drop at rated flow.

E. Vessel shell diameter is to be three (3) times the nominal inlet/outlet pipe diameter, with a minimum vessel volume for sufficient velocity reduction. The air separator must be designed, constructed and stamped for 125 psig @350°F (862kPa @177°C) in accordance with Section VII, Division I of the ASME Boiler and Pressure Vessel Code, registered with the National Board of Boiler and Pressure Vessel Inspectors. The air separator(s) shall be painted with one (1) shop coat of light gray air dry enamel.

F. A manufacturer's Data Report for Pressure Vessels, Form U-1 as required by the provisions of the ASME Boiler and Pressure Vessel Code, shall be furnished for each air separator upon request.

2.4 STRAINERS

A. Size 2 inch and Under: Screwed brass or iron body for 175 psig working pressure, Y-pattern with 1/32 inch stainless steel perforated screen. Provide full size blowdown with ball valve, cap and chain.

B. Size 2-1/2 inch and Over: Flanged iron body for 175 psig working pressure, basket pattern with 1/8 in stainless steel perforated screen. Provide full size blowdown with ball valve, cap and chain.

2.5 BALANCE VALVES

A. A. Manufacturers: Bell & Gossett or approved equal.

B. Valves ½" to 2" pipe size, NPT or Sweat
Valves 2-1/2" and 3" pipe size, NPT.

1. Valve Design and Construction

   All valves to be of bronze body/brass ball construction with glass and carbon filled TFE seat rings. Valves to have differential pressure read-out ports across valve seat area. Read-out ports to be fitted with internal EPT insert and check valve. Valve bodies to have ¼" NPT tapped drain/purge port. Valves to have memory stop feature to allow calve to be closed for service and then re-opened to set point without disturbing balance position. All valves to have calibrated nameplate to assure specific valve setting. Valves to be leak-tight at full rated worked pressure.

2. Pre-Formed Insulation

   All valves to be provided with molded insulation to permit access for balance and read-out.

3. Design Pressure/Temperature

   ½" – 3 NPT connections:
   300 psig (2069 kPa) at 250°F (121°C)
   ½" – 2" Sweat connections:
   200 psig (1379 kPa) at 250°F (121°C)

C. Valves 2-1/2" and 3" Pipe size, flanged
   Valves 4" to 12" pipe size, flanged or grooved

1. Valve shall be of heavy-duty cast iron construction with 125 psi flanged connections suitable up to 175 psi (1207 kPa) working pressure. Valves 2-1/2"- 3" pipe shall have a brass ball with glass and carbon filled TFE seat rings. Valves 4"- 12" shall be fitted with a bronze seat, replaceable bronze disc with EPDM seal insert, and stainless steel stem. Valves to have memory stop feature to allow valve to be closed for service and then reopened to set point without disturbing balance position. All valves to have calibrated nameplate to assure specific valve setting. Valves to be leak-tight at full rated working pressure.

2. Design Pressure/Temperature

   175 psig (1270 kPa) at 250°F (121°C)

D. CB4, 4" pipe size flanged

1. Valve Design and Construction

   Valves to be of cast iron body/brass vane construction with differential pressure read-out ports fitted with internal EPT insert and check valve.

2. Design Pressure/Temperature
   125 psig (862 kPa) at 250°F (121°C)

2.6 PRESSURE REDUCING VALVES

A. Manufacturer: B & G or Watts

B. Iron Body, low inlet pressure check valve, removable strainer. 125 psi working pressure.

C. PRVs shall have adjustable range with multiple setpoints.

2.7 RELIEF VALVES

A. Manufacturers: B & G, Watts.

B. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

2.8 FLEXIBLE COUPLINGS

A. Rotating and reciprocating equipment provided with suitable vibration isolating system. Isolation for all equipment above the ground floor designed for at least 95% absorption efficiency. Select isolators for proper loading to obtain desired efficiency.

B. Piping connections to pieces of equipment containing rotating or reciprocating machinery (except inline pumps) provide isolators to prevent transmission of vibration or noise to building structure. Water lines shall be provided with flexible Teflon coupling designed for service and operating pressure. Flexible metal hose shall be of approved design. Where such flexible connections do no accomplish full desired result, piping shall be suspended by means of properly loaded and distributed vibration eliminators design for support rods.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install specialties in accordance with manufacturer's instructions.

B. Provide manual air vents at system high points and as indicated.

C. Provide air separator on suction side of system pumps and connect to expansion tank.

D. Provide valved drain and hose connection on strainer blow down connection.

E. Provide combination pump discharge valve on discharge side of centrifugal pumps.

F. Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.

G. Select equipment relief valve capacity to exceed rating of connected equipment.

H. Pipe relief valve outlet to nearest floor drain.

I. Provide strainers on suction side of pump.

END OF SECTION

SECTION 23 21 23

HYDRONIC PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Inline pumps.

1.2 REFERENCES

A. UL 778 - Motor Operated Water Pumps.

B. NFPA 70 - National Electrical Code.

1.3 PERFORMANCE REQUIREMENTS

A. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

1.4 SUBMITTALS

A. Submit under provisions of Division-1.

B. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division-1.

B. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacture, assembly, and field performance of pumps with minimum five years' experience.

1.7 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Armstrong, Aurora, B & G, Patterson, Taco.

B. Approved equals will be considered.

2.2 INLINE PUMPS

A. Type: Vertical inline pumps, split-coupled or close-coupled as scheduled, single-stage, single or double suction type, with pump characteristics which provide rising heads to shut-off, suitable for 125 psig maximum working pressure.

B. Casing: Cast iron, with suction and discharge gage ports, seal flush line, drain plug, flanged suction and discharge.

C. Impeller: Bronze, fully enclosed, keyed to shaft.

D. Bearings: No bearings required in pump.

E. Shaft: Provide stainless steel pump shaft. If scheduled pump is close-coupled, provide bronze shaft sleeve over motor shaft.

F. Seal: For pumps 10 HP and smaller, close-coupled pumps are acceptable unless scheduled otherwise. Seal shall be of the inside type serviceable without disturbing piping connections.

G. Drive: Split-Coupled – Rigid split spacer type coupling to allow removal from pump and motor shaft leaving space between the shafts sufficient to replace all mechanical seal components without removal of pump or motor. Close-Coupled – Impeller connected directly to motor shaft. No coupling required.

H. Electrical Characteristics:
   1. Motor: 1750 rpm unless indicated otherwise. Pumps driven by VFDs shall have inverter duty motors.
   2. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials. Enclose terminal lugs in terminal box sized to NFPA 70.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions. Manufacturer’s representative shall align pumps in the field.

B. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer.

C. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings.

D. Provide line-sized shut-off valve, strainer and eccentric reducer on pump suction. Provide line sized combination pump discharge valve on pump discharge.

E. Provide drains for seals, piped to and discharging into floor drains.

F. Lubricate pumps before start-up.

G. Provide pump start-up report by pump manufacturer.

END OF SECTION

SECTION 23 31 00

DUCTWORK

PART 1 GENERAL

1.1 WORK INCLUDED

A. Low pressure supply, exhaust, return, outdoor air and relief ducts.

B. Medium Pressure Ducts.

C. Low Pressure Ducts

D. Insulated panels for plenums.

1.2 REFERENCES

A. ASTM A525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot Dip Process.

B. ASHRAE - Handbook 1981 Fundamentals; Chapter 33 - Duct Design.

C. NFPA 90A - Installations of Air Conditioning and Ventilating Systems.

D. SMACNA - Low Pressure Duct Construction Standards.

1.3 DEFINITIONS

A. Duct Sizes: Free area sheet metal dimension for unlined ducts. For lined ducts, size indicated is free area, inside clear of lining. Actual sheet metal size shall be increased by Contractor to accommodate lining.

B. Low Pressure: 2 inch WG positive or negative static pressure or less and velocities less than 2,200 fpm.

C. Medium Pressure: Static pressure in duct of greater than 2 inch WG and less than 6 inch WG, and velocities greater than 2200 feet per minute.

1.4 REGULATORY REQUIREMENTS

A. Fabricate ductwork in accordance with SMACNA duct construction standards, and the latest ASHRAE duct construction standards. Sealant shall be used on all low pressure ductwork.

B. Construct ductwork to NFPA 90A – Air Conditioning and Ventilating Systems, NFPA 90B – Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

1.5 SUBMITTALS

A. Refer to Section 230001 for requirements.

PART 2 PRODUCTS

2.1 MATERIALS

A. General: All ductwork shall be non-combustible and conform to UL requirements for Class I air duct, or UL 181, Class I.

B. Steel Ducts: ASTM A525 galvanized steel sheet, having zinc coating of 1.25 oz per sq. ft. for each side in conformance with ASTM A90 for all duct except for the hood exhaust ducts.

C. Carbon Steel Sheets: ASTM A366, cold-rolled sheets, commercial quality, with oiled, exposed matte finish.

D. Stainless Steel: ASTM A480, Type 304, sheet form, with No. 1 finish.

E. Fasteners: Rivets, bolts, or sheet metal screws.

F. Sealant: Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.

G. Hanger Rod: Steel, galvanized; threaded both ends, or continuously threaded.

H. Flexible Ducts: Interlocking spiral of galvanized steel or aluminum construction of fabric supported by helically wound spring steel wire or flat steel bands; rated to 2 inches WG positive and 1.5 inches WG negative pressure. Limit length to seven (7) feet.

I. Insulated Flexible Ducts: Flexible duct wrapped with flexible glass fiber insulation, enclosed by seamless aluminum pigmented plastic vapor barrier jacket; minimum R value of 6.0 hr.-sq. ft. -F/BTU at 75 degrees F.

2.2 ACCEPTABLE MANUFACTURERS

A. Metal Duct:

1. United McGill
2. East Coast Sheet Metal
3. Monroe Sheet Metal
4. Semco
5. R.V. Money
6. Hamlin Sheet Metal

2.3 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards- Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct. Where not possible and where rectangular elbows are used, provide single thickness turning vanes.

C. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 20 degrees; convergence downstream shall not exceed 30 degrees.

D. Provide standard 45 degree lateral wye takeoffs or 90 degree conical tee connections.

E. All ductwork must present a smooth interior and joints must be air tight.

F. Manual volume and splitter dampers to be furnished and installed where shown and where necessary for proper regulation of the air distribution. A quadrant and set screw equal to “Ventlock” #641 shall be installed for all dampers which are accessible.

G. When the system is in operation, the ductwork shall be free from rattles and air noises caused by poor duct construction.

H. For VAV duct systems, all supply ducts from supply fan to terminal unit shall meet SMACNA Pressure Class 4" and Seal Class "A". All supply ductwork from the fans to the VAV terminal units shall be leak and pressure tested in the presence of the Engineer to prove pressure class requirements are met. Provide a written report as indicated in Section 15011, Paragraph 2.2.

I. All low pressure duct systems, including supply and return duct inside buildings and exhaust air ducts shall meet SMACNA Pressure Class 2" **and Seal Class "A"**. Seal Class does not apply to non-metal fabric air duct, except at the points where fabric ducts connect to sheet metal ducts.

J. Fabricate goosenecks and other outside exposed ductwork and fittings to meet SMACNA guidelines for 80 MPH wind.

K. All duct fittings shall be engineered fittings and any sharp elbows shall be provided with turning vanes.

2.4 INSULATED PANELS FOR PLENUM

A. Double walled insulated, air pressure-tight plenum enclosure shall be provided where indicated on the drawings. Access doors to plenum shall have identical construction, air tight gasketing, and stainless steel hardware.

B. Panel Construction: 18 gauge galvanized steel outside and 20 gage inside. Panels shall be 4" thick, unless otherwise noted on plans, and completely metal enclosed with interior completely filled with glass fiber insulation 4 pounds per cubic foot, minimum density with the following UL Fire Resistance Ratings: Flame Spread – 25; Smoke Developed – 50. Insulation shall not settle, shed, or dust.

C. Structural: Panels shall be of tongue-and-groove construction, with adjacent panels held rigidly in position by the use of an integral continuous self-locking joint on inside and outside. Mechanical joints shall be made leak proof with duct sealer, which shall be retained between adjoining flat metal surfaces. Panel construction shall hold the assembly motionless to avoid wet sealer displacement. The assembled structure shall have deflection under load limited to 1/240 of the span at 10" w.g. pressure. For spans greater than 12'-0", structural reinforcement shall be employed to provide structural rigidity. The connection of roof-to-wall panels shall be by means of 16 gage angles held by sheet metal screws, using a suitable sealer to furnish an airtight seal.

2.9 MANUFACTURED DUCTWORK AND FITTINGS

A. Manufacturers: United McGill, East Coast Sheet Metal, Semco, Monroe Metal or R.V. Money.

B. Round ducts shall be prefabricated spiral lock seam conduit with fabricated fittings. All ells shall be 5-piece type. Take-offs shall be formed conical "T", or 45 degree "Y".

C. Manufacture in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressure indicated.

PART 3 EXECUTION

3.1 FLASHING

A. Flash and counterflash where mechanical equipment passes through weather or waterproofed walls, floors, and roofs.

B. Provide curbs for mechanical roof installations 8" minimum high above finished roof. Counterflash with steel, soldered and waterproofed.

C. Provide continuous lead or neoprene safes below air supply casing located above finished rooms. Solder at joints, turn up 6" into walls or to top of curbs and caulk into joints.

3.2 INSTALLATION

A. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

B. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust or weather from entering ductwork system.

C. Use double nuts and lock washers on threaded rod supports.

D. Runouts to diffusers and returns shall be flexible duct not exceeding 5 feet in length.

E. All duct work shown on plans is diagramatic for experienced mechanic to do take off and M. C. will be responsible to coordinate with other contractors prior to fabricating any duct.

F. Low pressure supply duct, return duct, outside air duct, and relief/exhaust duct shall be provided with acoustical liner in accordance with general notes on drawings.

END OF SECTION

SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air turning devices/extractors.

B. Backdraft dampers.

C. Fire dampers.

D. Duct access doors.

E. Duct test holes.

F. Flexible duct connections.

G. Volume control dampers.

1.2 REFERENCES

A. NFPA 90A - Installation of Air conditioning and Ventilating Systems.

B. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

C. UL 33 - Heat Responsive Links for Fire-Protection Service.

D. UL 555 - Fire Dampers and Ceiling Dampers.

E. UL 555S - Leakage Rated Dampers for Use in Smoke Control Systems.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division-1.

B. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.1 AIR TURNING DEVICES/EXTRACTORS

A. Multi-Blade device with blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.

B. Steel fixed vanes for 90 deg. Elbows.

2.2 BACKDRAFT DAMPERS

A. Manufacturers:
   1. Ruskin

2. Vent Products
3. Arrow

B. Gravity backdraft dampers furnished with air moving equipment may be air moving equipment manufacturer's standard construction.

C. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, extruded aluminum, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings and adjustment device to permit setting for varying differential pressure.

2.3 FIRE DAMPERS

A. Manufacturers:
1. Ruskin
2. Air Balance
3. Leader Industries
4. Safe Air
5. Prefco
6. United Air

B. Fabricate in accordance with NFPA 90A and UL 555. Fire dampers shall be Type "B" and dynamic operation.

C. Horizontal Dampers: Galvanized steel, 22 gage frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket. Configure with blades and frame out of the air stream.

D. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades and frame out of air stream.

E. Multiple Blade Dampers: 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8" x 1/2" plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

F. Fusible Links: UL 33, 160º F.

2.4 DUCT-MOUNTED ACCESS DOORS

A. Provide, whether shown or not, minimum 18" x 18", larger if required or shown, access doors in all ducts and construction in all locations where duct detectors, controls, fire dampers, thermometer bulbs, smoke dampers and automatic dampers are to be installed. Access doors shall have felt edges. In insulated ducts, access doors shall have 1" vapor seal fiber glass insulation "sandwiched" between 2 layers of 16 gage thick galvanized sheet metal. Access doors in ducts shall be hinged and shall have casement window type latches for locking. Provide at least 2 hinges and 2 latches per door. Where 18" x 18" cannot be accommodated, access door shall be as large as duct will accommodate.

2.5 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.6 FLEXIBLE DUCT CONNECTIONS

A. Manufacturers:
   1. Ventaire
   2. Z-Flex.
   3. Pepco

B. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.

C. UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 20 oz. per sq. yd., approximately 2" wide, crimped into metal edging strip.

2.7 VOLUME CONTROL DAMPERS

A. Manufacturers:
   1. Ruskin
   2. Pottorf
   3. Air Balance
   4. Safe Air

B. Fabricate in accordance with SMACNA Duct Construction Standards, and as indicated.

C. Control dampers will be low leakage dampers with leakage not more than 6 CFM/SF at a pressure differential of 4" w.g. when tested in accordance with AMCA standard 500.

D. Fabricate splitter dampers of material same gage as duct to 24" size in either direction, and two gages heavier for sizes over 24".

E. Fabricate splitter of double thickness sheet metal to streamline shape. Secure blade with continuous hinge or rod. Operate with minimum 1/4"diameter rod in self aligning, universal joint action flanged bushing with set screw.

F. Fabricate single blade dampers for duct sizes to 12" x 48".

G. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 122" x 72". Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

H. Except in round ductwork 12" and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.

I. Provide heavy duty locking, indicating quadrant regulators on single and multi-blade dampers with ¼" square jack shafts equal to Ventlock #641.

J. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

PART 3 <u>EXECUTION</u>

3.1 PREPARATION

A. Mechanical Contractor shall provide electrical power from the dedicated control circuit to electric operators, where required. If low voltage operators are used, MC shall provide transformer, electric power from the dedicated control circuit to the transformer and all low voltage wiring and connections to operators, as

required.

3.2 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Provide motorized dampers on exhaust fans or exhaust ducts nearest to outside and where indicated. Dampers shall be provided under Section 230923. Do not provide dampers for fan of grease laden exhaust.

C. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment.

D. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, smoke detectors, and elsewhere as indicated. Provide the maximum size that the duct can accommodate when 18" x 18" size cannot be provided due to duct dimensions. At smoke detectors, the air flow direction shall be permanently indicated on the duct, to assure sampling tubes are installed and maintained in the correct orientation.

E. Provide duct test holes where indicated and required for testing and balancing purposes. Neoprene plugs.

F. Install automatic dampers in manner directed by Temperature Control Sub-Contractor.

G. Provide fire dampers at locations indicted, where ducts and outlets pass through fire rated components. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges. Provide type B or C fire dampers in ductwork unless dampers are behind grilles or louvers in which case Type A fire dampers shall be used.

H. Provide balancing dampers at points on supply, return, outside air and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.

I. Provide balancing dampers on duct take-offs to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 23 34 00 - POWER VENTILATORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wall Exhausters

B. In Line Exhausters

C. Motors and drives.

D. Fan accessories.

1.2 RELATED SECTIONS

A. All Sections Apply.

1.3 REFERENCES

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

C. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.

D. AMCA 261 - Directory of Products Licensed to Use the AMCA Certified Ratings Seal.

E. AMCA 301 - Method for Calculating Fan Sound Ratings from Laboratory Test Data.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum 5 years documented experience.

1.5 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND PROTECTION

A. Protect motors, shafts, and bearings from weather and construction dust.

1.7 EXTRA MATERIALS

A. Supply two sets of belts for each fan.

PART 2 PRODUCTS

2.1 VENTILATORS/FANS, SUPPLY AND EXHAUST

A. Manufacturers:
   1. Cook.
   2. Other acceptable manufacturers offering equivalent products.

a) Greenheck
b) Twin City.

B. Fan Unit: V-belt or direct driven as indicated, with steel wall sleeves, rain hood, barometric backdraft damper, HOA Switch, Thermostat, resilient mounted motor; 1/2 inch mesh, 16 gage aluminum birdscreen.

C. Electrical Characteristics and Components, Single Phase Motors.

1. Motor: Refer to Section 15170.
2. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.
3. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor and solid state speed controller.

D. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with nylon bearings.

E. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position.

F. Fan shaft with self aligning pre-lubricated ball bearings.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install fans as indicated. Install with resilient mountings and with flexible electrical leads.

C. Provide fixed sheaves required for final air balance.

D. Provide safety screen where inlet or outlet is exposed.

END OF SECTION

SECTION 23 36 00

AIR TERMINAL UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Variable volume terminal units.

B. Integral heating coils.

C. Integral damper motor actuators.

1.2 REFERENCES

A. ADC 1062 - Air Distribution and Control Device Test Code.

B. NFPA 70 - National Electrical Code.

C. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

D. UL 181 - Factory-Made Air Ducts and Connectors.

1.3 PERFORMANCE TOLERANCES

A. Base performance on tests conducted in accordance with ADC 1062.

1.4 SUBMITTALS

A. Submit under provisions of Division 1.

B. Shop Drawings: Indicate configuration, general assembly, and materials used in fabrication, and electrical characteristics and connection requirements.

C. Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings which indicate air flow, static pressure, and NC designation. Include electrical characteristics and connection requirements.

D. Include schedules listing discharge and radiated sound power level for each of second through sixth octave bands at inlet static pressures of one to 4 inch wg (250 to 1000 Pa).

E. Manufacturer's Installation Instructions: Indicate support and hanging details, and service clearances required.

1.5 OPERATION AND MAINTENANCE DATA

A. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant volume regulators.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years experience.

1.7 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 MANUFACTURERS

1. Nailor
2. Envirotec
3. Kreuger
4. Titus
5. Trane

2.2 MANUFACTURED UNITS

A. Ceiling mounted variable air volume supply air control terminals for connection to single duct, central air systems, with electronic variable volume controls and hot water heating coils.

B. Identify each terminal unit with clearly marked identification label and air flow indicator. Include unit nominal air flow, maximum factory set airflow, minimum factory set air flow, and coil type.

2.3 SINGLE DUCT VARIABLE VOLUME UNITS

A. Basic Assembly:
1. Casings: Minimum 22gage galvanized steel.
2. Lining: Minimum ½ inch thick neoprene or vinyl coated fibrous glass insulation, 1.5 lb/cu ft (24 g/L) density, meeting NFPA 90A requirements and UL 181 erosion requirements.
3. Plenum Air Inlets: Round stub connections for duct attachment.
4. Plenum Air Outlets: S slip and drive connections.

B. Basic Unit:
1. Configuration: Air volume damper assembly inside unit casing. Locate control components inside protective metal shroud.
2. Volume Damper: Construct of galvanized steel with peripheral gasket and self lubricating bearings; maximum damper leakage: 2 percent of design air flow at 3 inches inlet static pressure.
3. Mount damper operator to position damper normally open.

C. Hot Water Heating Coil:
1. Construction: 1/2 inch copper tube mechanically expanded into aluminum plate fins, leak tested under water to 200 psig (10380 kPa) pressure, factory installed.
2. Capacity: Based as indicated in schedules. Provide 1-, 2-, 3- or 4-row coils as required.

D. Automatic Damper Actuator:
1. Electric Actuator: 24 volt. See Section 23 0923 – Instruments and Control Elements.

2. Velocity Reset Controller and Probe:
a) Calibration pressure taps for pressure independent control to compensate for varying inlet static pressure for electronic controller.
b) Minimum and maximum limits set at reset device.

c) Maintain air flow to within 5 percent of set point with inlet static pressure variations up to 2inches.
d) Reset span shall remain constant regardless of minimum or maximum setting.

3. Control system vendor shall provide the necessary control system to meet the sequence of operation specified in Section 23 0923. Coordinate closely with control system vendor to provide compatible controls.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide ceiling access doors or locate units above easily removable ceiling components.

C. Support units individually from structure. Do not support from adjacent ductwork.

D. Connect to ductwork with insulated flex duct.

3.2 ADJUSTING

A. Reset volume with damper actuator attached to assembly allowing flow range modulation from 100 percent of design flow to 50 percent full flow.

END OF SECTION

SECTION 23 37 13

DIFFUSERS, REGISTERS AND GRILLES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Diffusers.

B. Registers/grilles.

1.2 REFERENCES

A. AMCA 500 - Test Method for Louvers, Dampers and Shutters.

B. ARI 650 - Air Outlets and Inlets.

C. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.

D. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.3 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ASHRAE 70.

B. Test and rate louver performance in accordance with AMCA 500.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
1. Metalaire
2. E. H. Price
3. Krueger
4. Nailor
5. Titus

2.2 RECTANGULAR CEILING DIFFUSERS

A. Refer to schedules on drawings.

2.3 CEILING SUPPLY REGISTERS/GRILLES

A. Refer to schedules on drawings.

2.4 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

A. Refer to schedules on drawings.

2.5 WALL SUPPLY REGISTERS/GRILLES

A. Refer to schedules on drawings.

2.6 WALL EXHAUST AND RETURN REGISTERS/GRILLES

A. Refer to schedules on drawings.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and structural limitations.

C. Connect diffusers to ductwork with air tight connection.

D. Provide balancing dampers on duct take-off to diffusers, grilles and registers, despite whether dampers are specified as part of the diffuser, grille or register assembly.

E. Paint ductwork visible behind air outlets and inlets matte black.

END OF SECTION

SECTION 23 52 16

CONDENSING BOILERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Boilers and boiler trim.

B. Controls.

C. Hot water connections.

D. Fuel connection.

E. Chimney connection.

1.2 REFERENCES

A. AGA - Directory of Certified Appliances and Accessories.

B. ANSI Z21.13 - Gas Fired Low-Pressure Steam and Hot Water Boilers.

C. ASME SEC 4 - Boiler and Pressure Vessel Codes - Rules for Construction of Heating Boilers.

D. NFPA 54 (AGA Z223.1) - National Fuel Gas Code.

E. NFPA 70 - National Electrical Code.

F. UL - Gas and Oil Equipment Directory.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. The boiler manufacturer shall publish known part-load value efficiencies. The thermal efficiency shall increase as the firing rate decreases.

1.4 REGULATORY REQUIREMENTS

A. Conform to NFPA 70 for internal wiring of factory wired equipment.

B. Conform to ASME SEC 4 and SEC 8D and AGA Z21.13 UL 726 for boiler construction.

C. Units: AGA certified. UL labeled.

D. Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.5 WARRANTY

A. The pressure vessel/heat exchanger of the boiler shall carry a 7 year, or longer, prorated, limited warranty against failure due to condensate corrosion, thermal stress, mechanical defects or workmanship. Warranty shall begin at the time of Owner acceptance of the work. A copy shall be submitted to the Engineer for approval, and the manufacturer shall issue a Warranty Certificate to the Owner. Include copies of the warranty in the O & M Manual.

B. The burner shall carry a minimum 5-year warranty. Provide a certificate of warranty with the submittal and include copies in the O & M Manual.

1.6 DELIVERY, STORAGE, AND PROTECTION

A. Protect units before, during, and after installation from damage to casing by leaving factory shipping packaging in place until immediately prior to final acceptance.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Lochinvar

B. Laars

C. Bosch

2.2 MANUFACTURED UNITS

A. Boiler module shall be natural gas fired, condensing fire tube design with a modulating forced draft power burner and positive pressure vent discharge.

B. Each boiler shall be UL Listed, CSD-1 approved and ASME coded and stamped. Each boiler shall have a UL Listing for zero side wall clearance.

C. Each boiler shall be designed so that the thermal efficiency increases as the boiler firing rate decreases.

2.3 CONSTRUCTION

A. Assembly: Heat exchanger/combustion chamber shall incorporate a fire tube design that is self-supporting, baffle-free, and warranted to withstand thermal shock. The boiler shall be capable of handling return water temperature down to 50°F without any failure due to thermal shock or fireside condensation. The interior of the combustion chamber and flue collector shall be constructed completely of stainless steel so as to ensure corrosion protection. The heat exchanger shall be ASME stamped for a working pressure of not less than 150 psig and shall be National Board Listed.

B. The boiler shall be constructed with a 16 gauge galvanized steel jacket assembly. All inner and outer jacket panels shall be fully gasketed and sealed. The exterior of the jacket assembly shall be primed and pre-painted on both sides with a minimum dry film thickness of 0.70 mils. The boiler shall be certified for installation on combustible floors without additional safety provisions.

C. The water containing section shall consist of two integrated heat exchangers constructed of "Fin Tube" design, with straight copper tubes having extruded integral fins. The tubes shall be "rolled" securely into glass-lined, cast iron headers. There shall be no bolts, gaskets or "O" rings in the head configuration. Removable access plugs shall be provided on the heat exchanger headers for the purposes of inspection, cleaning or repair. Boiler drains shall be provided, having external access.

D. Boiler water connections shall be flanged 150 lb. ANSI rated.

E. The boiler may or may not be supplied with an integral circulating pump wired for continuous operation. If so provided, the circulating pump shall not operate when the boiler is in the “off” mode to prevent radiant heat loss.

F. The boiler shall use a combustion air blower to precisely control the fuel/air mixture for maximum efficiency. The all aluminum blower shall be mounted on the burner and draw gas and air from a premixing chamber.

G. Access: Inspection openings in the pressure vessel shall be in accordance with ASME Section 4 pressure vessel code.

H. Provide a hot water hose connection on each boiler for field testing.

I. Provide a packaged condensate acid neutralizing kit by manufacturer or suitable matching product.

2.4 BURNER

A. Gas Burner: Forced draft type for natural gas. The burner shall be capable of a 4-to-1 or better turndown ratio of the firing rate, without loss of combustion efficiency.

B. The burner surface shall be constructed of high temperature aluminum/chromium alloy woven mesh. The burner shall fire in a vertical plane within the sealed combustion chamber. The burner shall employ a perforated flame injection tube extending the entire length of the heat exchanger. The burner shall fire in a full 360-degree pattern resulting in uniform heat transfer upon every inch of heating surface. A viewing port shall be provided, permitting visual observation of burner operation.

C. The combustion air blower shall utilize a variable frequency drive to enable the blower to infinitely vary its' speed, therefore adjusting the volume of gas and air supplied for combustion.

D. Gas Burner Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after air flow proven and slight delay, allow gas valve to open.

E. Controls: Pre-wired, factory assembled electronic controls in control cabinet with flame scanner or detector, programming control, relays, and switches. Provide pre-purge and post-purge ignition and shut-down of burner in event of ignition pilot and main flame failure with manual reset.

2.5 EXHAUST AND VENTING

A. Each boiler shall be vented with a two pipe system constructed of Category IV vent pipe material where air is drawn form the side wall and flue products are vented with a positive draft vertically.

B. Flue connection size shall be as indicated on the drawings.

C. The exhaust manifold shall have a gravity drain for the elimination of the condensation with collecting reservoir.

D. Venting materials shall conform to all manufacturer’s recommendations and shall include a Stainless Steel AL-29-4C Positive Pressure U/L Listed Vent System.

2.6 BOILER SAFETY CONTROLS

A. Boiler controls shall be Underwriter Laboratories Recognized.

B. The combustion safeguard/flame monitoring system shall incorporate a UL recognized combustion safeguard system utilizing spark ignition and a rectification type flame sensor. An electro-hydraulic double-seated safety shutoff valve with proof of closure switch shall be an inherent part of the gas train.

C. Each boiler shall incorporate an electric type low water level cutoff with test and manual reset and dual over-temperature protection with manual reset in accordance with ASME Section IV and CSD-1. Remote fault alarm contacts, sensor failure detection and boiler status and failure annunciator shall be standard equipment.

2.7 BOILER TEMPERATURE CONTROLS

A. Standard operating controls shall include an adjustable immersion type, digital temperature controller and an immersion safety, adjustable manual reset high limit to regulate boiler water temperatures. Multiple air pressure switches shall be provided to prove operation of the combustion air fan, monitor combustion chamber pressures and monitor operation of the flue. The standard control system shall include an electronically proven Hot Surface Ignition system with full flame monitoring capability. Additional standard controls shall include a low voltage transformer for the control circuit, a flow switch to prove water flow, inlet and outlet temperature displays, and a factory installed ASME pressure relief valve. The manufacturer shall verify proper operation of the burners, all controls and the heat exchanger by connection to gas, water and venting for a full factory fire test prior to shipping. A quality test report shall be shipped with each unit. The Test Report shall be included with the submittal and copies included in the O & M Manual.

B. The units control panel shall contain a lighted on/off main power switch, alarm light and audible silence switch, and a high temperature alarm light. A central monitor for all boilers shall be provided. This monitor will provide a digital display of 21 data points on each unit and be capable of monitoring up to 16 individual units. Displayed data points include temperatures, unit operation status, operational sensor location, total run time, and firing rate. A 24 VAC control circuit and components shall be used in conjunction with a 24-volt circuit breaker. All components shall be easily accessed and serviceable from the front and top of the unit. All wiring harness connections shall have multi-pin plug in type connectors to ease service, troubleshooting and reduce removal and replacement cost.

C. Boiler controls shall be Underwriter Laboratories Recognized.

D. Each boiler shall include integral factory wired operating controls to control all operation and energy input of the boiler. The controller shall have the ability to vary boiler input throughout its full range to maximize the condensing capability of the boiler without header temperature swings.

E. The manufacturer shall provide a communications interface utilizing native BACnet or Lon Talk for control setpoints and diagnostic information. Gateways shall only be considered after discussion with CMS Engineering Staff (Senior Mechanical Engineer and Energy Manager) and the controls contractor. The boiler shall be provided with a terminal strip for easy communication wiring. Remote diagnostic and operation information shall be provided via the network connection. Inlet/Outlet water temperatures (AI), unit operation status (CI), various alarm status (DI), outdoor air reset programming, operational sensor location, total run time, sequencing operation, and firing rate shall be visible using the remote connection, adjustment of changeable points is required. Monitoring only is unacceptable.

F. If the building EMS signal to the boilers fails, the boilers shall run on their own internal controls, maintaining the loop setpoint set at each boiler operator interface.

PART 3 <u>EXECUTION</u>

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NFPA.

C. Install boiler on concrete housekeeping base, sized minimum 4 inches (100 mm) larger than boiler base.

D. Provide connection of natural gas service in accordance with NFPA 54.

E. Provide piping connections and accessories as indicated. Each boiler shall be provided with individual isolating shutoff valves for service and maintenance, and a hot water hose connection for field testing.

F. Pipe relief valves to nearest floor drain.

G. Pipe condensate through acid neutralizing kit to floor drain.

H. Provide for connection to electrical service.

3.2 MANUFACTURER'S FIELD SERVICES

A. The Contractor shall provide the services of a local factory authorized representative to supervise all phases of equipment startup.

B. Prepare and start systems under provisions of Division –1.

C. Instruct operating personnel in operation and maintenance of units. Provide certificate of completion that identifies trainees. Submit a copy to the Engineer and copies in the O & M Manual.

D. Provide a letter of compliance with all factory recommendations. Submit with O & M manuals.

END OF SECTION

SECTION 23 6313

AIR-COOLED CONDENSING UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Condensing unit package.

B. Charge of refrigerant and oil.

C. Controls and control connections.

D. Refrigerant piping connections.

E. Motor starters.

F. Electrical power connections.

1.2 REFERENCES

A. ARI 210/240 - Unitary Air-Conditioning Equipment.

B. ASHRAE 15 - Safety Code for Mechanical Refrigeration.

1.3 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.4 DELIVERY, STORAGE, AND PROTECTION

A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

B. Protect units on site from physical damage. Protect coils.

1.5 WARRANTY

A. Provide a five (5) year warranty to include coverage for refrigerant compressors and 2 years refrigerant warranty. The warranty will start on owner acceptance of the equipment. Include copies of warranties in the O & M Manual with warranty dates included.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Trane
B. York
C. McQuay

2.2 MANUFACTURED UNITS

A. Units: Self-contained, packaged, factory assembled and pre-wired units suitable for outdoor use consisting of cabinet, compressors, condensing coil and fans, integral sub-cooling coil, controls, liquid receiver. Unit shall be used in a refrigeration circuit matched with a packaged air handling unit or unit coil.

B. Performance Ratings: Energy Efficiency Rating (EER) not less than prescribed by the latest edition of the North Carolina Energy Code.

2.3 CASING

A. House components in galvanized steel panels having weather resistant, baked enamel finish. Unit shall have a heavy-gauge roll-formed perimeter base rail with slots and lifting rails for easy rigging.

B. Mount starters, disconnects, and controls in weatherproof panel provided with full opening access doors. Provide mechanical interlock to disconnect power when door is opened.

C. Provide removable access doors or panels with quick fasteners.

2.4 CONDENSER COILS

A. Coils: Aluminum fins mechanically bonded to seamless copper tubing. Provide sub-cooling circuits. Air test under water to 425 psig, and dehydrate. Seal with holding charge of nitrogen.

B. Coil Guard: PVC coat steel wire.

2.5 FANS AND MOTORS

A. Vertical discharge direct driven propeller type condenser fans with fan guard on discharge. Equip with roller or ball bearings with grease fittings extended to outside of casing. Shafts shall have inherent corrosion resistance.

B. Weatherproof motors suitable for outdoor use, single phase permanent split capacitor or 3 phase, with permanent lubricated ball bearings and built-in thermal overload protection.

C. Fan blades shall be statically and dynamically balanced.

2.6 COMPRESSORS

A. Compressor: Semi-hermetic reciprocating type or scroll type. Variable speed compressor.

B. Mounting: Statically and dynamically balance rotating parts and mount on spring vibration isolators with an isolation efficiency of no less than 95%.

C. Lubrication System: Reversible, positive displacement oil pump with oil charging valve, oil level sight glass, and magnetic plug or strainer.

D. Motor: Constant speed 1800 rpm suction gas cooled with electronic sensor and winding over temperature protection, designed for across-the-line starting.

E. Capacity Reduction Equipment: Suction valve unloaders, with lifting mechanism operated by electrically actuated solenoid valve, with unloaded compressor start; controlled from suction pressure.

F. Sump Oil Heater: Evaporates refrigerant returning to sump during shut down. Energize heater thermostatically when compressor is not operating.

2.7 REFRIGERANT CIRCUIT

A. Provide each unit with one or two independent refrigerant circuits, factory supplied and piped.

B. For each refrigerant circuit, provide:
1. Filter dryer.
2. Liquid line sight glass and moisture indicator.
3. Thermal expansion valve for maximum operating pressure.
4. Insulated suction line.
5. Suction and liquid line service valves and gage ports.
6. Liquid line solenoid valve.
7. Charging valve.
8. Discharge line check valve.
9. Compressor discharge service valve.
10. Condenser pressure relief valve.

2.8 CONTROLS

A. On unit, mount weatherproof steel control panel, NEMA 250, containing power and control wiring, molded case disconnect switch, factory wired with single point power connection.

B. For each compressor, provide across-the-line starter, non-recycling compressor overload, starter relay, and control power transformer or terminal for controls power. Provide manual reset current overload protection. For each condenser fan, provide across-the-line starter with starter relay.

C. Provide safety controls arranged so any one will shut down machine:
1. High discharge pressure switch (manual reset) for each compressor.
2. Low suction pressure switch (automatic reset) for each compressor.
3. Oil Pressure switch (manual reset).

D. Provide the following operating controls:
1. Thermostat located in supply air with outdoor reset cycles compressors, activates cylinder unloaders and activates solenoid valves in refrigerant circuit.
2. Five minute off timer.
3. Periodic pump-out timer to pump down on high evaporator refrigerant pressure.
4. Low ambient temperature controls (40ºF).

E. All the microprocessors provided with the unit shall be compatible, through BACnet or Lon Works, with the building EMS controls proposed for the project to allow the data and points to be transmitted to and controlled through the CMS central computer.

F. Gages: Pre-piped for suction and discharge refrigerant pressures.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's installation instructions.

B. Complete structural, mechanical, and electrical connections in accordance with manufacturer's installation instructions.

C. Provide for connection to electrical service.

D. Install units on concrete base.

E. Provide refrigeration piping system to evaporators.

F. Furnish charge of refrigerant and oil.

3.2 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrating installed work.

B. Supply initial charge of refrigerant and oil for each refrigeration system. Replace losses of oil or refrigerant prior to end of correction period.

C. Charge system with refrigerant and test entire system for leaks after completion of installation. Repair leaks, put system into operation, and test equipment performance.

D. Shut-down system if initial start-up and testing takes place in winter and machines are to remain inoperative. Repeat start-up and testing operation at beginning of first cooling season.

E. Provide cooling season start-up, and winter season shut-down for first year of operation.

F. Provide training to DOT Maintenance staff. Provide a certificate of training with the names of trainees to the Engineer and duplicate copies to the O & M Manuals.

END OF SECTION

SECTION 23 73 00

INDOOR AIR HANDLING UNITS

PART 1 - GENERAL REQUIREMENTS

1.1 WORK INCLUDED

A. Furnish central station type air handling units of the size, configuration and capacity scheduled on drawings.

1.2 QUALITY ASSURANCE

A. Certify unit components in accordance with ARI Standard 430.

B. Certify coil performance in accordance with ARI Standard 410.|

C. Provide ARI certified, computer-generated performance ratings for each fan and coil selection.

D. Provide certified sound power levels for all air handling systems operating above 3 inches total static pressure.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Trane

B. Carrier

C. McQuay

D. York

2.2 SPLIT SYSTEM AIR HANDLER

A. Materials

1. Provide units of sectionalized cabinet construction.

2. Fabricate sheet metal parts of continuous heavy gauge galvanized or phosphatized painted steel.

B. Blower Section

1. Provide SWSI fan with galvanized or phosphatized painted steel scroll housing.

2. Fan wheel design to be forward or backward curved. Refer to schedule for type of fan wheel.

3. Dynamically balance fans before and after installation in the cabinet section.

4. Key fan shaft to the wheel in accordance with manufacturer's standard design to meet the specified performance.

5. Select minimum fan rpm well below the first critical speed.

6. Equip units with internally mounted fan motors.

7. Mount motors on factory-supplied slide rail base complete with adjustment nits.

8. Provide access doors for access to internally mounted motors.

9. Furnish blower section with removable end panels or doors for access to fan and bearings.

10. Furnish all air handling units with adjustable pitch sheaves.

11. Provide spring type vibration isolators with 1- ½ inch static deflection for fan assembly. Fan and motor assembly shall be internally isolated from the unit casing. The isolation system shall be designed for seismic isolation.

12. Provide factory provided, unit mounted variable frequency drives (VFD) on supply and return air blowers for variable air volume air handler.

C. Bearings

1. Provide self-aligning, grease-lubricated, fan bearings of the following pillow block type design: Roller.

2. Provide extended lubrication lines from fan bearing to unit casing.

3. Connect lubrication lines to a Zerk fitting mounted on the casing.

4. Select bearings for an ABMA Standard 9 L-50 life at 200,000 hours.

D. Casing

1. Double wall casing with 1" thick, 1-1/2 pound density fiberglass with R of 7.69 degrees F-(feet)2-hr/BTU..

2. Insulation and adhesive to meet NFPA-90A standards.

3. Casing shall be designed to meet the operating pressures. Leakage from the casing shall be no more than ½ % at design pressures.

E. Coil Section

1. Fabricate coil casings of continuous galvanized or phosphatized steel.

2. Provide double sloped, stainless steel IAQ drain pan consisting of 1/2” urethane insulation covered with a stainless steel liner.

3. Coil headers to be completely enclosed within the insulated casing with connections extended through the cabinet.

4. Coil casing shall be double wall casing of solid galvanized steel with 1” thick, 1-1/2 point density fiberglass with R of 7.69 degrees F-(feet)2-hr/BTU..

F. Evaporator Coil Section

1. Provide heavy duty aluminum fins mechanically bonded to copper tubes. Evaporator coil shall be inter-circuited to maintain active coil face area at part load conditions. Coil shall also utilize internally enhanced tubing for maximum efficiency.

2. Provide a thermostatic expansion valve (TXV) for each refrigerant circuit. Factory pressure and leak test coil at 300 psi.

3. Provide IAQ pitched stainless steel drain pan to assure positive drainage of condensate from the unit casing. Drain pans shall be sloped in a minimum of two (2) planes complying with ASHRAE 62-2001.

G. Heating Coils - Hot Water

1. Coils to be constructed of 1/2” OR 5/8” OD copper tubing with aluminum fins bonded by mechanical expansion.

2. Provide coils with a maximum working pressure of 175 psig at 400 degree F.

3. Test coil with air pressure of 350 psig submerged in water.

H. Mixing Box: A section shall be provided that supports damper assembly for outside and return air. Dampers shall modulate the volume of outside, return air. Dampers shall be double-skin ultra low-leak airfoil design or equivalent with metal compressible jamb seals and extruded blade edge seals on all blades. The dampers shall be rated for a maximum leakage rate of less than 2 percent of nominal airflow at 1 inch wg. Blades shall rotate on stainless steel sleeve bearings. Dampers shall be arranged in parallel blade configuration.

I. FILTER SECTION

1. 2” throwaway pre-filters with MERV 7 filtration efficiency. Provide 2 sets.

2. Provide hinged access door with ventlock style two position latches operable from inside and outside.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install each unit on a level, rigid, and heavy concrete base.

B. Provide clearance at each unit for routine service including the changing of filters, removal of coils, bearing greasing, opening of access doors, and pulling of blower shaft.

C. Duct Connection:

1. Duct connections to each unit to allow for straight and smooth airflow.

2. Do not install duct turns at the fan discharge, which are in the opposite direction to a fan wheel rotation.

3. Provide flexible connections at duct connections to unit.

D. Piping Connections:

1. Support piping independently of coils and with adequate flexibility to prevent undue stress at coil header connections.

2. Install full size drain lines from the drain pan connection and trap to permit condensate to drain freely.

3. Route condensate drain piping to nearest floor drain.

4. Install service valves and companion flanges or unions on supply and return lines to coils.

5. Arrange piping such that valves can be shut off, a small section of pipe removed, and the coil pulled.

END OF SECTION

SECTION 23 82 39

UNIT HEATERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Unit heaters.

1.2 REFERENCES

A. ARI 443

1.3 SUBMITTALS FOR REVIEW

A. Section 230000 – Mechanical General .

B. Product Data: Provide typical catalog of information including arrangements.

C. Shop Drawings:
1. Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.
2. Submit schedules of equipment and enclosures, typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required vs. actual heat output.
3. Indicate mechanical and electrical service locations and requirements.
4. Include all performance data.

1.4 SUBMITTALS FOR INFORMATION

A. Manufacturer's Instructions: Indicate installation instructions and recommendations.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Division-1: Contract Closeout - Operation and Maintenance Data, Procedures for submittals.

B. Project Record Documents: Record actual locations of components.

C. Operation and Maintenance Data: Include manufacturer’s descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owners name and registered with manufacturer. Include copies of warranties in the O & M Manual with warranty dates included.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years experience.

1.7 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc.

1.8 EXTRA MATERIALS

A. Provide two sets of filters. Provide a written receipt of filters from CMS Maintenance staff and included in the O & M Manual.

PART 2 PRODUCTS

2.1 UNIT HEATERS

A. Manufacturer: Modine

B. Other acceptable manufacturers offering equivalent products.
   1. Airtherm.
   2. Sterling.
   3. Trane.

C. Casing: 0.0478" (1.2 mm) steel with threaded pipe connections for hanger rods.

D. Finish: Factory applied phosphatized baked enamel color.

E. Fan: Direct-drive propeller type, statically and dynamically balanced, with fan guard.

F. Air Outlet: Adjustable pattern diffuser on vertical models and four way louvers on horizontal throw models.

G. Motor: Except as noted, permanently lubricated sleeve bearings on horizontal models, grease lubricated ball bearings on vertical models 1/3 H.P. and larger.

H. Provide FM approved natural gas fuel train complete with valves, regulators, strainers, fittings, etc.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Unit Heaters: Hang from building structure, with pipe hangers anchored to building, not from piping. Mount as high as possible to maintain greatest headroom unless otherwise indicated.

3.2 CLEANING

A. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.

B. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

END OF SECTION

DIVISION 13 MAINTENANCE/BRIDGE MAINTENANCE ASSEMBLY OFFICE

SCO ID# 14-11263-01A

MCKIM AND CREED PROJECT NO. 07002-0002

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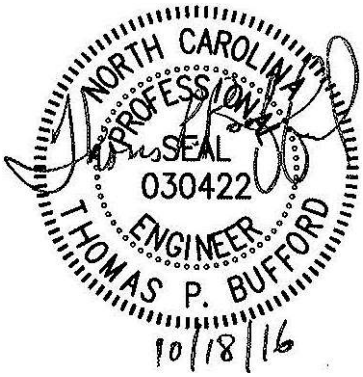

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SECTION 26 01 00

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 REQUIREMENTS

A. General Conditions of the Contract, Special Conditions, Instructions to Bidders, and other General Requirements contained in Division 1 and 2 are a part of these Specifications.

1.2 EXTENT OF THE WORK

A. This Contractor shall furnish all labor, materials, and equipment, and perform all operations necessary for installation of complete electrical work within the intent of, and as indicated on, the drawings and as herein specified.

1.3 REGULATIONS AND COMPLIANCE

A. Latest editions of the National Electrical Code and the North Carolina State Building Code govern this work. All their requirements shall be satisfied. Also the requirements of the N.C. Department of Administration, State Construction Office shall be met.

B. This Contractor shall secure and pay for all permits, fees, inspections, and licenses if any are required. Upon completion of the job he shall present to the Engineer a certificate of inspection and approval from the inspection authorities.

C. Contractor shall coordinate all necessary power outages with Mitchell County Department of Transportation as required by giving a 30 day written notice. No power shall be applied to facility or equipment until an inspection and certificate is obtained from the State Construction Office Electrical Inspector of the State Construction Office.

D. Contractor shall notify the Mitchell County Department of Transportation for the location of all underground utilities prior to digging. Contractor must obtain a digging permit prior to beginning work.

E. Contractor shall notify the State Construction Office of the NC Department of Administration to schedule all required inspections with the State Electrical Inspector. A certificate of completion is required on electrical work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All materials shall be new, with required Underwriter's Laboratories (or other agency approved by the State) label, and with manufacturer's label or nameplate giving complete electrical data.

B. Where a manufacturer's catalog number is used, all parts shall be furnished to make it complete and to fit the construction intended.

C. Within ten days after award, Contractor shall submit to Engineer a complete list in triplicate of all materials he proposes to use. List shall show a single manufacturer with not only major materials and equipment, but also such items as condulet fittings, raceway supports, conductive pipe thread compound, asphaltum, sealing material, clamps, anchors, outlet boxes, gutters, terminal cabinets, wire-pulling compound, splice connectors, tape, wire markers, lamps, etc.

D. Material shall be the make and number given in these Specifications or shown on Drawings, or equivalent where specifically stated as being allowed. Equivalent items or materials will be subject to acceptance by the Engineer at submittal stage. If Contractor wishes to furnish a make or number other than that specified (or equivalent where allowed), he shall furnish complete, detailed data and obtain approval of the substitution in writing from the Engineer no later that 10 days prior to bid. In some cases, at the request of the Engineer, samples of the substitute items shall be submitted for review. Data (and sample if required) shall be submitted in a timely manner such that approval by Engineer can be returned to Contractor no later than 10 days prior to bid date. Data or sample not submitted in sufficient time to allow evaluation by Engineer will be automatically rejected.

E. Engineer's review of samples, cut sheets, shop drawings, and other matter submitted by the Contractor shall not relieve the Contractor of responsibility for full compliance with the Drawings and Specifications. If a submitted item does not comply in any way (color, style, quality, function, or performance), Contractor shall call the specific non-compliance to the attention of the Engineer in writing in a cover letter to the submittals requesting a deviation from specifications. This does not imply that approval of requested deviation will be given, only that it will be reviewed.

F. Engineer's review of submittals is not intended to confirm quantity counts of materials and equipment made by Contractor. Contractor is required to provide quantities of items as necessary for systems to function as described and shown on the plans and in these specifications.

G. Specialty systems such as fire alarm systems, etc., that are included as part of the Electrical Contract shall be furnished and installed by an authorized representative of the manufacturer of the equipment supplied. This includes use of factory trained and authorized installers where required to fulfill manufacturer's warranty provisions.

H. Submit cuts of fixtures, shop drawings on panels, and other descriptive materials requested, in six copies, or as required by the General Requirements section. Submittals will not be accepted or reviewed by the Engineer unless the electrical contractor's stamp signifying his review and approval is evident on the submittals.

I. Materials should be inspected upon their arrival at the site to be sure they are correct. No extension of time for completion will be allowed because materials received are wrong. Completely adequate housing shall be provided on the site for orderly and careful storage of all materials and equipment. Nothing shall be stored outside except conduit, which may be stored in racks so it is at least 12 inches above ground and not subject to mud being spattered on it.

2.2 PAINTING

A. Suitable finish coatings shall be provided under this section of the Specifications on all items of electrical equipment and wiring which are exposed. This shall consist of either an approved factory applied finish or an acceptable finish applied during or after installation. Equipment which is furnished in finishes such as stainless steel or satin aluminum are not to be painted. Exposed equipment and/or wiring in finished areas such as panel covers or surface raceway shall be supplied with factory applied prime coat and shall be professionally painted or enameled as directed to result in a completely coated and attractively finished manner. All such finishing shall be as directed by and shall be satisfactory to the Engineer.

PART 3 - EXECUTION

3.1 COORDINATION WITH OTHER TRADES

A. Coordinate all work of each section with work of other sections to avoid interference. Bidders are cautioned to check their equipment against space available as indicated on drawings and shall make sure that proposed equipment can be accommodated. If interferences occur and clearances cannot be maintained as recommended by the manufacturer and as required for maintenance and inspection of equipment and by NEC, Contractor shall bring them to the attention of Architect/Engineer, in writing, prior to signing of contract; or, Contractor shall, at his own expense, provide proper materials, equipment and labor to correct any damage due to defects in his work caused by such interference.

B. Prepare coordination drawings at scale of ¼"= 1'.0" or larger, detailing major elements, components and systems of electrical and mechanical equipment and materials in relationship with other systems, installations and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the work. The Mechanical Contractor will administer the effort of coordination between various trades. Other trades will use the coordination drawings prepared by the Mechanical Contractor to show their equipment and materials for coordination between trades. The coordination drawings will be prepared before installation of any P, M, E work and will be shown as a task on the project schedule to be prepared by the GC.

3.2 GENERAL INSTALLATION

A. The electrical drawings are diagrammatic only, and are intended to explain system function and define quality of materials and installation. They are not intended to define construction methods.

B. Contractor shall keep on the site at all times one set of electrical drawings and specifications, and one set of drawings and specifications on the work of other trades. In addition, one complete set of all electrical submittals and shop drawings shall be maintained at the site by the electrical contractor.

C. The electrician shall check other trades' drawings, specifications, and shop drawings to see if there are any conflicts. If so, he shall contact the Engineer for instructions.

D. The Contractor shall properly protect his work against damage by weather or other trades. All work shall be left well cleaned, and damaged finishes shall be restored to original condition.

E. The Contractor shall place his own sleeves and notify other trades of chases and openings far enough ahead so they can be properly built in. Where any raceways, supports, etc., installed under the contract pierce the roof, suitable pitch pockets shall be provided and coordinated with the roofing contractor as necessary to be acceptable to the Engineer. Provide suitable fittings where any raceways or equipment cross expansion joints.

F. This contractor shall be responsible for all trenching, backfilling, cutting, core drilling, and patching related to his work.

G. Contractor should not scale drawings for outlet and equipment locations. Unless specifically dimensioned on drawings or defined in specifications, outlets and equipment shall be located as evidently intended or as detailed on Architectural drawings. Lighting outlets are to be centered or spaced symmetrically unless they are dimensioned. Any dimensions shown on the drawings shall be verified in the field by the contractor prior to roughing. All outlet and equipment locations shall be coordinated with the other trades. If any doubt arises, contact the Engineer prior to roughing.

H. Contractor shall keep premises free of debris resulting from this work.

3.3 TESTS AND GUARANTEES

A. All current-carrying phase conductors and neutrals shall be tested as installed, and before connections are made, for insulation resistance and accidental grounds. Each fixture and item of equipment for connection under the Contract shall be tested for insulation resistance from its conductors to its grounded surface or contact. These tests shall be performed with a 500 volt (minimum) high voltage "megger."

B. Minimum readings shall be one million (1,000,000) or more ohms for #6 AWG and smaller wire, 250,000 ohms or more for #4 AWG and larger wire, between conductors and between conductor and the grounding conductor.

C. The contractor shall send a letter to the engineer and the State Construction Office certifying that the above has been done and showing the tabulation of the megger readings for each panel or feeder. This shall be done at least four (4) days prior to final walk-through by engineer and the State Construction Office (SCO).

D. At final walk-through by the engineer and the SCO, the contractor shall furnish a megger and demonstrate that the panels comply with the above requirements. He shall also furnish a clamp-on type ammeter and a voltmeter to take current and voltage readings as directed by the engineer or the SCO representatives.

E. Validity of the ground path shall be assured by constant and careful attention to the thorough tightening of all couplings, connectors, locknuts, screws, bolts, etc., and by frequent checking of the path resistance with a quality low-range ohmmeter. Resistance of the path should not exceed one ohm between any two points. If a reading in excess of this is observed, it shall be discussed with the Engineer for an appraisal of the condition.

F. Contractor shall guarantee that the work is done in accordance with drawings and specifications, and that it is free of imperfect materials or defective workmanship. Anything unsatisfactory shall be corrected immediately and at Contractor's expense.

G. For the period of one year after acceptance by the Owner, the Contractor shall replace, without any expense to the Owner, any imperfect materials or defective workmanship.

3.4 RECORD DRAWINGS/MANUALS

A. Upon completion of the installation, Contractor shall submit to the Engineer marked prints of Drawings showing any changes made in circuits, location of equipment, panelboards, or any other revision in the Contract Drawings, for the Owner's use in maintenance work and for future additions and expansions. Marked changes shall also include changes due to change orders unless already recorded by revised drawing or bulletin drawing.

B. These record drawings shall be submitted in one of two formats: either a clean, legible, marked set of prints with all markings in distinguishable colored pencil such as red; or a set of reverse-run reproducible sepia prints marked in soft pencil so that prints can be reproduced as required. The format to be used shall be as defined in the General Requirements section of the contract documents. If no format is defined, the marked prints shall be submitted.

C. Operation and Maintenance manuals shall be submitted to the Engineer at the end of the project prior to closeout of the project. Information included shall be a copy of all submittal data, shop drawings, and necessary operating and maintenance instructions and wiring diagrams on all major items of equipment and all special systems (fire alarm, intercom, etc.). Submit these manuals in the quantities and format described in the General Requirements Section.

END OF SECTION 26 01 00

SECTION 26 01 01

SHOP DRAWINGS AND SUBMITTALS

PART 1 - GENERAL

1.1 REQUIREMENTS

A. General Conditions of the Contract, Special Conditions, Instructions to Bidders, and other General Requirements contained in Division 1 and 2 are a part of these Specifications.

1.2 DEFINITIONS

A. Shop Drawing: Project shop drawings and other data prepared specifically for fulfillment of the project requirements. Shop drawings include fabrication, layout, wiring diagrams, erection, setting, coordination and similar drawings and diagrams, and include performance data associated therewith, including weights, capacities, speeds, outputs, consumption, efficiencies, voltages, amperages, cycles, phases, noise levels, operating ranges and similar information.

B. Samples: Units of typical work, materials or equipment items, showing the workmanship, pattern, trim and similar qualities proposed for the work to be provided, as designated.

C. Manufacturer's Data: Product manufacturer's standard printed product information, including promotional brochures, product specifications, installation instructions and diagrams, statements of compliance with standard performance charts or curves, and similar information concerning the standard portions of the manufacturer's products.

D. Test Reports: Specific reports prepared by independent testing laboratories and others, showing the results of specified testing on either the material/equipment provided or on identical material/equipment, and on installed electrical systems.

E. Industry Standards: Printed copies of the current standards recognized in the industry. Current means the latest issue as of the date of these specifications, unless otherwise indicated; within the text of these specifications the date-suffix frequently shown with identification numbers has been omitted.

F. Manufacturer's Product Warranties: Manufacturer's standard printed commitment in reference to a specific product and normal application, stating that certain acts of restitution will be performed for the Purchaser or Owner by the Manufacturer, when and if the product fails within certain operational conditions and time limits.

G. Operating Instructions: The written instructions by the manufacturers, fabricators, or installer of equipment or systems, detailing the procedures to be followed by the Owner in operation, control and shut-down of each operating item of the equipment and each electrical system.

H. Maintenance Manuals: The compiled information provided for the Owner that certain acts of restitution will be performed when and if certain portions of electrical work fail within certain operational conditions and time limits.

1.3 SUBMITTAL FORM AND PROCEDURES:

A. General: Comply with Division 1 requirements for identification, quantities processing, scheduling and similar general requirements applicable to electrical submittals, except as otherwise indicated.

B. Quantities: Provide quantities as listed in the General Conditions or as otherwise indicated in the Division 26 Specifications.

C. Substitutions: Electrical submittals are not opportunities for gaining acceptance of substitutions. Where three or more manufacturers are specified by name, or by catalog reference, Contractor shall select for use any of those so specified.

D. Should contractor desire to substitute another manufacturer's equipment for one specified by name, the contractor shall apply in writing at least 10 days prior to bid date for such permission. He shall provide supporting data and samples for Engineers consideration. No substitution shall be made for any material, article, or process required under the contract unless approved by the Engineer.

E. Any time that is required by the Engineer for a request to review submittals for substitute equipment after the award of bids will be billed to the contractor at the Engineers current hourly billing rate. The Engineers review time will be billed to the contractor whether the proposed substitution is accepted or rejected.

F. Operating Instructions: The written instructions by the manufacturer, fabricator, or installer of equipment or systems, detailing the procedures to be followed by the Owner in operation.

G. Response to Submittals: Where standard product data have been submitted in fulfillment of project requirements, it is recognized that the submitter has already determined that the products fulfill the specified requirements, and that the submittals are for the Architects' or Engineers' information only, but will be returned without action where observed to be non-complying with the requirements. Where uniquely prepared information is submitted, it is recognized to represent the preparer's interpretation or solution to the specified requirements, subject to the Architects', or Engineers' concurrence and appropriate action as indicated in Division 1.

H. Shop Drawings and Samples: After checking and verifying all field measurements, the Contractor shall submit to the Engineer for review, in accordance with the accepted schedule of shop drawings submissions, copies of all shop drawings, which shall have been checked by and stamped with the approval of the Contractor and identified as the Engineer may require. The data shown on the shop drawings shall be complete with respect to dimensions, design criteria, materials of construction and the like to enable the Engineer to review the information as required.

I. The Contractor shall also submit to the Engineer for review, with such promptness as to cause no delay in work, all samples required by the Contract Documents. All samples shall have been

checked by and stamped with the approval of the Contractor, identified clearly as to material, manufacturer, any pertinent catalog numbers and the use for which intended.

J. At the time of each submission, the Contractor shall in writing call the Engineer's attention to any deviations that the shop drawings or sample may have from the requirements of the Contract Documents.

K. No work requiring a shop drawing or sample submission shall be commenced until the submission has been reviewed by the Engineer. A copy of each shop drawing and each approved sample shall be kept in good order by the Contractor at the site and shall be available to the Engineer.

L. The Engineer's review of shop drawings or samples shall not relieve the Contractor from his responsibility for any deviations from the requirements of the Contract Documents unless the Contractor has in writing called the Engineer's attention to such deviation at the time of submission and the Engineer has given written approval to the specific deviation, nor shall any review by the Engineer relieve the Contractor from responsibility for errors or omissions in the shop drawings.

M. The Contractor's shop drawing stamp shall indicate that the shop drawings have been checked for conformity to the Contract Documents and appropriate means have been taken to insure that the material and /or equipment will fit into the space available. Shop drawings will be returned without review if the submittals do not have the Contractor's stamp or the submittals have not been reviewed by the Contractor.

N. The Engineer’s review of shop drawings is for general conformance with design concept only. The Contractor is responsible for all quantities, dimensions and coordination of the work of all trades. Corrections or comments made on the shop drawing during this review do not relieve the contractor from compliance with requirements of the contract documents. The Contractor is responsible for selecting fabrication processes and techniques of construction and for performing all work in a safe and satisfactory manner.

O. The Contractor shall stamp the shop drawings and submittals and verify by his/her signature that the shop drawings and submittals have been checked for compliance with the contract documents.

P. The Contractor shall provide TABLE 1.3 as a cover letter with the submittals. The “Date Submitted” column shall be filled in by the Contractor. The remaining three columns are for the Engineer’s use.

Q. Table 1.3 may not identify all required submittals. Contractor to refer to individual specification sections and provide shop drawings in addition to those required in Table 1.3.

TABLE 1.3 - Shop Drawings Required

Shop Drawings and Submittals Required for this Project	Date Submitted by Contractor	Date Received by Engineer	Date Returned by Engineer	Status (Approved, Approved as Noted, Rejected, etc…
260503 – Equipment Connections				
260519 – Wires and Cables				
260548 – Seismic Requirements				
260923 – Occupancy Sensors				
262416 – Panelboards				
262416 – Electrical Distribution System				
263213 – Standby Power Generator				
264100 - Lightning Protection				
264313 – Surge Protective Devices				
265000 - Lighting				
283100 – Fire Alarm System				

I have reviewed the shop drawings and submittals listed above for compliance with the contract documents.

_____
Contractor's Signature

1.4 GENERAL SUBMITTAL REQUIREMENTS:

A. Applicability: Wherever it is indicated that a shop drawing, sample, manufacturer's brochure, certification, test, copy of standard operating instruction, manual, extra stock, guarantee or warranty is required, the appropriate submittal is required regardless of whether it is specified as a "submittal"; the Architects' or Engineers' decision shall be final.

END OF SECTION 26 01 01

SECTION 26 05 03

EQUIPMENT CONNECTIONS

PART 1 - GENERAL

1.1 REQUIREMENTS

A. Motors, controllers, and other special equipment are provided and installed by other trades. This section specifies typical connections to that equipment.

B. All individual motor starters or VFD's for mechanical equipment (fans, pumps, etc.) shall be furnished and installed by the Mechanical Contractor. Under Division 26, power wiring shall be provided to starters or disconnect switch line side. Power wiring on the load side shall be by Division 23 or the division supplying equipment. All control wiring shall be furnished by the Mechanical Contractor or division supplying the equipment.

PART 2 - PRODUCTS

2.1 EXHAUST FANS

A. Exhaust fans are indicated by special symbol on plans. Unless otherwise noted, they will be furnished and set by others and connected by the Electrical Contractor. Controller will be provided by others. Electrical Contractor shall provide a local disconnect switch at fan if unit is not provided with one. Wiring on the load side of Disc SW is by Division 23.

2.2 UNIT HEATERS

A. Unit heater, ventilator, cooler, or similar outlets - designated by special symbol - are located approximately on drawings. Exact location of outlet shall be obtained from Heating, Ventilating, and Air Conditioning Contractor. Unless indicated otherwise, outlet shall be a 4" box fitted with an oversized blank cover with 1/2" center knockout, mounted in wall or ceiling, and fed on circuit shown beside symbol. These outlets shall be located behind or within equipment cabinets where possible and still be accessible. Provide local disconnect switch if one is not provided with unit. Unless specified otherwise herein or on drawings, power connection to the outlet will be by the Electrical Contractor and from outlet to equipment will be by the Mechanical Contractor. Control wiring will be done by the Mechanical Contractor.

2.3 TROUGHS

A. Electrical troughs, junction boxes, switches, or breakers for air conditioning, heating, or plumbing equipment are indicated on drawings. Exact locations shall be obtained from Heating and Air Conditioning or Plumbing Contractors but Code clearances shall be maintained. Unless specifically noted otherwise, all power wiring for equipment and controllers beyond these points will be done by Heating and Air Conditioning or Plumbing Contractors. Control wiring will be by Heating and Air Conditioning or Plumbing Contractors.

2.4 OTHER

A. Other equipment connections are generally indicated on drawings by a special symbol. These are then defined in notes or details. Where catalog numbers, models, or types, and manufacturer's name are given, these items of equipment shall be furnished and installed by the Electrical Contractor, unless specifically noted otherwise. Provide disconnect switch if one is not furnished with equipment.

B. Junction box - designated as a circled J. Size of such boxes is generally noted on drawings. Where this is not done, they shall be sized in accord with NEC and purpose evidently intended.

C. Where unscheduled junction boxes are used by Contractor to facilitate wiring or to comply with limits of elbows and bends, they shall be concealed if at all possible to do so and still be left accessible. If this is impossible, they shall be recessed in walls or ceilings and provided with an oversized cover which shall be painted out to match adjacent surfaces. If it is necessary to mount such boxes exposed, the location shall be approved by the Engineer.

D. All contactors, motor starters and combination type starters specified under this contract shall be equipped with Hand-Off-Automatic switches, pilot (run indicating) light, 120 volt control transformer, and two sets of auxiliary contacts. The switch and light shall be located on the unit cover. Starters shall be Square D, Cutler-Hammer, General Electric Co., or equivalent by others.

A. All safety switches shall be heavy-duty type, NEMA 1 for indoor and NEMA 3R for outdoor use unless specifically stated otherwise. They shall be fused type unless specifically indicated otherwise on plans. Fused type shall be equipped with Bussmann Fusetron type fuses, or approved equivalent. Fused type (600 volts or less) shall be equipped with the following: Service Entrance and Feeder Circuits over 600A – Class L, UL Listed, current limiting with 200K interrupting rating; Service Entrance and Feeder Circuits 600A and less – Class RK1 or J, UL Listed, current limiting with 200K interrupting rating; Motor, Motor Controller and Transformer Circuits – Class RK5, UL Listed, current limiting time delay with 200K interrupting rating; and individual Equipment where fault current does not exceed 50kA – Class K5, UL Listed, with 50K interrupting rating. Fusible safety switches with short circuit withstand rating of 100K or 200K shall include Class R or Class J rejection fuse block feature. Switches shall be equipped with defeatable door interlocks and padlocking provisions in the on and off positions. Padlocks shall be provided for switches located in public areas. Switches shall be by Square D, Cutler-Hammer, General Electric Co., or equivalent by others. In addition, safety switches shall be provided with the following requirements or features:

1. Safety switches shall be third party listed.
2. Switches shall have door interlocks that prevent the door from opening when the operating handle is in the “on” position.
3. Switches shall have handles whose positions are easily recognizable in the “on” or “off” position. For safety reasons, padlock shall be provided for switches unless they are located in a locked electrical room.
4. Switches shall have positive quick make-quick break mechanisms.
5. Switches shall be properly labeled. Refer to Specification 260553.

E. The Electrical contractor is to provide to the Owner as spares, 10% of the quantity of fuses used of each type and rating, with a minimum of one (1) set of each type.

F. All safety switches, motor starters, or other boxes or panels, designated as NEMA 3R or otherwise intended for outdoor use or use in wet areas, shall use rain-tight conduit hub fittings with bonding screw.

G. Control wiring shall not be installed in the same raceways as power wiring.

PART 3 - EXECUTION

3.1 NOT USED

END OF SECTION 26 05 03

SECTION 26 05 19

WIRES AND CABLES

PART 1 - GENERAL

1.1 REQUIREMENTS

A. All material shall be U.L. listed and shall be installed in conformance with the National Electrical Code.

B. All conductors and cables specified in 260519 shall be defined for use at 600 volts and below.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufactured by American/Leviton, Hi-tech, Rome, or Triangle, General Cable, Prysmian, Southwire, United, Cerro or Encore.

B. Normal trade standard "building wire" of copper.

C. Number 10 and smaller shall be solid; number 8 and larger shall be stranded.

D. Maximum conductor size shall be 500 kcmil.

E. All sizes shall bear easily readable size and insulation grade marking along entire length.

F. Insulation on #6 and smaller shall be suitably colored in manufacturing. Conductors #4 and larger may be identified with bands of proper color plastic tape near each termination and in each junction box.

G. Insulation on service and feeders shall be 600 volt Type XHHW or THHN/THWN unless shown otherwise on the drawings.

H. Branch circuits shall be a minimum of #12, with 600 volt THHN/THWN insulation unless Code requires another type. Circuit wires carried through rows of fluorescent fixtures shall be at least Type RHH or THHN.

I. Conductors in any location subject to temperatures higher than 60°C shall have insulation of a type approved by NEC for temperature encountered.

J. Control and signal conductors shall be type and size indicated in those sections of the Specifications, or as indicated on drawings.

K. Fire alarm and control wiring shall have stranded copper conductors.

2.2 VFD CABLE REQUIREMENTS

A. Provide and install VFD rated cable installed in conduit between variable frequency drive and motor.

B. Cable:

1. The cable shall be 600V/1000V rated, with stranded tinned copper conductors, shielded, suitable for use with Variable Frequency Drives and UL listed for the purpose.

2. The insulation shall be rated for 90 degrees Celsius Wet/Dry operating temperature.

3. Cable shall be suitable for use in wet/dry locations, indoors and outdoors for use in conduits and in underground ducts.

C. Conductor: The conductor shall be annealed stranded tinned copper per ASTM B3, B8, and B33.

D. Insulation:

1. The insulation thickness shall have a minimum average wall thickness of 30 mils. The insulation material shall be XLPE with a XHHW-2 listing per UL44. Each insulated conductor shall be identified by color code.

2. The insulated conductors are to be cabled together with a three (3) ground wires symmetrically placed in the interstices between the phase conductors each touching the shield.

3. Fillers shall be included as necessary to make the cable round.

E. Shielding: The cables assembly shall be shielded by applying helically two (2)-mil copper tapes. The shield shall provide 100% coverage over the assembly.

F. Jacket:

1. All cables shall have a continuous overall outer sheath of Polyvinyl Chloride (PVC), suitable for 90°C use.

2. The jacket shall have identification with permanent markings that shall be clearly embossed or printed at approximately 2 foot intervals on the outer jacket for the entire length of the cable as follows: Manufacturer's name and/or Trade Mark; Number of Conductors and size (--AWG); Type of Insulation (XLPE) or NEC Listed Conductor Type (XHHW-2); Voltage Rating.

G. Submittals: Submit manufacturer's product data for cables to the Engineer. Cable data shall include both physical and electrical characteristics of conductor and insulation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All wiring shall be color coded:

1. On 120/240 volt, 3 phase 4 wire delta high leg system – phase A, black; phase B, orange (high leg); phase C, blue; neutral, white. On 120/240 volt 1 phase 3 wire system – phase A, black; phase B, red; neutral, white. On 120/208 volt, 3 phase, 4 wire systems - phase A, black; phase B, red; phase C, blue; neutral, white. On 277/480 volt, 3 phase, 4 wire systems - phase A, brown; phase B, orange; phase C, yellow; neutral, natural gray. Ground conductor on all systems shall be green.

2. Unless noted or accepted otherwise, busses in panels and switchgear shall be considered "A", "B", and "C" from left to right, top to bottom, or front to back when facing equipment.

3. Control wiring shall not use black, red, or blue; but shall use white for neutrals and green for grounding. Any other colors may be used but the coding shall provide same color between any two terminals being joined.

4. Switchlegs, including "travelers" in 3-way and 4-way switching systems, shall be same color as phase leg.

B. Joints in #10 and smaller wire may be either made with approved twist-type connectors such as Ideal, Buchanan, T&B, Scotch, etc. “Stakon” or other permanent type crimp connectors shall not be used for branch circuit wiring.

C. Joints in #8 and larger wire shall be made with approved Burndy, T&B, or O.Z. Manufacturing Co., mechanical pressure type connectors or lugs along with their UL approved insulating covers.

D. Manufactured insulators for connectors may be used, provided they cover completely and securely all exposed metal. If joints and splices are taped, they shall be carefully covered with top-grade Okonite, Scotch Brand, or approved equivalent plastic or rubber and friction, laid on with half laps to result in a joint insulation equivalent to that of the conductor insulation.

E. Circuit joints shall not be made on twin screws of convenience receptacles. Make joints as described above and run single leads to receptacle.

F. All wiring lugs throughout the project, including, but not limited to, breakers, panelboard/switchboard lugs, safety switch lugs, and transformers lugs, shall be rated for use with 75 degree conductors sized in accordance with NEC Table 310-16.

G. Wm. Brady Co., or approved equivalent, labels or the type made with a punch on plastic tape, giving the circuit number, shall be securely fastened to each branch circuit conductor within panelboards. They shall also be installed on all conductors within junction boxes, pull boxes,

gutters, wireways, cabinets, or equipment where two or more wires of the same color occur.

H. Where connected under screw or bolt heads, stranded wire shall be fitted with a lug of proper size. Make solid conductor loops clockwise so as to be forced closed as screw is tightened. Only one solid wire loop may be held under a single screw.

I. Make all connections tight.

J. Wires within panelboards, terminal cabinets, and similar equipment shall be neatly squared, "bunched" together, and held so with plastic ties at several places.

K. Where paralleling of conductors is shown for feeders or service entrance, it is absolutely required they be exactly the same length between points of bonding together. Lay out side by side and cut to same length before drawing into raceways. Provide for each end of run a Burndy Q2A or W3A lug, or approved equal, and terminate parallels in these without cutting.

L. Provide and install shielded cable from VFD to the motor installed in conduit. Terminate all cable in accordance with the manufacturer's recommendations.

M. Voltage Drop Requirements:

1. Conductors for branch circuits shall be sized to prevent a voltage drop exceeding three percent (3%) at the farthest outlet of power, heating and lighting loads, or any combination of such loads. The maximum total voltage drop on both feeders and branch circuits to the farthest outlet shall not exceed five percent (5%).

2. Where the conductor length from the panel to the first outlet on a 277-volt circuit exceeds 125 feet, the branch circuit conductors from the panel to the first outlet shall not be smaller than #10 AWG.

3. Where the conductor length from the panel to the first outlet on a 120-volt circuit exceeds 50 feet, the branch circuit conductors from the panel to the first outlet shall not be smaller than #10 AWG.

N. All wire and cable shall be run in raceway.

END OF SECTION 26 05 19

SECTION 26 05 26
GROUNDING AND BONDING

PART 1 - GENERAL

1.1 REQUIREMENTS

A. All systems and equipment shall be grounded in accordance with NEC Article 250.

B. The raceway system shall not be relied on for ground continuity. A green grounding conductor, properly sized per NEC Table 250-122, shall be run in ALL raceways except for telecommunications, data, audio conductors raceways and PVC conduits installed for services.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufactured by Thomas & Betts, Burndy, OZ Gedney, Steel City or approved equivalent. Thomas & Betts model numbers are used herein to establish quality and type of product required for project.

B. Bonding shall be done with #3800 series insulated bonding bushings and compression type lugs.

C. Grounding conductor shall be Type THHN/THWN run in heavy wall conduit, and of size shown on drawings or required by NEC.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The main service ground clamp shall be attached to the cold water main at an accessible point and before its size is reduced immediately, within five (5) feet, after it enters the building. Clamp shall be accessible after construction is complete. Grounding conductor shall be without splice into the service enclosure where it shall be connected to main service neutral.

B. In addition to the clamp on the water main, a supplemental electrode shall be provided. This supplemental electrode shall consist of the following:

1. Three (3) 10 foot minimum copper clad ground rods, 3/4" in diameter, driven to a depth so top of rod is below finished grade. Grounding conductor shall be continuous and sized as shown on plans. The grounding conductor conduit shall be fastened to service

enclosure with double locknuts and bonding bushing.

C. In addition, the metal frame of the building shall be bonded to the grounding electrode system using a conductor sized the same as the main grounding conductor on the drawings.

D. Upon completion of installation of the grounding electrode and bonding system, the ground resistance shall be tested with a ground resistance tester. Resistance to ground shall be less than 25 ohms. If test indicates a greater resistance, appropriate measures shall be taken, including driving additional ground rods, to reduce the resistance to less than 25 ohms. Contractor shall send a letter to the engineer and State Construction Office certifying that the ground resistance test has been performed and stating the resistance measured. Also, a copy of the ground resistance test report shall be sent to the Engineer and the State Construction Office.

E. The size of ground rods shall not be less than 3 /4” in diameter and 10 feet in length.

F. Any feeder raceway anywhere in the system which enters a box or cabinet through part of a concentric or oversized knockout shall be fitted with an insulated bonding bushing and jumper. These bushings shall also be used wherever conduits stub into switchboards or transformer cabinets. Grounding type insulated bushings shall always be used on both ends of conduits feeding panelboards. The bonding jumper shall be sized by NEC Section 250 and lugged to the box.

G. Ground all fixed and portable appliances and equipment connected under this Contract with an insulated green grounding conductor. This wire shall be carried inside the raceway with the feeder wires and connected to the designated ground terminal inside each piece of equipment. Connect each end with suitable lugs.

H. All grounding type receptacles shall have a green wire jumper from their grounding terminal to box in which mounted. Attach jumper to box, not plaster ring, with a bolt or Steel City #"G" grounding clip or approved equal. Jumper shall be sized by NEC with #12 minimum.

I. Bond the aboveground portion of the gas piping system upstream from equipment shutoff valve to the building electrical service ground. The bonding jumper shall be sized per NEC Table 250-66.

END OF SECTION 26 05 26

SECTION 26 05 33

RACEWAY, BOXES, AND SUPPORTS

PART 1 - GENERAL

1.1 REQUIREMENTS

A. All material shall be U.L. listed and shall be installed in conformance with the National Electrical Code.

PART 2 - PRODUCTS

2.1 RACEWAYS

A. Galvanized steel manufactured by Allied, Triangle, Wheatland or approved equivalent.

B. All conduits shall be provided with insulated throat.

C. Rigid metal conduit (RMC) shall be used for feeders leaving all freestanding switchboards, switchgears, and all panel feeders. Raceways used in service entrance concrete ductbanks shall be PVC Schedule 40, except for the stub-ups and elbows which shall be RMC. RMC shall be used for feeder or branch circuits exposed to weather unless shown otherwise on plans. RMC shall also be used where indicated on plans. RMC shall be used in all mechanical rooms and masonry partitions. Where exposed and subject to damage RMC shall be used below 8' AFF, Above Finished Floor, in the balance of the facility and Electric Metallic Tubing, EMT, can be used above 8' AFF for general branch circuits in the balance of the facility. Provide RMC for any metal raceway larger than 2 inches in diameter.

D. Electric metallic tubing (EMT) may be used for general branch circuits unless indicated otherwise on plans or stated otherwise in these specifications. Provide a junction box for transition between EMT and rigid conduits. EMT <u>shall not</u> be installed in any location where exposed or subject to severe physical damage, severe corrosive influence, outdoors, underground, in/below slab-on-grade, in earth or in concrete, cinderblock or brick walls.

E. EMT couplings and connectors shall be compression-gland type of malleable steel, galvanized or sherardized. Connectors shall be insulated-throat type. Set screw, indentor, or cast type fittings are not acceptable.

F. All service entrances shall be concrete encased schedule 40 PVC.

G. All telecom fiber and copper backbone entrances shall be concrete encased schedule 40 PVC.

H. Use PVC conduit underslab and underground only as noted on the drawings, or specified herein. No exposed PVC allowed. Fittings for PVC shall be U.L. listed for the use, and shall be

installed per the manufacturer's instructions. Underslab PVC conduit runs shall utilize RMC elbows and RMC up through slab, and transition to EMT in drywall partitions or RMC in masonry walls. Use PVC for underground outdoor branch circuits and underslab branch circuits. Bends in PVC shall be made by methods approved by the manufacturer and the NEC. PVC schedule 40 shall not be used exposed or concealed in gypsum walls, but may be used in CMU walls. PVC schedule 40 may be used in elevated floor slabs and in the foundation slabs. The minimum concrete cover shall be ¾ inches at finished or formed surface and shall be 3 inches at concrete surface cast against earth or for slabs placed on grade. Greater amounts of concrete cover shall be used in areas subject to demage or correction. Installed system shall comply with the minimum requirements of ACI 1318 Chapter 6.

I. Galvanized "flex" in dry and "sealtite" in wet locations shall be used for connection to mechanical equipment or transformers, or for lighting fixture whips. Green ground wire shall be installed and NEC followed. Flex runs shall be no greater than six feet in length.

2.2 BOXES

A. Manufactured by Midland Ross/Steel City, T&B, Raco, or Appleton.

B. Galvanized or aluminum of gauge required by NEC.

2.3 FASTENINGS AND SUPPORTS

A. Shall be of good quality, galvanized steel or other non-corroding material.

PART 3 - EXECUTION

3.1 RACEWAY INSTALLATION

A. Minimum raceway size shall be 1/2" unless noted otherwise. Minimum raceway size for raceways run underground external to the building shall be 3/4” and shall be approved by the NEC as “suitable for direct burial”. For telecommunications the minimum raceway size shall be 1".

B. All runs of empty conduit only shall have a 100# nylon pull rope installed in the conduit.

C. Rigid metal conduit shall be made up with full threads to which T&B "Kopre-Shield" compound has been applied, and butted in couplings.

D. Z. Split or "Erickson" couplings where necessary.

E. Where it is necessary to run underneath a concrete slab poured on-grade, conduit shall be buried in trench beneath gravel base and turned up through slab.

F. Underground runs, except under concrete floor slabs, shall have a minimum of 24" cover. Backfill shall be made in 6" layers - tamping each layer to a density of 95% of maximum possible.

G. Raceways run external to building foundation walls, with the exception of branch circuit raceways, shall be encased with a minimum of 3” of concrete on all sides. Unless noted otherwise encased raceways shall have a minimum cover of 18”, except for raceways containing circuits with voltages above 600 volts, which shall have a minimum cover of 30”.

H. Encased raceways shall be of a type approved by the NEC as “suitable for concrete encasement”.

I. Branch circuit raceways run underground external to building foundation shall be run in raceways installed in accordance with the NEC, and shall be of a type approved by the NEC as “suitable for direct burial”.

J. All underground raceways shall be identified by underground line marking tape located directly above the raceway at 6” to 8” below finished grade. Tape shall be permanent, bright colored, continuous printed, plastic tape compounded for direct burial not less than 6” wide and 4 mils thick. Printed legend on tape shall indicate general type of underground line below.

K. Where underground raceways are required to turn up to cabinets, equipment, etc., and on to poles, the elbow required and the stub-up through the slab or earth to equipment shall be of rigid steel conduit.

L. Where passing through a “below grade” wall from a conditioned interior building space , raceways shall be sealed utilizing fittings similar and equivalent to OZ Gedney type “FSK” through-wall fitting with “FSKA” membrane clamp adapter if required.

M. Attach rigid metal conduits with double locknuts - one inside and one outside - and fiber bushing.

N. Grounding type insulated bushings shall be used where raceway enters boxes with concentric or oversized knockouts. These bushings shall also be used wherever conduits stub into switchboards or transformer cabinets. Grounding type insulated bushings shall always be used on both ends of conduits feeding panelboards.

O. Provide suitable fittings where raceway crosses building expansion joints.

P. Securely fasten in place using approved strap or hanger within three feet of each termination and not over ten feet apart in runs.

Q. Run concealed in finished areas unless otherwise noted.

R. All PVC conduits, except those installed for services, shall contain green grounding conductor.

S. Make all cuts square with hacksaw. Remove any burrs or shoulders by reaming.

T. Installation shall meet seismic requirements of Section 260548 of these specifications.

U. All runs exposed and all runs above accessible ceilings shall be neat and square with building structure such as walls and ceiling/roof structures. Multiple parallel runs shall use trapeze supports where possible.

V. "Flex" and "Sealtite" connections with T&B "Tite-Bite" and "Super-Tite" or approved equivalent fittings. Shall have insulated throats.

W. The use of “LB’s” shall be limited where possible. Where necessary to use “LB’s” sized above 2 inches, mogul units shall be installed.

X. Conduits, JB’s, Troughs and any enclosure when mounted outside shall be mounted off the walls by one inch.

3.2 EMT conduit provided below roof deck shall be installed 1-1/2 inches away from the deck to avoid penetration from reroofing screws.

3.3 BOX INSTALLATION

A. Attach EMT with connector only.

B. Outlet boxes shall be sized in accord with NEC Section 370. All lighting outlet boxes shall have fixture studs. Device boxes shall be sectional type or 4" square equipped with plaster rings as required to mount the device. Set edge flush with finished surface. Boxes may be installed at top or bottom of a masonry course. Raco masonry boxes in sawed block. 1-1/4" and deeper plaster rings may be of die-cast aluminum of Steel City make.

C. Where installed in metal stud partitions, wall boxes shall be supported from two adjacent studs using a system such as Caddy Bar Hanger Assembly, or equivalent. Support on a single stud is not acceptable.

D. Fixtures weighing more than six pounds shall be supported from the fixture stud.

E. Where not shown differently on the drawings, mount:

1. Switch boxes 46" from finished floor to center. Boxes beside doors shall be mounted so edge of trim plate is 2" from edge of door trim on strike side.

2. Telephone boxes 18" from finished floor to center and vertical. Boxes for wall phones shall be 46" from finished floor and vertical.

3. Bracket light boxes as indicated on plans or as directed by Engineer .

4. Panel cans 6'-4" ($\pm$4" in concrete block construction) from finished floor to top of can.

F. Where not shown differently on the drawings, mount boxes for receptacles to receive device in a vertical position and be:

1. Centered 18" above finished floor.

2. Centered 6" above counters, shelves, or cabinets where apparently intended to be so placed.

3. Centered 4" above high edge of backsplashes.

4. Where devices are to be ganged, provide boxes to receive devices trimmed with a gang plate.

G. As soon as installed, all raceway openings shall be closed with plastic inserts to prevent entrance of foreign matter during construction. All enclosures shall be kept clean of any foreign matter. Install Jordan "Kover-All" plastic covers over outlet boxes ahead of plastering or painting.

H. All outlet boxes, junction boxes and pull boxes shall have their covers and exterior visible surfaces painted with colors to match color scheme outlined in Section 260553. This includes covers on boxes above all type ceilings. Junction and pull boxes for branch circuits and signal or communication systems also shall be identified by spray painting the interior of the box. In addition, the box cover shall be labeled using a permanent, black marking pen to identify circuits or systems in box.

3.4 FASTENINGS AND SUPPORTS INSTALLATION

A. Inserts in masonry shall be lead, fiber, or plastic types installed in drilled holes. Wooden plugs shall not be used. Lead only shall be used on all exterior masonry or interior masonry subject to permanent moisture. Hung raceways shall be supported from the structure with rod supports at least 5/16" in diameter.

B. All equipment and flat raceways attached to outside wall or interior walls subject to permanent moisture shall be shimmed out with non-corrodible material so as to provide 1/4" air space between wall and equipment or raceway.

C. All materials, whether exposed or concealed, shall be firmly and adequately held in place. Fastening and support shall afford safety factor of three or higher.

D. All fixtures, raceways, and equipment shall be supported from the structure. Nothing may be supported on suspended ceilings, including the hanger wires, unless definitely noted so on the drawings or specifically permitted by the Engineer.

E. Recessed fixtures shall be supported with 10 gauge steel wire or with the same type of wire used to support the lay-in ceiling track if heaver/stronger than 10 gauge steel wire adjusted as necessary to level fixture, minimum of two wires for 18" or less wide by 48" fluorescent, two wires for 24" x 48" and two wires for incandescent fixture under 15 lbs. Continuous row may use one wire (for 12" wide) or two wires (for 24" wide) each four feet plus row end supports. Fixture shall be supported at the two opposite ends of the fixture to the building. Attach one end of the support wire to one corner of the luminaire and the other end to the building's structural system. The lay-in luminaire shall be screwed to the main runners of the lay-in

ceiling track at all four corners using sheet metal screws.

F. Recessed ceiling speakers, where specified with an enclosure, shall have the enclosure supported directly from the structure with a minimum of two 10 gauge wires run perpendicular to the ceiling and not pulling to one side. If recessed ceiling speaker is specified without an enclosure and is mounted in a suspended ceiling, the speaker shall be supported using T-Bar bridges such as Soundolier No. 81-8, or other device specifically designed for such support. In addition, each of the four corners of the ceiling grid block enclosing the speaker shall be supported from the structure using 10 gauge steel wire run perpendicular to the ceiling plane.

G. Other devices using octagonal or 4" square ceiling boxes, such as smoke detectors, dome lights, exit signs, etc., where installed in suspended ceilings shall be supported from the ceiling system using Caddy, or other, hangers specifically designed for such support. In addition, each of the four corners of the grid block enclosing the box shall be supported from the structure using 10 gauge steel wires run perpendicular to the ceiling plane.

END OF SECTION 26 05 33

SECTION 26 05 48

SEISMIC REQUIREMENTS FOR ELECTRICAL EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Electrical installation shall meet the seismic requirements as specified by Section 1621 of the North Carolina State Building Code. Section 1621 states that the project shall be classified by Seismic Hazard Exposure Group and Seismic Category and shall meet the requirements of Section 1621 of the North Carolina State Building Code for seismic design of electrical components. See Appendix B in the set of drawings for references to these criteria either in the Architectural or Structural drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All free standing electrical equipment such as switchboards, transformers, generators, cable trays, etc., shall be anchored to the structure in a manner that will satisfy the requirements of the NC State Building Code. Manufacturer of the equipment shall detail methods to be used to meet these requirements on the shop drawings of the equipment. Design calculations for the restraint methods used shall be included with the shop drawings. Drawings with these details, as well as the design calculation sheets, shall carry the seal of a registered Professional Engineer. Manufacturer shall make provisions for a field visit by his Engineer to verify that the installation conforms to the design. A certifying letter shall be sent to the Electrical Engineer stating that the installation does conform to the manufacturer's design and does meet the requirements of the NC State Building Code.

B. Mounting methods of internal components of manufactured equipment shall be certified by the manufacturer that the methods used meet the seismic requirements. Certification compliance information shall be submitted with shop drawings.

C. Raceway, busduct, and other hung or suspended components of the electrical installation shall be installed in compliance with the NC State Building Code. Seismic restraint systems shall be Unistrut, Kindorf, B-Line, or approved equivalent. Seismic restraint systems shall be designed by the vendor. Submit to the Engineer record copies of all calculations and system information. Calculations and details shall be sealed by a registered professional engineer. Where specific pre-engineered systems are not readily available, the contractor may use the latest edition of "Seismic Restraint Manual Guidelines for Mechanical Systems" published by SMACNA for determining correct restraint systems to be used. Submit SMACNA systems to be used at same time as shop drawings of other pre-engineered systems. Either the vendor or the contractor, as applicable, shall make provisions for a field visit by a registered professional engineer to verify that the installation conforms to the vendor's design or the SMACNA design, as appropriate, and that the installation meets the requirements of the State Building Code.

D. Housekeeping pads specified for equipment shall be mechanically connected to the structural floor.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Review of the seismic design and shop drawings by the Engineer shall not relieve the Contractor of his responsibility to comply with the seismic or any other requirements of the NC State Building Code.

END OF SECTION 26 05 48

SECTION 26 05 53

EQUIPMENT IDENTIFICATION LABELS

PART 1 - GENERAL

1.1 NAMEPLATES

A. Furnish and install engraved laminated phenolic nameplates for all safety switches, panelboards, transformers, switchboards, low voltage systems, medium voltage cables, medium voltage switches, underground 15kV duct and other electrical equipment supplied for the project for identification of equipment controlled or served, phase, voltage, etc.

B. All lighting switch and receptacle device box cover plates shall be provided with label indicating panelboard and circuit serving the device (Example: A-1, PPM-5, etc.). Contractor to submit sample of label for Owner approval.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Nameplate material colors shall be:

1. Blue surface with white core for 120/240 volt equipment.

2. Black surface with white core for 277/480 volt equipment.

3. Bright red surface with white core for all equipment related to fire alarm system.

4. Dark red (burgundy) surface with white core for all equipment related to security and CCTV systems.

5. Green surface with white core for all equipment related to "Emergency" systems.

6. Orange surface with white core for all equipment related to telephone systems.

7. Brown surface with white core for all equipment related to data systems including underground telecom duct bank.

8. Yellow surface with black core for all equipment related to medium voltage power including underground power duct bank.

B. All empty conduit runs and conduit with conductors for future use shall be identified for use and shall indicate where they terminate. Identification shall be by phenolic tags with wire attached to conduit or outlet.

C. All empty/spare underground ducts (telecom and power) shall be identified for future use and shall indicate where they terminate. Identification shall be by phenolic tags with wire attached to duct in each manhole.

D. All outlet boxes, junction boxes and pull boxes shall have their covers and exterior visible surfaces painted with colors to match color scheme outlined above. This includes covers on boxes above all type ceilings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Nameplates shall be securely attached to equipment with self-tapping stainless steel screws, and shall identify equipment controlled, attached, etc. Letters shall be 1/2 inch high minimum. Embossed, self-adhesive plastic tape is NOT acceptable for marking equipment and shall not be used.

B. Nameplates shall be attached to medium voltage cabling with plastic tie-wraps (2 per nameplate). Nameplates for medium voltage cabling shall indicate the circuit designation, phase and the "from and to" location information, i.e. 'CKT I, PHASE B, FROM S-35A WAY 2 TO S-34 WAY C1". Place labels on cables inside switches and manholes (at entry and exit points).

C. Furnish and install engraved laminated plastic nameplates for each "way" on the new medium voltage switches. Each nameplate shall indicate the location controlled or feeding and circuit number, i.e. "TO S-34, CIRCUIT I". Also furnish and install engraved plastic nameplate for exterior of switch enclosure indicating "Switch 35A".

END OF SECTION 26 05 53

SECTION 26 09 23

OCCUPANCY SENSORS

PART 1 - GENERAL REQUIREMENTS

1.1 SCOPE

A. Contractor's work to include all labor, materials, tools, appliances, control hardware, sensor, wire, junction boxes and equipment necessary for and incidental to the delivery, installation and furnishing of a completely operational occupancy sensor lighting control system, as described herein.

B. Contractor shall examine all general specification provisions and drawings for related electrical work required as work under Division 16.

C. Contractor must submit data sheets on sensors, control units and all junction boxes and mounting accessories, including all wiring diagrams.

1.2 EQUIPMENT QUALIFICATION

A. All components shall be U.L. listed and offer a five (5) year warranty.

1.3 OBJECTIVE DESCRIPTION

A. The objective of this section is to ensure the proper installation of the occupancy sensor based lighting control system so that lighting is turned off automatically after reasonable time delay when a room or area is vacated by the last person to occupy said room or area.

B. The occupancy sensor based lighting control shall accommodate all conditions of space utilization and all irregular work hours and habits.

C. Contractor shall warrant all equipment furnished in accordance to this specification to be undamaged, free of defects in materials and workmanship, and in conformance with the specifications. The Contractor's obligation shall include repair or replacement, and testing without charge to the Owner, all or any parts of equipment which are found to be damaged, defective or non-conforming and returned to the supplier. Warranty on sensors and controls units will be for a period of five (5) years. The warranty shall commence upon the owner's acceptance of the project. Warranty on labor shall be for a minimum period of one (1) year.

D. The Contractor shall provide, at the owner's facility, the training necessary to familiarize the Owner's personnel with the operation, use, adjustment, and problem solving diagnosis of the occupancy sensing devices and systems.

PART 2 - PRODUCTS

2.1 SPECIFIC REQUIREMENTS

A. OCCUPANCY SENSORS

1. Wall switch sensors shall be capable of detection of motion at desk top level up to 300 square feet.

2. Wall switch sensors shall accommodate loads from 0 to 800 watts at 120 volts; 0 to 1000 watts at 277 volts.

3. Bi-level wall switch sensors shall accommodate up to two loads from 50 to 800 watts at 120 volts; 50 to 1000 watts at 277 volts, for each load.

4. Wall switch sensors shall have a 180° coverage capability.

5. Passive Infrared sensors shall have a multiple segmented Lodif Fresnel lens with grooves-in to eliminate dust and residue build-up.

6. Passive Infrared and Dual Technology sensors shall have fully automatic operation, offer daylighting foot-candle adjustment control and be able to accommodate dual level lighting.

7. Ceiling mount sensors shall provide a minor motion coverage range of 150 to 1300 square feet with an overall 1/2 step coverage range from 300 to 2000 square feet.

8. Occupancy sensors shall provide coverage of 90 to 100% of the controlled area.

9. All sensors shall be capable of operating normally with electronic ballasts and PL lamp systems.

10. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.

11. All sensors shall have readily accessible, user adjustable controls for time delay and sensitivity. Controls shall be recessed to limit tampering.

12. In the event of failure, a bypass manual "override on" feature shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. The override feature shall be designed for use by building maintenance personnel and shall not be readily achieved by building occupants.

13. Ultrasonic operating frequency shall be crystal controlled to within plus or minus 0.005% tolerance to assure reliable performance.

14. Ultrasonic microphone receiver frequency shall be 25 KHz or greater and shall be temperature and humidity resistant.

15. All sensors shall provide an LED indication light to verify that motion is being detected and that the unit is working. Acceptable vendors are WattStopper, Leviton and Sensor

Switch. All sensors shall be equal to Watt Stopper model numbers:

a. Ceiling sensors: W-500A, W-1000A, W-2000A, W-2000H, WPIR, DT-100L, CI-100, CI-200

b. Wall Sensors: WI-120A, WI-277A, WI-120-4, WI-277-4, WS-120, WS-277

c. Power Packs: A-120E, A-277E, S-120/277/347E

16. Decibel levels for ultrasonic sensors shall comply with the following criteria:

a.

Mid frequency of Sound Pressure Third Octave Band (KHz) micropascals)	Maximum dB level within Third Octave Band in dB reference 20
Less than 20	80
or more to less than 25	105
or more to less than 31.5	110
or more	115

17. All sensors shall have no leakage current in OFF mode and shall have voltage drop protection.

18. All sensors shall have UL rated, 94V-0 plastic enclosures.

19. Sensors shall be suitable for N.E.C. 725 Class 2 wiring and use plenum cable when required.

2.2 CIRCUIT CONTROL HARDWARE - CU

A. Control Units - For ease of mounting, installation and future service, control unit(s) shall be able to mount on external J boxes and be integrated self-contained unit consisting internally of load switching control relay and a transformer to provide low-voltage power to a minimum of two (2) sensors.

B. Relay Contacts shall have ratings of:

1. 10A - 120 VAC Tungsten

2. 20A - 120 VAC Ballast

3. 20A - 277 VAC Ballast

C. Relay contacts shall be isolated.

D. Control units shall be UL listed.

E. Between sensors and controls units shall be three (3) conductors, 18 AWG, stranded UL Classified, PVC insulated or TEFLON jacketed cable approved for use in plenums.

PART 3 - EXECUTION

3.1 It shall be the Contractor's responsibility with the supplier's assistance to locate and aim sensory in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas. Rooms shall have ninety (90) to one hundred (100) percent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location with in the room(s). The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only rooms which are to be provided with sensors. The contractor shall provide additional sensors if required to properly and completely cover the respective room. Proper judgment must be exercised in executing the work so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components. “No emergency lighting is to be connected to an occupancy sensor”.

END OF SECTION 26 09 23

SECTION 26 24 16

DISTRIBUTION AND BRANCH CIRCUIT PANELBOARDS

PART 1 - GENERAL

1.1 REQUIREMENTS

A. Equipment shall be built to NEMA Standards where such standards exist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Square D panelboards are specified. Equivalents by Siemens, Cutler-Hammer or General Electric Company or approved equal may also be provided. Square D models and types are listed herein to establish type and quality required for the project.

B. Types, sizes, capacities and characteristics shall be as shown on riser diagram or in schedules. Service equipment shall be labeled "UL Approved for Service Entrance Use".

C. Branch circuit panelboards shall be bolt-on type, Square D NQOD or NF types, or equivalent. Distribution panelboards shall be Square D I-Line types HCN, HCM, HCW, as indicated on plans, or equivalent.

2.2 CONSTRUCTION FEATURES

A. Housing shall be constructed of Code gauge galvanized sheet steel and shall be securely fabricated with screws, bolts, rivets or by welding. Housings for branch circuit panelboards shall be 20" wide and 5-3/4" deep. Housings for distribution panelboards shall be no larger than the panelboard specified or as shown on the plans. Space is at a premium and oversized panelboards, in most cases, will not allow for proper Code clearances. Panels shall be sized so that they will pass through door openings and hatch openings, be assembled if required within the room that they are located/mounted, installed to meet NEC clearance requirements and installed for maintainability.

B. Top or bottom space shall be increased six inches where feeder loops through panel. End plates shall be galvanized Code gauge (minimum) and shall be supplied without knockouts.

C. Covers shall be constructed of high grade flat sheet steel of Code gauge minimum with the following:

1. Door flush with face and closed against a full inside trim stop. Hinges shall be inside type.

2. A combination flush latch and Yale, Corbin or equivalent, tumbler-type lock, so panel door may be held closed without being locked. All such locks on same job shall be keyed alike. Plastic lock type trims are not acceptable.

3. Finish of manufacturer's standard color of top-grade enamel over a phosphatized or other approved rust inhibitor treatment and prime coat, or as specified in Section 260100.

4. Four or more cover fasteners of a type which will permit mounting plumb on box. Cover shall also have inside support studs to rest on lower edge of can while being fastened.

5. Distribution and lighting type panelboards shall be furnished with covers hinged to backbox. Hinge shall be continuous “piano” hinge type permanently spot welded to the panelboard cover. Hinge shall in turn bolt securely to the backbox. Hinge cover shall not be required for flush mounted distribution panelboards.

D. A means of readily adjusting projection of panel interior assembly with all connections in place shall be provided. A method requiring stacking of washers is not acceptable.

E. Interior trim shall fit neatly between interior assembly and cover - leaving no gaps between the two.

F. For lighting panels:

1. Individual breakers shall be securely and tightly mounted on their supporting structure so they do not depend upon the current-carrying bus for support, unless a combination support/bus is considered adequately strong by the Engineer.

2. Breakers shall be "Quicklag" type bolted to the supply bus. Plug-in types are not acceptable unless specifically called for on plans.

G. Supply lugs shall be installed on busses and neutral bar so they may be readily and securely tightened from the front with panel in place and wired. A suitable arrangement shall limit their movement out of plumb. It shall not be possible to move the lugs so that metal parts between phases are closer than 3/8".

H. All panels shall have copper busses, with substantial connections where breakers bolt to busses.

I. All wiring lugs in panelboards and all breakers shall be rated for use with 75 degree conductors sized in accordance with NEC Table 310-16.

J. All branch circuit panels shall be equipped with copper ground busses.

K. Breakers in lighting or branch circuit power panelboards shall be physically arranged in locations shown in panel schedules and be connected to the phases shown. Any deviation shall be approved by the engineer in advance. Panelboards shall be equipped with directory cards mounted behind heavy clear plastic shields in substantial frames attached to inside face of doors. Cards shall be a minimum of three inches wide.

L. Submittals: All panel submittals shall be in the form of a panel schedule showing the physical location, layout and bus position of each circuit breaker. Lists showing numbers of circuit breakers will not be acceptable. Submittals that are not in accordance with this section will be rejected without review.

M. All panelboards on building exterior shall be rated NEMA 3R (weatherproof) and lockable.

N. Maximum numbers of breakers in a panelboard shall not exceed 42 poles.

O. The number of the branch circuit shall be identified with permanent wire tag attached to the wire.

2.3 METERING AND INSTRUMENTATION – NOT USED

2.4 COORDINATION AND ARC FAULT STUDIES

A. As a part of this contract, the gear manufacturer shall provide a device coordination and arc fault studies complete with settings for all breakers and labels for all electrical equipment. Available fault current at point of delivery shall be obtained from the Construction Documents (Riser Diagram).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Flush-mounted panel housings shall be flush with finished wall.

B. Mount equipment plumb and level.

C. Openings in boxes, cabinets, or gutters shall be cut or sawed. Burning of openings is prohibited.

D. Only one (1) solid wire is allowable under a screw. Use lug for connecting stranded wire or more than one (1) solid conductor.

E. Label all equipment in conformance with Section 260553.

F. Panelboard directory card shall be neatly typed with circuits assigned as shown on schedules. Space typing on card so all is visible when inserted into frame. Use room names and numbers as provided by Owner, not those shown on schedule. Names and numbers on schedule relate to plans only for construction. Indicate spare breakers in pencil (not typed) so that Owner can erase as necessary in the future.

G. Next to each breaker within the main or distribution panelboards, attach a label indicating what it feeds. Wording shall be as shown on its diagram or schedule. Labeling shall also be attached to separately mounted breakers, switches, transformers, wiring gutters and controllers of all types.

H. Centered above the door on the panel cover, attach a label indicating panel designation – for example, "PANEL A"; voltage – "120/208 VOLTS"; and from where served – "FED FROM PANEL MDP". See Section 260553 for label requirements and details.

I. Interrupting capacities shall be as indicated on the panel schedules. All ratings are for fully rated panels and breakers; series rating are not acceptable.

J. The equipment manufacturer shall provide as a part of this contract a device coordination study complete with settings for all breakers. Available fault current at the point of delivery shall be obtained from the design documents.

K. The contractor shall provide an arc-flash study and label each panel with appropriate label.

L. The E.C. shall set breakers in accordance with the coordination and arc flash studies.

3.2 SUBMITTALS

A. Submittal shall include complete information which addresses all features specified here-in and indicated on the drawings. Interrupting capacities of all breakers, bus ratings, dimensions, etc. shall be clearly shown. Submittal shall include equipment elevation complete with all dimensions, and proposed breaker layout. Incomplete submittals will be rejected. Coordination study shall be included with the gear submittal, or submittal will be rejected.

B. All panel submittals shall be in the form of a panel schedule showing the physical location, layout and bus position of each circuit breaker. Lists showing numbers of circuit breakers will not be acceptable. Submittals that are not in accordance with this section will be rejected without review.

END OF SECTION 26 24 16

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 WIRING METHOD FOR BRANCH CIRCUITS

A. Outlets in the same general area are circuited together. Circuit numbers are shown as noted in symbol schedule.

B. Provide dedicated neutrals for each branch circuit. Sharing of neutrals is not allowed.

C. Three phase circuits shall be limited to one circuit per raceway (three different phase wires and a neutral if needed).

D. The neutral carrying all or any part of the current of any specific load or run shall be contained in the same raceway or enclosure with the phase wire or wires also carrying that current. No split neutrals permitted.

E. Circuits shall be connected to panels as shown in the panel schedule. Any deviation shall be approved in advance by the engineer.

F. Under the above requirements and with required color coding system no feeder or branch circuit raceway will contain more than one wire of the same color, except for switch legs and control circuits.

G. Conductors feeding lighting outlets may be combined in the same raceway with conductors feeding convenience receptacles; but lighting outlets and convenience receptacles shall not be put on the same circuit unless specifically indicated.

PART 2 - PRODUCTS

2.1 WIRING DEVICES

A. Switches considered equivalent are as follows:

1. Single Pole:
   Hubbell 1221
   P & S 20AC1
   Leviton 1221

2. Three Way:
   Hubbell 1223

P & S 20AC3
Leviton 1223

3. Four Way:
Hubbell 1224
P & S 20AC4
Leviton 1224

B. Duplex receptacles considered equivalent are as follows:
NEMA 5-20R, 20A, 125V

1. Heavy Duty, Specification Grade:
Hubbell 5362
P & S 5362
Leviton 5362

2 Ground Fault Interrupt: (Specification Grade)
Hubbell GFR5362
P & S
Leviton 6898-HG

3 Ground Fault Interrupter type duplex receptacles shall be heavy duty specification grade. Where used outdoors, they shall also be weather resistant type and have a "while in use", lockable protective cover.

C. All devices on normal power circuits shall be ivory in color. Samples will be required prior to acceptance of any proposed equivalents not specifically mentioned above. All like devices shall be by the same manufacturer (i.e.; all switches, all duplex receptacles, etc.).

D. Unless noted or specified otherwise, device trim plates shall be type 302 stainless steel to suit device. All plates in the job shall be same make and match throughout.

E. Wiring devices shall be 20 amp minimum and shall be of the grounding type, with hex-head green grounding screw, to be connected to the green ground conductor. Self-grounding type is not acceptable.

F. All receptacles in wet locations shall be "weather resistant while in-use" and GFI. Weather resistant while-in use cover shall be die cast Alloy 360 copper-free aluminum for maximum corrosion resistance and durability. The finish shall be aluminum lacquer. Hubbell #WP26M, Thomas & Betts #CKSGV or equal.

G. All receptacles in damp locations shall be weather resistant and GFI.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Devices shall be mounted tightly to boxes and be adjusted plumb and level.

B. Two or more devices ganged shall be trimmed with gang plate.

END OF SECTION 26 27 26

SECTION 26 32 13
OPTIONAL STANDBY POWER GENERATOR

OWNER WILL RELOCATE EXISTING GENERATOR, SO THAT PORTION OF THE SPECIFICATION IS ONLY SHOWN FOR INFORMATIONAL PURPOSE. THE CONTRACTOR WILL HAVE TO INSTALL A NEW ATS AS PART OF THIS SCOPE OF WORK AND IS LISTED IN SECTION 2.6 OF THIS SPECIFICATION

PART 1 - GENERAL

1.1 REQUIREMENTS

A. Furnish and install a complete emergency engine generator package including engine/generator set, outdoor housing, transfer switches, fuel feed lines, muffler, exhaust piping, wiring, etc., as necessary to provide a complete emergency power system.

B. Equipment and resulting installation shall comply with all state and local codes.

PART 2 - PRODUCTS

2.1 ENGINE GENERATOR SET

A. Engine generator set shall be Caterpillar, Cummins, Kohler, or approved equivalent. Specifications are based on Caterpillar.

B. Packaged generator set shall be third party listed. UL2200 or CSA or both.

C. New tier 3 engine generator shall have KW (KVA) continuous standby rating as shown on the drawings; 120/240D volt, 1800 rpm maximum, 60 hertz, 0.8 power factor, 4-cycle, diesel engine driven, capable of operating on No. 2 diesel fuel. This rating shall be in accordance with the requirements of SAE J1349. This rating is for continuous electrical service during interruption of normal utility service.

D. The generator set shall be capable of cranking and picking up the assigned loads, meeting the minimum frequency and voltage stability requirements of these specifications, within 10 seconds after loss of utility power.

E. Engine shall be water cooled, solid-injection type, either vertical in-line or v-type. The engine shall be equipped with fuel filter, lube oil filter, intake air filter, lube oil cooler, fuel oil cooler, fuel transfer pump, fuel priming pump, service meter, gear-driven water pump, and instruments, including a fuel pressure gauge, water temperature gauge, lubricating oil pump and pressure gauge, battery charging ammeter, and engine hour meter.

F. Certified engine horsepower curves shall be submitted showing the manufacturer's approval of the engine rating for generator set standby power application. Special ratings or "maximum" ratings are not acceptable.

G. Engine shall be provided with an electronic, isochronous, temperature compensated, governor capable of keeping the frequency at any constant load, including no load, within a steady state band width of ±0.25% of rated frequency. The governor shall not permit frequency modulation (number of times per second that the frequency varies from the average frequency) to exceed one cycle per second. Single phase sensing control and speed ramp shall be included.

H. Engine shall be furnished with a 24 volt starting system with batteries and battery heaters. Provide battery heaters in accordance with NFPA 110. Batteries shall be industrial grade lead acid with current limiting battery charger. Batteries shall be oversized for proper starting in temperature extremes. The battery charging system shall be automatic, solid state, current limiting and float equalizing and shall maintain the battery at normal capacity, recharge battery after cranking and be capable or recharging a completely discharged battery within 8 hours. System shall be capable of automatically switching from one charging rate to another to meet the needs of the battery. The battery charging system shall have a 120 volt input and shall also be equipped with overload protection, voltage surge suppressors, D.C. ammeter, D.C. voltmeter, low D.C. voltage alarm relay, battery charger malfunction alarm contact and have a minimum continuous output of 10 amperes D.C. and be third party listed.

I. Engine shall be equipped with one 208 volt jacket water heater with 120 volt recirculating pump. Heater and pump shall be a single assembly with a single point power feed connection.

J. Engine shall have radio frequency suppression.

K. Generator breakers (3) must be physically separated with a barrier from each other. Line and load side wiring to breakers must also be separated with a barrier.

L. Air flow shall be away from engine. The radiator shall be protected by a strong grille or screen guard and the fan shall be provided with a screen guard.

M. Engine shall be equipped with an institutional grade (critical) muffler-silencer. Critical grade silencer shall be provided to reduce engine exhaust noise to a maximum dBA level of 85 at a distance of 10 feet. Contractor shall also furnish all necessary flexible and hard exhaust piping necessary for a satisfactory installation. Terminate exhaust piping using a hinged cap on top of pipe to keep out rain. Top of the exhaust piping shall be as noted on drawings. Exhaust piping and silencer shall be stainless steel to prevent rusting or be internally mounted. Exhaust pipe size shall be such that exhaust back pressure does not exceed maximum limitation required by engine manufacturer. Silencer shall provide a minimum of 32 dbA attenuation.

N. The generator shall be a salient pole synchronous alternator of the single bearing type built to NEMA and IEEE standards, brushless type, with packaged high performance transistorized voltage regulator and voltage adjusting rheostat.

O. The generator excitation shall be provided by a direct connected, unit mounted pilot exciter (PMG) of sufficient rating for the generator. Exciter shall be capable of maintaining a 300% short circuit current on the alternator and provide full exciter power, regardless of alternator voltage, for motor starting and sustaining voltage for sufficient time for protective devices to operate.

P. Generator-exciter-regulator package shall provide a voltage regulation of +1% of rated voltage. Voltage regulation shall apply to any load from no load to rated load at rated power factor. Regulator shall be digitally controlled incorporating LCD display screen.

Q. The maximum allowable voltage dip during inrush shall be 15%. Documentation regarding this performance shall be included in the shop drawing submittals.

R. The generator shall have five-sixths pitch. Stator insulation shall be Class "H" rated for 155 degree C rise by resistance above a 40 degree C ambient with Class “F” temperature rise. Insulation shall be moisture proof.

S. Generator shall have amortisseur windings with the end plates connected between poles to minimize harmonic content and provide good transient performance and paralleling capability.

T. Generator shall be equipped with taps or adjustments for voltage such that voltage can be adjusted to match the utility voltage at the transfer switches within +2%.

U. The engine generator set shall be completely assembled and tested at the factory prior to shipping to the job site. The engine shall be run under full load conditions for a sufficient length of time to allow all piston rings to seat themselves prior to shipment to job site. Proof of testing shall be documented and sent to the engineer.

V. The generator set shall have a digital control panel mounted, no higher than six (6) feet AFG, on the unit with LCD readout and controls listed by the manufacturer as standard as well as those specified herein. Controls shall provide for automatic shutdown in case of high water temperature, overspeed, overcrank, or low oil pressure. Include additional alarms for NFPA 110 and 99 compliance.

W. The generator set shall be equipped with main line circuit breakers (see plans) mounted on the unit. Circuit breakers shall be adjustable electronic trip type, molded case, rated as indicated on plans, and with shunt trip for engine shut down tripping. Furnish with auxiliary position contacts. Do <u>not</u> provide magnetic-only circuit breakers.

X. Provide generator set with battery-powered emergency lighting suitable for installation. The battery-powered emergency lighting shall be powered from the load side of the automatic transfer switch.

Y. Provide engine generator set with service platform and steps so that engine generator set, including control panel and breakers, can be properly accessed for service, maintenance, inspection, etc.

2.2 BASE TANK

A. Furnish and install a fuel supply system base tank (minimum of 8 hour fuel supply at 100% consumption rate) and all associated piping from the tank to the engine generator. This tank shall be of double wall construction to provide secondary containment of fuel in event of a weld seam failure in the fuel storage section of the tank. Rupture basin section of tank shall be a minimum of 110% of the actual fuel tank capacity.

B. Tank design shall incorporate use of channel or I-beam structural steel side rails common to both fuel tank and rupture basin. Side rails shall allow a minimum of 3" between fuel section and rupture basin bottom. Internal tank crossmembers as well as rupture basin crossmembers shall be relieved to allow fuel to flow equally through tank. Cross members shall be sized accordingly to support generator and equipment mounted on tank floor. A minimum of 4 points shall be provided and sized for lifting complete unit tank (dry), generator set, and accessories as one unit. Conduit stub-up sleeves shall be provided and sized accordingly. This sleeve shall not compromise the secondary containment criteria previously stated.

C. Materials shall meet ASTM A36 standards. Tank sheets shall be a minimum of 10 gauge steel (0.1344"). All materials shall be new and rust free.

D. Construction of the tank shall be in 2 steps. The fuel tank section shall be constructed, deburred, and pressure tested at a minimum of 10 psi prior to construction of rupture basin section. Rupture basin section shall also be constructed, deburred, and pressure tested at a minimum of 10 psi. Any defects shall be repaired and retested. All welds shall be continuous MIG or dual shield type.

E. Fuel fittings shall include:

1. NPT manual fill with cap.

2. Mechanical fuel level sight gauge located to allow monitoring during filling process of overfill protection.

3. Fuel pick-up and return fittings.

4. Flexible supply and return fuel lines shall be provided between tank and engine.

5. NPT vent with screen mushroom cap shall be provided for fuel storage and rupture basin sections of tank.

6. A minimum of four 3/4" diameter, 2 per side, shall be provided for anchoring purposes in side rail lower flange.

7. Leak detection device mounted in secondary containment with dry contacts to annunciate at alarm at a remote location (to be determined).

8. Flow fuel alarm contact to annunciator light with 3 hours of fuel oil remaining.

Electrical contractor shall fill storage tanks to full capacity with no. 2 diesel fuel at his expense at the completion of the job, after all tests have been performed. Fuel necessary for testing shall be furnished by the electrical contractor.

2.3 OUTDOOR ENCLOSURE

A. Generator shall be housed in an outdoor enclosure intended for both weather protection as well as sound reduction. Housing shall be oven baked, powder-coat type, pre-painted steel, 14 ga. minimum, with access doors with panic hardware. Doors shall provide full access for operation and servicing and be lockable via in-handle lock tumblers.

B. Acoustic insulation shall reduce engine generator noise to an average of 79 dbA at 23 feet. Air intake and discharge inlets shall be supplied. Acoustic insulation material shall consist of sound absorbing material.

C. Dimensions shall be sufficient to house engine generator and associated equipment.

D. Engine silencer shall be independently supported from the engine-generator.

E. Engine shall be provided with oil and water drains to exterior of enclosure with a bronze body ball valve installed on engine and plumbed to exterior coupling with high quality hose. Fumes disposal shall be extended to radiator discharge using an oil resistant high quality hose.

F. Service Platform: Provide service access platform complete with access steps and railing to comply with OSHA and ADA requirements.

2.4 CONCRETE PAD

A. Contractor shall provide a separate concrete pad for generator enclosure. Pads shall be a minimum of 12" beyond base x 12 inches deep with No. 6 rebar on 12 inch centers in a horizontal grid pattern. Rebar should clear surfaces by 3 inches minimum in all directions. Concrete mixture shall be a 1:2:3 mixture of cement, sand, and aggregate with maximum of 4 inch slump and 28-day compressive strength of 3000 psi.

2.5 REMOTE MONITOR PANEL

A. Provide and install a 16-light remote monitor panel for the emergency generator in the location indicated on plans and a remote alarm indicator (derangement signal) again located as indicated on plans.

B. Alarm panel shall be U.L. labeled and shall operate on 24 volts DC. Power shall be supplied from the generator starting batteries.

C. The remote alarm panel shall be designed to contain all the alarm and monitor functions for the generator individually plus alarms and indicators to the emergency system. These alarms and indications shall comply with NFPA 110 and NEC Sections 700 and 701, and shall include the following as a minimum:

1. For generator:

   a) Battery charger malfunction
   b) Low lubricating oil pressure
   c) Low coolant temperature
   d) High coolant temperature
   e) Overcrank
   f) Overspeed
   g) Generator running
   h) Generator Not in automatic
   i)Alarm buzzer and silence switch (for all alarms)
   j)Lamp test switch (for all lamps)
   k) Utility power available
   l)ATS in normal
   m) ATS in emergency
   n) Low fuel, main fuel tank
   o) Panel shall also include an emergency “STOP” button (mushroom type).

D. The derangement alarm panel shall contain an alarm light and signal with silence switch to give an indication of any of the alarm conditions above, but shall not indicate them separately. In addition, it shall indicate utility and/or emergency power "on" using a green lamp and red lamp respectively. A lamp test switch shall also be provided.

E. Panels, alarms, meters, etc., shall be appropriately labeled using laminated plastic labels, red letters on white background, professionally engraved. Contractor shall submit a drawing for approval showing layout prior to purchase or fabrication.

2.6 AUTOMATIC TRANSFER SWITCHES

A. Contractor shall furnish and install NEMA 1 enclosed automatic transfer switches with by-pass. Switches shall be 120/240D volt, 4 wire, 4 pole, 100% rated continuous. Switches specified are Russelectric RTS03AB Series. Approved equivalents by ASCO, or Zenith are acceptable. Features and functions shall be as follows:

1. Shall be UL 1008 listed.

2. Shall be capable of switching the load to either source under all conditions.

3. Visual indication of switch positions.

4. Complete engine starting capability.

5. Adjustable time delay on transfer to emergency and retransfer to utility, adjustable from 0-30 minutes.

6. Adjustable time delay for engine cool-down after re-transfer to normal, adjustable from 0-30 minutes.

7. Switches shall be capable of switching the load to either source under all conditions.

8. Switches shall have complete engine starting capability with adjustable time delay for momentary utility power outages or dips.

9. Each transfer switch shall be equipped with a U.L. listed manual operator in the event the electrical operator should become inoperative. The manual operator shall provide the same contact-to-contact transfer speed as the electrical operator to prevent flashover, and shall be arranged so that the transfer switch can be manually operated under load, without opening the enclosure door.

10. All solid state control circuitry.

11. Contacts shall be silver plated copper.

12. Shall be rated 42,000 amps withstand current, symmetrical.

13. Switching shall incorporate a time adjustable transition neutral position where the load is disconnected from both power sources.

14. Timed auxiliary contacts. Two individually timed N.O.-N.C. contacts.

15. Controls shall be digital incorporating LCD backlit display visible while the enclosure door is closed.

16. The dimensions of the automatic transfer switch shall not exceed 36 inches wide and 38 inches deep.

17. All standard features as listed for Russelectric RTBD type transfer switch.

18. A selectable load/no-load digitally programmable exerciser shall be incorporated within ATS.

19. ATS switches shall have 4 sets of NO/NC contacts that operate on change of switch state (emergency/normal).

B. Operation of transfer switch shall be as follows:

1. The switch shall automatically transfer to the emergency source in less than 10 seconds upon loss of utility power.

2. When the utility source returns, switch should automatically, after a time delay, return to the utility position.

3. Loss of utility power on any phase, or reduction of voltage on any phase below 80%, the transfer switch shall cause generator start.

C. Transfer switch shall be completely assembled, wired, and tested at the factory prior to shipping and installation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Engine generator set shall be mounted on heavy structural steel base fastened to the concrete pad. Provide pad depth to accommodate the slope of the grade while keeping the pad a minimum of 6 inches above grade. Generator set shall be mounted using heavy duty, open, stable viscous vibration dampers of the type approved for seismic areas. Vibration dampers shall be mounted between the engine/generator and base frame.

B. Installation shall meet seismic requirements as stated in Section 260548 of these specifications.

C. All power wiring to the generator shall be in concrete encased PVC Schedule 40 conduit with flex connection at the generator and rigid metal conduit stub-ups.

D. Submittals and shop drawings shall include cut sheets, drawings, details, and instructions necessary for complete installation of the engine generator set and all associated equipment such as fuel piping, wiring, battery/charger, alarms and controls, etc.

E. Supplier shall provide a competent factory trained service engineer\technician to coordinate the installation, check-out, and start-up and testing of the complete generator system.

F. On-site testing in the presence of the Owner shall be in accordance with NFPA 110, Chapter No. 7.13 requirements. Supplier shall furnish load bank.

G. Supplier shall provide complete on-site training in the operation of the systems for the Owner at times chosen by the Owner to include all work shifts.

H. Supplier shall provide, upon completion of installation but before final acceptance by Owner, three complete sets of operating instructions, maintenance manuals, and drawings, showing full details for care and maintenance of each item of equipment. In addition a simplified set of step-by-step operating instructions, encased in a suitable frame for placing at the generator location, shall be provided with the operation and maintenance manuals.

3.2 WARRANTY

A. The engine generator set, ATS and related equipment shall be guaranteed against defective parts or workmanship for a period of five years from the date of final inspection and acceptance. Warranty conditions shall be included in submittals. Warranty shall include all parts and labor, including travel to and from the job site and expenses and equipment necessary to perform replacement and and/or repairs.

END OF SECTION 26 32 13

SECTION 26 41 00

LIGHTNING PROTECTION SYSTEM

PART 1 - GENERAL

1.1 REQUIREMENTS

A. Provide a functional and aesthetically unobtrusive lightning protection system, including the furnishing of all labor, materials and items of service required. All materials shall meet the requirements of Underwriters Laboratories UL 96 and UL 96A and shall have the UL Listing label. The installation methods and techniques used in the lightning protection system shall conform to the requirements and specifications of Underwriters Laboratories standards for safety UL 96A and to the Installation Requirements for Lighting Protection Systems, NFPA-780 and NFPA 70. Experienced personnel who have been certified by Underwriters Laboratories as a Master Label installer must perform the installation.

B. All installations shall be performed to meet UL Master Label standards, to the extent that the structure to be protected is eligible under the standards of UL 96A. An Underwriters Laboratories Master Label (certification) shall be provided for the installation upon completion of work. If the structure is not eligible under the standards of Underwriters Laboratories UL 96A, a Letter of Findings shall be provided for the installation before work is started.

C. Product and technical support shall be provided by the manufacturer or its authorized representative.

D. The system to be furnished under this specification shall be the standard product of a manufacturer regularly engaged in the production of lightning protection systems and shall be the manufacturer's latest approved design. Manufacturer: Firm regularly engaged in manufacture of lightning protection systems, whose products have been in satisfactory use in similar applications for not less than (5) five years.

E. The manufacturers shall carry manufacturer comprehensive general liability in a minimum amount of one million dollars and shall supply certificates of insurance evidencing such coverage to the owner as requested before work is begun.

F. The Contractor shall be responsible for accompanying the owner on a walk through of each structure as the installation on that structure is completed, and on a walk through of the building after completion of the project.

G. Air terminals shall be mounted on all outside corners of each structure, around the perimeter of each structure at intervals not to exceed 20 feet and interior of each structure in such a manner that no 2 terminals are separated by a distance of more than 50 feet. In the event this is not practical, such as on a large open tank, air terminal spacing around the perimeter shall be decreased to not more than fifteen feet, with a total number around the perimeter not less than the total of the normally required perimeter air terminals, plus the additional number of air terminals if air terminals had been installed on the interiors at intervals not greater than 50 feet.

H. Each air terminal shall be provided with 2 continuous paths to the system ground which is also the system ground for the building.

PART 2 - PRODUCTS

2.1 Materials

A. All products employed shall meet the standards of UL96, Lightning Protection Components. The products employed shall be produced by Manufacturers who have obtained on these products Underwriters Laboratories listing appropriate to the class of devices employed. Each component shall have affixed thereon a UL Listing mark or label appropriate to the class of service in which it is employed. Components shall be constructed of materials as specified by UL 96 and UL 96A for a system employing copper components, unless otherwise specified by the owner or necessary to prevent dissimilar metals from coming into contact.

B. All equipment used in this installation shall be UL listed and labeled in accordance with UL procedures, with each air terminal bearing an “A” label and all main conductors bearing a “B” label at 10’- 0” intervals.

C. All equipment shall be new, the product of a single manufacturer as outlined above, and of a design and construction to suit the application where it is used in accordance with accepted industry standards and UL code requirements.

D. Ground rods shall be copperclad a minimum ¾” in diameter and 10’- 0” long. They shall be connected to the system with exothermic type welds.

E. Cable fasteners shall be substantial in construction, electrolytically compatible with the conductor and mounting surface and shall be according to UL code requirements.

F. Bonding devices, cable splices and miscellaneous connectors shall be of cast bronze or aluminum with bolt pressure connections to cable. Cast or stamped crimp fittings are not acceptable.

G. Equipment on stacks and chimneys, etc. shall be protected from corrosion and sized in accordance with UL requirements.

H. All miscellaneous bolts, nuts, and screws shall be brass, bronze or stainless steel.

I. Conductors and air terminals for the system shall be aluminum. Transition down conductors to copper not less than 18” above earth level.

J. A metallic conduit compatible with the grounding conductor shall be used to prevent direct contact with grounding conductors below the second floor.

PART 3 - EXECUTION

3.1 Installation

A. Installation shall be neat. Dissimilar metals shall not be allowed to be in contact. Bi-metal conductors shall be used for transitions between copper and aluminum. Lead coating shall not

be acceptable as a Bi-metal transition.

B. Terminations at service entrance equipment shall be accomplished with barrel type, double crimp, two hole compression lugs. Terminations shall be done according to Aluminum Association and manufacturer's instructions using oxide inhibiting compound and proper torque values.

C. The installation shall be accomplished by an experienced installer listed with Underwriter's Laboratories.

D. All equipment shall be installed in a neat workmanlike manner in the most inconspicuous manner possible. The system shall consist of a complete cable network on the roof including all air terminals, splices, and bonds with cable downleads routed concealed to ground.

E. The limitations on areas of usage for aluminum cables and for copper and aluminum materials together as outlined in UL 96A shall be observed.

F. The system shall be grounded to the steel frame of the building, provided the building is effectively grounded, in addition to the ground grid as required by UL.

G. Building steel may be used as the ground conductor.

H. The lightning protection installer will work with other trades to insure a correct, neat and unobtrusive installation.

3.2 SUBMITTALS

A. Complete shop drawings showing the type, size and locations of all equipment, grounds, building layout, mounting details, cable routings, etc., shall be submitted to the Engineer for approval prior to start of work. Submit complete set of catalog data showing equipment to be used. Samples and pertinent catalog data shall be submitted to the Engineer for approval upon request.

3.3 COMPLETION

A. The lightning protection installer shall secure and deliver a UL master label (certification) to the Engineer for the Owner upon completion of the installation.

B. The Contractor shall submit four (4) copies of as-built shop drawings with UL master label (certification).

END OF SECTION 26 09 23

SECTION 26 43 13

SURGE PROTECTION DEVICE

PART 1 - GENERAL

1.1 REQUIREMENTS

A. PROVIDE THE WORK OF THIS SECTION as indicated and specified.

B. ALL REFERENCED manufacturer's requirements and specifications and nationally recognized and accepted standards and specifications shall be the latest edition unless specified otherwise and shall be used as they are applicable for products and craftsmanship incorporated in the Contract Drawings and this Section only. The references to these standards and specifications do not imply acceptance of any and all products described in the standards and specifications.

C. THE MANUFACTURER SHALL REVIEW the use, details, and method of installation of his product as indicated in the Contract Documents and shall disclose to the Architect any and all deviations therein from the manufacturer’s recommended use and method of installation and shall also disclose to the Architect the manufacturer’s acceptance or rejection of the deviation, or his recommendation for an alternative use and method of installation of his product, still guaranteeing to achieve the intended purpose and result. Such disclosures shall be made within the time stipulated for submission of shop drawings.

1.2 APPLICABLE STANDARDS AND TESTING

A. Underwriters Laboratories: UL1449-4th edition (2014) and all applicable most recent UL standards
B. ANSI/IEEE C62.41.1-2002, C62.41.2-2002, C62.45-2002
C. National Electrical Code: Article 285
D. NEMA LS-1(rescinded)

1.3 SUBMITTALS:

A. GENERAL: Submit the following for Architect's review:

B. MUST HAVE FIFTEEN DAY PRIOR APPROVAL to bid on project. Request for submittal must be in writing and attached with independent documentation of the following items.

C. PRODUCT DATA: Submit manufacturer’s data on transient surge protection devices and components, to include rated capacities, dimensions, and accessories.

D. SHOW DRAWINGS: Electrical and mechanical drawings shall be provided by the manufacturer which show unit dimensions, weights, mounting provisions, connection notes, wire size and wiring diagram.

E. EQUIPMENT MANUAL: The manufacturer shall furnish an installation manual with installation notes, start-up and operating instructions for the specified system. Installation instructions shall clearly state whether the system requires an external overcurrent device to maintain the system's UL 1449, 4th edition listing.

F.

A. Submittals shall include UL 1449 4th edition listing documentation verifying:
   1. Short Circuit Current Rating (SCCR)
   2. Voltage Protection Ratings (VPRs) for all modes
   3. Maximum Continuous Operating Voltage rating (MCOV)
   4. I-nominal rating (I-n)
   5. Type 1 Device Listing

   VPR, MCOV, I-n, and Type 1 information is posted at www.UL.com, under Certifications, searching using UL Category Code: VZCA. SCCRs are posted in manufacturer's UL docs.

   UL data and visual inspection takes precedence over manufacturer's published documentation.

B. Submittals shall include shop drawings including manufacturer installation instruction manual and line drawings detailing dimensions and weight of enclosure, internal wiring diagram illustrating all modes of protection in each type of SPD required, wiring diagram showing all field connections and manufacturer's recommended wire and circuit protection device size.

C. Upon request, an unencapsulated but complete SPD shall be presented for visual inspection; proprietary technology included. MOV type & quantity shall reflect kA ratings on cutsheets, verification of diagnostic monitoring, thermal & overcurrent protection, etc.

D. Any product submittals containing Asbestos or Selenium are to be accompanied by proof of insurance to indemnify and hold harmless the engineer, contractor, and the end use facility owner and operator.

Minimum of ten (10) year warranty for service entrance, transfer switch, distribution panelboard, and motor control center applications.

1.4 QUALITY ASSURANCE:

A. QUALITY: Shall mean the meticulous attention to the detail of installation and workmanship necessary to the assemblage of products in the highest grade of excellence by skilled craftsmen of the trade.

B. MANUFACTURER'S QUALIFICATIONS: Shall be firms who are regularly engaged in manufacture of transient voltage suppression equipment and ancillary equipment, of types, ratings and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

C. LISTING AND LABELING: Provide electrically operated equipment specified in this Section that is listed and labeled by a "Nationally Recognized Laboratory" as defined in OSHA regulation 1910.7.

D. SYSTEM shall be in accordance with NFPA 70.

1.5 DELIVERY, STORAGE AND HANDLING:

A. DELIVER EQUIPMENT AND COMPONENTS in factory-fabricated type containers or wrappings, which properly protect equipment from damage.

B. STORE EQUIPMENT in original packaging and protect from weather and construction traffic. Wherever possible, store indoors; where necessary to store outdoors, store above grade and enclose with watertight wrapping.

C. HANDLE EQUIPMENT carefully to prevent physical damage to equipment and components. Do not install damaged equipment; remove from site and replace damaged equipment with new undamaged equipment.

PART 2 - PRODUCTS

2.1 SERVICE ENTRANCE/SWITCHBOARD/SWITCHGEAR/PANEL

A. Acceptable Manufacturers and Models:

Mersen
Advanced Protection Technologies
Siemens

A. SPD shall be UL labeled with at 200kA Short Circuit Current Rating (SCCR). Fuse ratings shall not be considered in lieu of demonstrated withstand testing of SPD, per NEC 285.6.
B. SPD shall be UL labeled as Type 1 (verifiable at UL.com), intended for use without need for external or supplemental overcurrent devices. Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal over-temperature controls. SPDs relying upon external or supplementary installed safety disconnectors do not meet the intent of this specification.
C. SPD shall be UL labeled with 20kA $I_{nominal}$ (I_n) (verifiable at UL.com) for compliance to UL 96A Lightning Protection Master Label and NFPA 780.
D. Suppression components shall be heavy duty ‘large block’ 50kA surge-rated MOVs, each exceeding 30mm diameter.
E. Minimum surge current capability (single pulse rated) per phase shall be:
Service Entrance 200kA

F. SPD shall provide surge current paths for all modes of protection:
   1. L-N, L-G, L-L and N-G for Wye systems
   2. L-N, L-G, and L-L for Wye systems when N-G bonding is specified at SPD application point
   3. L-L, L-G in Delta and impedance grounded Wye systems.

G. UL 1449 Listed Voltage Protection Ratings (VPRs) shall not exceed the following:

System Voltage	L-N	L-G	L-L	N-G
480Y/277	1200V	1200V	2000V	1200V

(Mode VPRs must be verifiable at UL.com. Numerically lower is allowed/preferred; old-style Suppressed Voltage Ratings(SVRs) shall not be submitted, nor evaluated due to outdated testing)

H. UL 1449 Listed Maximum Continuous Operating Voltage (MCOV) (verifiable at UL.com):

System Voltage	Allowable System Voltage Fluctuation (%)	MCOV
480Y/277	15%	320V

I. Service Entrance SPD shall have EMI/RFI filtering up to -50dB from 10Khz to 100MHz.
J. SPD shall include visual LED diagnostics including a minimum of one LED indicator per phase, and one red service LED.
K. OPTIONS
   1. SPD shall be provided with 1 set of NO/NC dry contacts

PART 3 - EXECUTION

3.1 COORDINATION

A. Please verify all voltages and quantities on drawings, one-line and panelboard schedules.

3.2 INSTALLATION

A. The specified service entrance system shall be installed with the shortest lead length possible not to exceed twelve (12”) inches from the power conductor(s) it is protecting, must have a grounding of 25 Ohms (NEC Article 250.56) or less and shall avoid any unnecessary or sharp bends. Utilize a 3 pole 60 amp breaker for connection means.

3.3 WARRANTY

A. Manufacturer shall provide a product warranty for a period of not less than ten (10) years from date of installation. Warranty shall cover unlimited replacement of SPD modules during the warranty period. Those firms responding to this specification shall provide proof that they have been regularly engaged in the design, manufacturing and testing of SPD for not less than twenty five (25) years.

END OF SECTION 26 43 13

SECTION 26 50 00

LIGHTING

GENERAL

1.1 SUMMARY

A. Section Includes:
1. LED Interior lighting fixtures, and drivers.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.

1.2 RELATED SECTIONS

A. Section 26 05 19 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

B. Section 26 05 33 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

C. Section 26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEMS

D. Section 26 27 26 WIRING DEVICES

1.3 REFERENCES

A. Definitions
1. CCT: Correlated color temperature.
2. CRI: Color-rendering index.
3. LED: Light emitting diode
4. LER: Luminaire efficacy rating.
5. Lumen: Measured output of luminaire.
6. Luminaire: Complete lighting fixture, including driver housing if provided.
7. UV: Ultraviolet

B. American National Standards Institute, Inc. (ANSI)
1. ANSI C78.377 Specification for the Chromaticity of Solid State Lighting Products
2. ANSI RP-16-10 Nomenclature and definitions for Illuminating Engineering

C. American Society for Testing and Materials (ASTM)
1. ASTM A580/A580M - Standard Specification for Stainless Steel Wire
2. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire

D. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE PAR1789 A Review of Literature on Light Flicker: Ergonomics, Biological Attributes, Potential Health Effects, and Methods in Which Some LED Lighting May Introduce Flicker
2. C62.41.1 - IEEE Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits
3. IEEE C62.41.2 - Standard for Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits

E. Illuminating Engineering Society of North America (IESNA)
1. IES LM-79 IESNA Approved Method for the Electrical and Photometric Measurements of Solid-Sate Lighting Products
2. IES LM-80 IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources
3. IES TM-21-01 Projecting Long Term Lumen Maintenance of LED Light Sources

F. National Electrical Manufacturers Association (NEMA)
1. NEMA SSL-1 Electric Drivers for LED Devices, Arrays, or Systems
2. NEMA SSL-3 High-Power White LED Binning for General Illumination
3. NEMA SSL-6 Solid State Lighting for Incandescent Replacement - Dimming

G. National Fire Protection Association (NFPA)
1. NFPA 70 - National Electrical Code

H. Underwriters Laboratories (UL)
1. UL 924 - Emergency Lighting and Power Equipment
2. UL 1598 - Luminaires

1.4 SUBMITTALS

A. Action Submittals
1. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
   a. Physical description of lighting fixture including dimensions.
   b. Emergency lighting units including battery and charger.
   c. Driver, including heat Rejection.
   d. Energy-efficiency data.
   e. Life, output (lumens, CCT, and CRI), and energy-efficiency data for LEDs.
   f. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for LED, Driver, and accessories identical to those indicated for the lighting fixture as applied in this Project.
      1) Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

2. Installation instructions.

B. Informational Submittals
   1. Field quality-control reports.
   2. Warranty: Sample of special warranty.

C. Closeout Submittals
   1. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
      a. Provide a list of all luminaire types used on Project; use ANSI and manufacturers' codes.

D. Maintenance Material Submittals
   1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
      a. LED Fixtures: 10 extra high bay LED fixtures for every 100 of each type and rating installed. Furnish at least one extra fixture of each type.
      b. LED drivers: 10 for every 100 of each type and rating installed. Furnish at least one for each type.
      c. Plastic Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
      d. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.5 SYSTEMS DESCRIPTION

A. Provide complete and operable lighting system as indicated on Drawings.

1.6 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

D. Coordination
   1. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including structural members, HVAC equipment, piping, and partition assemblies.

PRODUCTS

1.7 MATERIALS

A. Manufacturers
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, product(s) indicated on Drawings.

B. General Requirements For Lighting Fixtures And Components
   1. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
   2. Metal Parts: Free of burrs and sharp corners and edges.
   3. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
   4. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit repair without use of specialty tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during repair and when secured in operating position.
   5. Diffusers and Globes:
      a. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
         1) Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
         2) UV stabilized.
      b. Glass: Annealed crystal glass unless otherwise indicated.
   6. Factory-Applied Labels: Comply with UL 1598. Include recommended LED and drivers. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when LEDs are in place.
      a. Label shall include the following LED and driver characteristics:
         1) "USE ONLY" and include specific LED type.
         2) LED nominal wattage for luminaires.
         3) Driver type for luminaires.
         4) CCT and CRI for all luminaires.
   7. Luminaires controlled by occupancy sensors shall have drivers rated for control by occupancy sensors.

   8. LED Fixed Output Drivers Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, product(s) indicated on Drawings.

C. LED Fixed Output Driver Products
   1. Drivers shall operate LEDs at a frequency of 60 Hz.
   2. Driver shall operate from 60 Hz input source of 120 V through 277 V with sustained variations of (+/- 10% voltage and frequency) with no damage to the Driver.
   3. Driver shall have a Power Factor greater than 0.95 for primary applications.
   4. Driver input current shall have Total Harmonic Distortion (THD) of less than 20%.
   5. Driver shall have a Class A sound rating.
   6. Driver shall have a minimum operating temperature of -40C (-40F).

7. Driver shall tolerate sustained open circuit and short Circuit output conditions without fail and without need for external fuses or trip devices.
8. Driver shall carry IP66 rating to protect against dust and intermittent flooding.
9. Driver shall meet the RoHS Directive 2002/95EC on the restriction of hazardous substances such as lead, cadmium, mercury, hexavalent chromium, PBBs and PBDEs.
10. Driver shall be Underwriters Laboratories (UL) listed Class 2 Outdoor.
11. Driver shall have minimum 2.5 KV surge protection integral to the driver.

D. LED Boards LED
1. LED boards shall be RoHS (Restriction of Hazardous Substances) compliant
2. LED boards shall offer lumen maintenance of L85 at 50,000 hours
3. LED boards shall provide <3 SDCM (Standard Deviation Color Matching)
4. LED boards shall operate to minimum -30C ambient
5. LED boards shall be dimmable to 1%
6. LED boards shall operate at maximum 1.050 Amps
7. LED boards shall provide minimum of 115 lumens per watt at 3500K
8. LED boards shall be field replaceable and upgradable

E. Exit Signs
1. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
2. Internally Lighted Signs:
   a. LED for AC Operation: LEDs, 70,000 hours minimum rated life.
      1) Battery: Sealed, maintenance-free, nickel-cadmium type.
      2) Charger: Fully automatic, solid-state type with sealed transfer relay.
      3) Operation: Relay automatically energizes luminaire from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects luminaire from battery, and battery is automatically recharged and floated on charger.
      4) Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
      5) LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
      6) Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

F. Emergency Lighting Units
1. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.
   a. Battery: Sealed, maintenance-free, lead-acid type.
   b. Charger: Fully automatic, solid-state type with sealed transfer relay.
   c. Operation: Relay automatically turns luminaire on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Luminaire automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects luminaire from battery, and battery is automatically recharged and floated on charger.
   d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
f. Integral Time-Delay Relay: Holds unit on for fixed interval of 5 minutes when power is restored after an outage.
g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

G. Luminaire Support Components
1. Comply with Section 26 05 33 RACEWAY, BOXES AND SUPPORTS for channel- and angle-iron supports and nonmetallic channel and angle supports.
2. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
3. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
4. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.
5. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.
6. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

1.8 FABRICATION

A. Factory-assembled lighting fixtures and associated devices.

1.9 INSPECTION AND TESTING

A. Perform tests and inspections and prepare test reports.

1.10 WARRANTY

A. Special Warranty for LED drivers and LED luminaires. LED’s shall be listed for 70,000 hours and drivers shall be warrantied for 5 years from the date of Final Acceptance by NC State Construction Office.

B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
1. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Final Acceptance by NC State Construction Office. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.
2. Warranty Period for Self-Powered Exit Sign Batteries: Seven years from date of Final Acceptance by NC State Construction Office. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

EXECUTION

1.11 GENERAL

A. Comply with typical, administrative, and procedural requirements of Section 01 73 00 EXECUTION.

1.12 PRE-INSTALLATION

A. Complete raceway installation before starting conductor installation.

B. Comply with requirements in Section 26 05 33 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS for raceway requirements.

1.13 INSTALLATION

A. Lighting fixtures:
   1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
   2. Provide mounting hardware per manufacturer's recommendations.

B. Temporary Lighting: If it is necessary, and approved by Owner's Representative, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly and reinstall.

C. Remote Mounting of LED Drivers: Distance between the driver and fixture shall not exceed that recommended by luminaire manufacturer. Verify, with driver manufacturers, maximum distance between driver and luminaire.

D. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.
   1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than (6 inches) from lighting fixture corners.
   2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
   3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two - 3/4-inch metal channels spanning and secured to ceiling tees.
   4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

E. Suspended Lighting Fixture Support:
   1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
   2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
   3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
   4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. Connect wiring according to Section 26 05 19 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.

G. Identification
   1. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEMS.

H. Adjusting
   1. Occupancy Adjustments: When requested within 12 months of date of Fianl Acceptance, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.
      a. Adjust aimable luminaires in the presence of City's Representative.

1.14 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 26 50 00

DIVISION 14, MAINTENANCE/BRIDGE MAINTENANCE ASSEMBLY OFFICE

SCO ID# 14-11263-01A

MCKIM AND CREED PROJECT NO. 7002-0002

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McKim & Creed, Inc.
8020 Tower Point Drive
Charlotte, North Carolina 28227
NC License No. F-1222

SECTION 301000 – SITE WORK

PART 1 – GENERAL

1.1 SUMMARY:

A. The General Conditions, Supplementary General Conditions of the Specifications shall be included as a part of these Specifications.

B. The Specifications and drawings shall be considered as supplementary to each other, requiring materials and labor indicated, specified, or implied by either specifications or drawings and shall be supplied and installed as through specifically called for by both.

C. Reference herein to Engineers shall be the firm of McKim & Creed Engineers, Asheville, North Carolina.

1.2 EXAMINATION OF SITE:

A. Before submitting a proposal, the contractor shall examine the site, familiarize himself with all existing conditions and obtain such information as is required to enable him to carry out installation. The contractor's failure to comply with this requirement will not relieve him of the responsibility of any errors which might have been avoided by his compliance.

1.3 CONFORMANCE TO SPECIFICATIONS AND SUBMITTAL OF MATERIALS:

A. A typed listing of all materials hereinafter specified or shown on the drawing or required for the complete and proper installation of the Site/Civil contract involved shall be furnished to the architects and engineers within two weeks after the date of contract signing. The list shall include all specified and proposed substitute items as acceptable under A. & C. above. At the time the list is submitted, complete submittal data on any proposed substitute items shall be furnished. Contractor shall furnish any additional information, data and shop drawings required by the architects and engineers to establish conformation with the specifications and drawings. At discretion of the architects and engineers, no substitutions will be considered which are submitted after said two-week period has elapsed.

B. After approval of the list of materials, one copy shall be returned to the contractor, who shall then proceed with submittal data not submitted with list, including resubmittal of disapproved items. All submittal data shall be furnished within 30 days after the date of contract signing by this contractor.

C. A minimum of five (5) copies of submittal data shall be furnished, plus any additional copies the contractor may wish above one.

D. All time required to evaluate substitute items after time constraints set forth above will be billed to the contractor at the Engineer's hourly billing rate; whether the proposed substitute is accepted or not. In no case shall additional renumeration be allowed because of the rejection of a proposed substitute.

1.4 APPROVAL:

A. Wherever the words "approved" or "approval" are used, they shall mean "approved by the architects or engineers" or "approval of the architects and engineers."

1.5 DIAGRAMS:

A. The drawings are diagrammatic and shall be followed as closely as possible. However, the contractors shall be responsible to coordinate their installation and work out interferences that might occur among themselves. Should interferences occur, the engineers will assist in working them out in the best interests of all contractors concerned and with as little change in the systems as originally planned as possible.

B. The drawings indicated major offsets but by no means indicate all such situations. Should contractor elect to proceed beyond the pace of other trades, he shall do so at the risk of having to make field changes to avoid structure or other trades at his own expense. Owners, architects, and engineers shall not be liable for extra expenses involved because of the contractor's failure to include adequate allowance in his price for such field problems.

C. Contractor shall consult architectural, plumbing and mechanical drawings for all dimensions, building locations, equipment locations, utility routing, existing conditions to remain, existing conditions to be removed, etc.

1.6 PERMITS:

A. The Site Contractor shall obtain and pay for all permits, arrange for necessary inspection and furnish a certificate of inspection and approval from the public authority and underwriters having jurisdiction where the apparatus is installed. All fees and charges in connection with the above shall be paid for by the Site Contractor.

1.7 LAWS AND ORDINANCES:

A. N. C. State Department of Transportation Standards and Guidelines, latest edition, is hereby incorporated into and made a part of these specifications and their provisions shall be carried out by the contractor. Anything contained in the specifications or shown on the drawings which conflicts with the code shall be installed in accordance with the code and such conflicts shall be brought to the attention of the engineers during bid period for clarification. Installation shall also meet local building inspection department approval.

1.8 SHOP DRAWINGS:

A. Shop drawings of all equipment, materials, or fabricated work shall be submitted for approval. Five sets of such prints must be presented, and no work shall be done until such approval has been obtained.

B. The approval of shop drawings will be general and shall not relieve the contractor from the responsibility for adherence to the contract nor shall it relieve him of the responsibility for any error which may exist, including quantities.

1.9 COORDINATION:

A. Contractor shall coordinate his work and the installation of his work with the other contractors and should any condition arise where the work of this contractor shall interfere with, or prevent proper and satisfactory installation, the contractor shall be responsible for working out such problems to allow proper installation. Should such interference involve changes in the plans and/or specifications, the contractor shall notify the architect and engineers in writing before proceeding with changes.

1.10 PROTECTION OF EQUIPMENT:

A. The contractor shall be responsible for all work damaged by him in executing contract. All work damaged by the contractor shall be replaced by him and placed in the pre-damaged condition without extra cost. Any construction work damaged shall be made acceptable to architects, engineers, and owners. The contractor shall at all times be responsible for any damaged equipment or work in conjunction with executing contract.

1.11 EXCAVATING AND BACKFILLING:

A. The contractor shall be responsible for all excavating in connection with his work. All such excavating shall be done in a manner as not to endanger the stability of the structure or any work in place by other contractors. All backfilling shall be thoroughly tamped as directed. Special care shall be taken with PVC piping, since it must be solidly bedded to prevent sagging and cracking of pipe and joints, and tightly tamped to prevent washouts and settlement. This contractor shall coordinate this tamping with general contractor to insure protection and positive slope on his piping.

1.12 CUTTING AND PATCHING:

A. Various cutting and patching will be required for the installation of the drives, parking, building pads and site work, and this contractor shall provide such work.

1.13 CLEANING UP:

A. The contractor shall keep the premises and points at the building free of rubbish and waste material due to the installation of the work included in this specification and shown on the plans.

B. After completion of the work and all tests have been made, the contractor shall remove all rubbish incidental to contract and shall leave all portions of the work in a clean condition.

1.14 INSPECTION:

A. The contractor must at all times lend any assistance necessary for architects or engineers or their authorized representative to make tests, inspections, etc. Provide all materials, equipment and labor necessary for tests or inspection as required.

1.15 TESTS:

A. Upon completion of the installation, all systems shall be properly and tested by the contractor and placed in perfect operating condition, subject to the approval of the architects and engineers. Provide all labor and equipment to perform this work

B. Any defects indicated by the tests shall be corrected immediately by this contractor without cost to the owners.

1.16 PROGRESS:

A. The work must be installed as fast as the progress of the other trades will permit and when directed by the architects and engineers.

1.17 WORKMANSHIP:

A. All materials shall be installed and completed in a first class workmanlike manner. The architects and engineers reserve the right to reject any unsuitable materials and to direct the removal and replacement of any items, which in their opinion shall not represent acceptable workmanship. Such removal and replacement shall be done when directed in writing by the architects and engineers at the contractor's expense and without additional cost to the owners.

1.18 GUARANTEE:

A. Contractor shall guarantee all materials and workmanship for a period of 12 months after date of final acceptance of building by architects, engineers, and owners, or for 12 months after occupancy of owners, or their tenants, should occupancy precede acceptance. All guarantee failures shall be corrected or replaced by contractor as soon as possible after notification of such failure.

1.19 WORK INCLUDED:

A. All labor and materials to provide complete site preparation and improvement systems as shown on the drawings and as specified hereinafter. This shall include the following:

1. Demolition and Removal

2. Clearing, Grubbing, Grading, Excavation and Filling

3. Subgrade Preparation for Roads, Drives and Parking Areas.

4. Aggregate Base Course

5. Control of Erosion, Siltation and Pollution.

6. Seeding and Mulching

7. Water Mains

8. Storm Drains and Appurtenances

9. Sanitary Sewers

10. Landscaping

11. Concrete Paving

12. Handrails and Railings

13. All other accessory and incidental items not itemized above, but specified or implied hereinafter.

14. Provision for all contingencies and supply of all labor, materials, light electrical energy, temporary wiring, scaffolding, fixtures, tools, transportation, etc. necessary for the proper installation of all work described in this section of the specification and indicated on the drawings.

1.20 MATERIALS VARIATION:

A. Should contractor submit substitutes which vary in quality, physical size, texture etc. from those specified, this contractor shall bear any and all expenses that may arise in other contractor's work that must be altered to allow use of such substitute equipment. Approval of any such equipment shall be voided should contractor fail to bear any such expense.

END OF SECTION 301000

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Temporary erosion- and sedimentation-control measures.

1.2 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.3 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

B. Utility Locator Service: Notify owner) before any excavation. Contact ULOCO (800) 632-4949 for locating existing utilities.

Do not commence site clearing operations until temporary erosion and sedimentation control and plant protection measures are in place.

C. The following practices are prohibited within protection zones:
1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Division 31 Section "Earth Moving." Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated.

C. Protect existing site improvements to remain from damage during construction.

D. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to Civil Grading/Drainage/EC Plan Sheet C103 and requirements of authorities having jurisdiction.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

A. General: Protect trees and plants remaining on-site according to Plans.

B. Protect all trees that are to be retained with tree protection fencing. Place fencing as shown on Plans or as director by Owner.

3.4 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

B. Stumps and root mat shall be removed completely.

C. Use only hand methods for grubbing within protection zones.

D. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

E. Place fill material in horizontal layers not exceeding a loose depth of **8 inches**, and compact each layer to a density equal to adjacent original ground.

All debris from tree pruning and removal shall be disposed of lawfully.

3.5 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to a depth of 6 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

3.6 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

3.7 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off-site in accordance with local, state, and/or federal regulations governing such operations.

B. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

SECTION 312000 - EARTH MOVING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preparing subgrades for walks, pavements, turf and grasses and plants.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for concrete slabs-on-grade.
4. Subbase course for concrete walks.
5. Subbase course and base course for asphalt paving.
6. Excavating and backfilling for utility trenches.

1.2 DEFINITIONS

A. Backfill: Soil material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and proposed gravel lot.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Owner. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Owner. Unauthorized excavation, as well as remedial work directed by Owner, shall be without additional compensation.
3. Additional fill material is required and shall be provided as part of the contract in quantities as required to achieve finish grade.

G. Fill: Soil materials used to raise existing grades.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

K. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.3 QUALITY ASSURANCE

A. Preexcavation Conference: Conduct conference at the Project site.

1.4 PROJECT CONDITIONS

A. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth moving operations. Some existing utilities were located by SUE survey. Contractor to verify location of all existing utilities.

B. Do not commence earth moving operations until plant-protection measures specified on Plans are in place.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487 or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. Acceptable PL and LL as recommended by geotechnical engineer.

C. Unsatisfactory Soils: All materials having greater than 5% organic material content, all miscellaneous construction debris and those materials which are highly plastic or deemed to be unacceptable by the geotechnical engineer shall be undercut to firm bearing material and replaced with suitable on-site material or off-site borrow material. The on-site geotechnical engineer shall observe all undercut operations. No work related to undercut shall be undertaken without prior approval of SAID material by an approved testing agency or the engineer.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

H. Drainage Course: Narrowly graded mixture of washed, crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

PART 3 - EXECUTION

3.1 PREPARATION

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

B. Protect and maintain erosion and sedimentation controls during earth moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 EXCAVATION, GENERAL

A. All excavation is unclassified unless noted otherwise. Contractor is required to accept actual conditions at site and do work specified without additional compensation for possible variation from grades and conditions shown, whether surface or subsurface.

B. Rock excavation includes removal and disposal of rock material and obstructions encountered that cannot be removed by the following heavy-duty rock excavating equipment without blasting or ripping.

C. Rock material includes boulders ½ cu. Yd. or more in volume and rock in beds, ledges, unstratified masses, and conglomerate deposits.

D. Rock excavating equipment for footings, trenches, and pits shall be equivalent to a Caterpillar 325DL or equivalent track-mounted hydraulic excavator, equipped with a short-tip radius rock bucket, with new rock teeth, rated at 0.81 cubic yard (heaped) capacity placed on a machine rated at not less than 204 HP fly wheel power and 55,977 pounds drawbar pull.

3.3 EXCAVATIONS AT EDGES OF TREE- AND PLANT-PROTECTION ZONES

A. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

B. Cut and protect roots according to requirements on Plans and Section 015639 “Tree Protection and Trimming”. After trenching in exposed tree toot area, contractor shall request inspection of root protection by Owner and Engineer prior to backfilling. Contractor shall give a minimum of 24 hours notice for this inspection.

3.4 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.5 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 12 inches each side of pipe or conduit.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material, 4 inches deeper elsewhere, to allow for bedding course, if required.

3.6 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees. Stockpile soil shall remain within limits of construction at all times.

3.7 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Roadways: Provide 4-inch-thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course

D. Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.

E. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

F. Place and compact final backfill of satisfactory soil to final subgrade elevation.

3.8 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.

2. Under walks and pavements, use satisfactory soil material.

3. Under steps and ramps, use engineered fill.

4. Under building slabs, use engineered fill.

5. Under footings and foundations, use engineered fill.

3.9 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content and/or as directed by the geotechnical engineer.

B. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.

C. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight, as directed by the geotechnical engineer.

3.10 COMPACTION OF SOIL BACKFILLS AND FILLS

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

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

1. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:

2. Under structures, building slabs, steps, and pavements, scarify and recompact top 6 inches of existing subgrade and each layer of backfill or fill soil material at 98 percent.

3. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.

4. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.

5. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.

3.11 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch.

2. Walks: Plus or minus 1 inch.

3. Pavements: Plus or minus 1/2 inch.

3.12 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:

1. Shape subbase course and base course to required crown elevations and cross-slope grades.

2. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.

3. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.13 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

C. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.14 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

D. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.15 TRENCH SAFETY

A. Contractor to coordinate construction sequence to provide shortest practical time that trenches will be open to avoid hazard to the public. There shall be no trenches left open unattended or after working hours.

B. Contractor to provide proper construction work zone signage and fencing to notify public. In areas of pedestrian traffic, contractor shall provide signage to direct pedestrians around construction zones. Particular attention should be placed in areas of pedestrian traffic within the project site. Signs shall conform to the MUTCD and all federal, state and local codes.

C. Contractor shall ensure that all Occupational Safety and Health Administration (OSHA) regulations and standards are followed during all phases of the construction project.

D. The contractor and any subcontractors shall be responsible for the total compliance with all federal, state and local ordinances, laws and regulations as related to safe construction practices and to protecting the and employees and public's health and safety.

E. DISPOSAL OF SURPLUS AND WASTE MATERIALS

1. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off-site in accordance with all local, state, and/or federal regulations governing such activities.

END OF SECTION 312000

SECTION 312500 – EROSION AND SEDIMENTATION CONTROLS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

Drawings, general provisions of Contract, and other Division 31 Specification Sections apply to this Section.

1.2 SUMMARY

A. This Section includes the following: Soil Erosion and sedimentation control for all areas of the site that are graded or disturbed by any construction operations and elsewhere as indicated on the Drawings or specified herein. Erosion control shall be as specified herein and as may be required by actual conditions and governing authorities.

B. The Contractor is fully responsible for all applicable permits and approvals for off-site borrow and waste areas.

C. The Contractor shall have full responsibility for the construction and maintenance of erosion control and sedimentation control facilities as shown on the Drawings and as specified herein. The Contractor shall at all times provide the operation and maintenance necessary to operate the permitted sediment and erosion controls at optimum efficiency.

D. All swales, ditches, perimeter slopes and all slopes steeper than 3:1 shall be provided temporary or permanent stabilization with ground cover as soon as practicable but in any event within seven (7) calendar days from the last land-disturbing activity. All other disturbed areas shall be provided temporary or permanent stabilization as soon as practicable but in any event within fourteen (14) calendar days from the last land disturbing activity.

E. Related Sections: The following Sections contain requirements that relate to this Section:

1. Site Clearing
2. Earth Moving

1.3 PRODUCT HANDLING

A. Deliver seed, fertilizer and other packaged material in unopened original packages with labels legible and intact. Seed packages shall bear a guaranteed analysis by a recognized authority.

B. On-site storage of materials shall be kept to a minimum. Wet or damaged seed or other material shall be removed from the project immediately.

1.4 MONITORING AND RECORD KEEPING

A. All sediment and erosion control devices and facilities shall be inspected at least once every seven (7) calendar days or within 24 hours after any storm event of greater than 0.5 inches of rain per 24 hour period.

B. Stormwater discharges shall be inspected by observation for stormwater discharge characteristics (as listed below) at the above frequency to evaluate the effectiveness of the sediment control facilities, devices or practices. Observations shall be made at all stormwater discharge outfalls and other locations

were concentrated stormwater discharges from the site. Observations shall be qualitative, no analytical testing or sampling is required. If any visible off-site sedimentation is leaving the site, corrective action shall be taken to reduce the discharge of sediments.

1. Color
2. Odor
3. Clarity
4. Floating solids
5. Suspended solids
6. Foam
7. Oil sheen
8. Other obvious indicators of stormwater pollution

C. The contractor shall perform and keep records of the above inspections on the attached form entitled "Stormwater Inspections for General Permit NCG010000 – Land Disturbing Activities". Visible sedimentation found off the site shall be recorded with an explanation of the measures taken to prevent future release as well as any measures taken to clean up the sediment that has left the site. This record shall be made available to the Owner, Designer, and governmental authorities.

2.1 PRODUCTS

A. SOIL AMENDMENTS AND SEED

1. Refer to Construction Drawings

2.2 MISCELLANEOUS

Gravel for stone filters: Washed No. 57 stone or as indicated on the drawings.

Silt Fabric: A synthetic filter fabric or a previous sheet of polypropylene, nylon, polyester, or polyethylene yarn, which is certified by the manufacturer or supplier as conforming to the following requirements.

1. Filtering efficiency: 85% min.
2. Tensile Strength at 20% (max.) elongation: 30lb./lin in (min.)
3. Slurry Flow Rate: 0.3 gal/sq-ft/min. (min.)
4. Fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected useable construction life.

Filter Fabric (for installation under riprap): Woven geotextile fabric, apparent opening size no larger than US Standard Sieve No. 70, min. grad strength of 120lbs.

Riprap: Provide riprap of the class and quantity indicated on the Drawings. While no specific gradation is required, the various sizes of the stone shall be equally distributed within the required size range. The size of an individual stone shall be determined by measuring its long dimension. Stone shall meet the requirement of the following table for class and size distribution. No more than 5% of the material furnished can be less than the minimum size specified nor no more than 10% of the material can exceed the maximum size specified.

REQUIRED STONE SIZES – INCHES			
CLASS	MINIMUM	MIDRANGE	MAXIMUM

A	2	4	6
B	5	8	12
1	5	10	17
2	9	14	23

PART 3 EXECUTION

3.1 GENERAL

A. Existing Structures and Facilities

1. Existing structures, facilities, and water courses shall be protected from sedimentation.
2. The Contractor shall be responsible for the construction of necessary measures, and all costs shall be at the expense of the Contractor.
3. Items to be protected from sedimentation deposits shall include, but are not limited to, all down stream property, natural waterways, streams, lakes and ponds, catch basins, drainage ditches, road gutters, and natural buffer zones.
4. Control measures such as the erection of silt fences, barriers, dams, or other structures shall begin prior to any land disturbing activity. Additional measures shall be constructed as required during the construction.
5. All facilities installed shall be maintained continuously during construction until the disturbed areas are stabilized. Contractor shall remove all erosion control measures at the end of the project at his expense unless otherwise directed by the Owner or his representative.
6. Perform monitoring and record keeping as specified in this section.

B. PROTECTIVE MEASURES

1. Protective measures shall conform to all State and Local requirements.

2. Construction and maintenance of sediment and erosion control measures shall be in accordance with all applicable laws, codes, ordinances, rules and regulations.

2. Silt Fence: Hog wire or wire mesh fastened to posts as recommended by the Manufacturer, and covered with silt fabric.
3. Mulching: Mulching shall be used to prevent erosion and to hold soil and seed in place during establishment of vegetation.
4. Matting: Temporary matting shall be used for temporary stabilization during the established of seeded cover in all grassed ditches, channels, long slopes, and steep banks (6:1 or greater) as indicated on plans. Matting shall be installed on any area on site as needed to provide temporary stabilization whether or not matting is indicated on the plan.
5. Construction Entrances: Construct all entrances in accordance with plans. Maintain all ingress/egress points to prevent tracking of soil onto the Owner's. public or private roads. Any soil that is tracked onto the roads shall be removed immediately.
6. Riprap: Stone shall be graded so that the smaller stones are uniformly distributed throughout the mass. Stone may be placed by mechanical methods, augmented by hand placing where necessary, provided that when the riprap is completed it forms a properly graded, dense, neat layer of stone.
7. Other Measures: Other methods of protecting existing structures and facilities, such as vegetative filter strips, diversions, riprap, baffle boards, and ditch checks used for reduction of sediment movement and erosion, may be used at the option of the Contractor when approved by the Engineer and the appropriate State or Local authorities.

C. STABILIZATION

1. Permanently protect stabilized areas prior to the removal of protective devices.

2. After the final establishment of permanent stabilization, remove temporary sediment control measures. Respread accumulated sediments as specified.

3. Permanently stabilize all areas disturbed by the removal and re-spreading operations immediately.

D. TEMPORARY SEEDING

1. In accordance with the schedule required by NCDENR.

E. PERMANENT SEEDING

1. In accordance with the schedule required by NCDENR.

F. MULCHING AND MATTING

1. Apply mulch or matting to retain soil and grass.

2. Mulch areas with slope greater than 5% by spreading a light cover of mulch over seeded area at the rate of not less than 85lbs. per 1000 sq. ft.

3. Install temporary matting in all grassed ditches, channels, long slopes, and steep banks (6:1 or greater) and other areas indicated on plans or where extra protection from erosion is needed.

END OF SECTION 312500

STORMWATER INSPECTIONS FOR GENERAL PERMIT NCG010000 – LAND DISTURBING ACTIVITIES

PROJECT:_____**MONITORING FOR THE WEEK BEGINNING:**_____

All erosion and sedimentation control facilities and stormwater discharge outfalls must be inspected at least once (twice, if on 303(d) listed stream for construction related parameters*) per seven calendar days and within 24 hours of a rainfall of 0.5 inches per 24 hours. Pe rmittee must keep a record of inspections.

RAINFALL: Gauge must be maintained on site

Date Of Rain	Amount (inches)	Name

By this signature, I certify (in accordance with Part II Section B, 10 of the NCG010000 permit) that this report is accurate and complete to the best of my knowledge:

_____

(Signature of Permittee or Designee)

EROSION AND SEDIMENTATION CONTROL FACILITIES INSPECTED: Identification of all facilities may require additional pages.

Facility Identification (all measures)	Date of inspection	Time of inspection	Name of inspector	Operating Properly (Y/N)	Describe corrective actions taken (may need to attach additional information)

E. OBSERVATIONS OF RUNOFF AT STORMWATER DISCHARGE OUTFALLS: Take immediate corrective action to control the discharge of sediments outside the F. disturbed limits of the site. May require additional pages.

Stormwater F. Discharge Outfall Identification	Date of inspection	Time of inspection	Name of inspector	Clarity (1-10)	Floating solids (1-10)	Suspended Solids (1-10)	Oil sheen (Y/N)	Other obvious indicators of stormwater pollution (list & describe)	Visible sediment leaving the site? (Y/N)	If yes, describe actions taken to prevent future releases (may need to attach additional information)	Describe measures taken to clean up sediment outside of the disturbed limits (may need to attach additional information)

Clarity: Choose the number which best describes the clarity of the discharge where 1 is clear and 10 is very cloudy
Floating Solids: Choose the number which best describes the amount of floating solids in the discharge where 1 is no solids and 10 the surface is covered in floating solids
Suspended Solids: Choose the number which best describes the amount of suspended solids in the discharge where 1 is no solids and 10 is extremely muddy

Has all land disturbing construction been completed? _____ **(Y/N) Has the final permanent ground cover been completed & established?** _____ **(Y/N)**

* 303(d) listed streams for construction related parameters – The latest approved list may be obtained from the Division of Water Quality, or from the following website location:
http://h2o.enr.state.nc.us/su/construction303d

SECTION 321216 - ASPHALT PAVING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hot-mix asphalt patching.
2. Hot-mix asphalt paving.
3. Hot-mix asphalt paving overlay.
4. Pavement-marking paint.

B. Related Sections:

1. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders
2. Division 32 Section "Concrete Paving" for joint sealants and fillers at paving terminations.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

1. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
2. Job-Mix Designs: For each job mix proposed for the Work.

B. Material Certificates: For each paving material, from manufacturer.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the NCDOT.

B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the NCDOT for asphalt paving work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

C. Preinstallation Conference: Conduct conference at the Project site.

1.4 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Tack Coat: Minimum surface temperature of 60 deg F.

2. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.

3. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials and not exceeding 95 deg F.

PART 2 PRODUCTS

2.1 AGGREGATES

A. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

B. Fine Aggregate: ASTM D 1073, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

C. Mineral Filler: ASTM D 242, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: AASHTO M 320 or AASHTO MP 1a.

B. Tack Coat: ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

2.3 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.

B. Pavement-Marking Paint: MPI #32 Alkyd Traffic Marking Paint.

1. Color: White.

C. Pavement-Marking Paint: MPI #97 Latex Traffic Marking Paint.

1. Color: White.

D. Glass Beads: AASHTO M 247, Type 1.

2.4 MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction; designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types".

PART 3 EXECUTION

3.1 EXAMINATION

A. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

B. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 PATCHING

A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.

1. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.

C. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd..

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving

2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

D. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

3.3 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd..

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.

2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.4 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Spread mix at minimum temperature of 250 deg F.

2. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface

3.5 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.

2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.

3. Offset transverse joints, in successive courses, a minimum of 24 inches.

4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."

3.6 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

1. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.7 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch.

2. Surface Course: Plus 1/4 inch, no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch.

2. Surface Course: 1/8 inch.

3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.8 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow paving to age for 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

E. Broadcast glass beads uniformly into wet pavement markings at a rate of 6 lb/gal.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Replace and compact hot-mix asphalt where core tests were taken.

C. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

D. DISPOSAL

1. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

END OF SECTION 321216

SECTION 321313 – CONCRETE PAVING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, general provisions of Contract, and Division 32 Specification Sections apply to this Section.

1.2 SUMMARY

A. This Section includes work required to install all concrete walks and paving, together with related items necessary to complete work indicated on the Drawings and described in the Specifications.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Earth Moving

1.3 SUBMITTALS

A. Furnish Samples, Manufacturer's Product Data, Test Reports, and Material Certifications as required in Division 32.

B. Furnish Drawings indicating jointing pattern proposed for all areas of concrete pavement for approval by the Engineer. Only information completely checked by the manufacturer and the General Contractor will be considered by the Engineer.

1.4 STANDARDS

A. Products and methods of execution are specified by reference to North Carolina State Department of Transportation and Highway Safety's "Standard Specifications for Roads and Structures" (latest edition). The abbreviation NCDOT is used to designate this publication. Equivalent alternate products and methods of execution as defined by the specifications. All methods and substitutions must be approved by the Engineer.

1.5 QUALITY ASSURANCE

A. Codes and Standards: Comply with local governing regulations.

B. Testing: The Owner shall employ and pay for the services of an Independent Testing Laboratory (ITL) to evaluate concrete delivered to and placed at the site in accordance with requirements of Division 32.

2.1 MATERIALS

A. Forms: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Forms shall remain in place for a minimum of 24 hours after concrete placement or until concrete is secure. Use straight forms, free of distortion and defects, extending the full depth of concrete. All forms shall receive a form coating the full depth of concrete. All forms shall receive a form coating per Division 32 of these specifications prior to placing concrete.

B. Expansion Joint Fillers: Expansion joint fillers shall be 1/2 inch thick unless otherwise shown on Drawings, equivalent to Celotex "Flexcell", "Fibre", by W.R. Meadows, or "Tex-Lite", by J & P Petroleum Products or equivalent, and shall conform to NCDOT Section 1028.

C. Concrete: Concrete and equipment, workmanship and materials for forming shall conform to applicable requirements of Division 32, unless otherwise specified. Concrete shall be standard-weight with minimum compressive strength as specified on the construction drawings for the various concrete paving and walkway applications.

D. Joint Dowel Bars: Plain steel bars, ASTM A-615, Grade 60. Cut bars true to length with ends square and free of burrs.

E. Reinforcing Bars: Deformed steel bars, ASTM A-615, Grade 60.

F. Curing Compound: Shall be "Clear Bond" by Guardian Chemical Company, "Sealkure" by Toch Brothers, Inc., "Klearseal" by Penn-Dixie or equivalent.

G. Backer Rod: Shall be closed cell polyethylene foam as manufactured by ITP, Nomaco, RoAn Corporation or equivalent.

H. Joint Sealer: Silicone sealant as manufactured by Surebond Inc., Dow Corning, Silka Corporation or equivalent.

I. Welded Wire Fabric: ASTM A-185.

J. Automatic Machine Curb and Gutter

1. Automatic machine may be used for curb and gutter placement at Contractor's option. If machine placement is to be used, Contractor shall submit revised mix design and laboratory test resulted which meet or exceeds minimums specified.
2. Machine placement must produce curb and gutters to required cross-section, line grades, finish, and jointing as specified for formed concrete. If results are not acceptable, Contractor shall remove and replace with formed concrete as specified.

K. Filter Fabric: Filter fabric is non-woven drainage geo-textile, minimum 4-mil thickness. Use Propex 4546 manufactured by Ikex Company or comparable product.

L. ABC Aggregate: The aggregate base course shall comply with Section 520 of the NCDOT Specifications. Aggregate shall be a maximum diameter of 1-1/2” and conform to the graduation requirements of ASTM D-2940. See Aggregate Base Course Gradation Acceptance Ranges below:

Sieve Size	% Passing
1 1/2"	100
1”	75-97
1/2”	55-80
#4	35-55
#10	25-45
#40	14-30
#200a	4-12
#200b	4-10

M. Contractor must submit to owner proof that the aggregate for base is:
1. from a NC DOT certified quarry
2. a test certificate from the quarry indicating 100% maximum dry density
3. a batch ticket from the quarry certifying that aggregate is ABC

3.1 EXECUTION

3.2 INSPECTION

A. Examine the areas and conditions under which concrete walks are to be installed and notify the Engineer in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in an acceptable manner.

3.3 INSTALLATION

A. Subgrade

Bring subgrades, after final compaction, to required grades and section.

Deposit fill material under paving for final 24" in horizontal layers not exceeding 6" in depth before compacting. Spread fill evenly and compact each layer by uniformly rolling, pneumatic tamping or use of other approved equipment to 100 percent density as defined by ASTM D 698. If necessary, soil shall be moistened, or allowed to dry to the correct moisture content before compaction.
Subgrade for curbs shall extend 1'-0" behind back of the curb and shall be moist when concrete is placed, free from frost.

B. Reinforcement:

1. Reinforcement shall be as specified on the construction drawings for the concrete paving, sidewalks or curb and gutter sections.

2. Placing Concrete: In concrete paving areas, utilize a vibratory screed capable of consolidating 10 inches of concrete. Utilize hand vibrator along form faces, rigid structures, and in areas vibratory screed cannot access. Concrete shall be placed in accordance with requirements of Owner and the construction details for the various types of concrete installation (curb and gutter section, sidewalk section and concrete pavement section).

3. Joints: Construct expansion, contraction, and construction joints true to line with face perpendicular to surface of concrete. Construct transverse joints at right angles to the centerline, unless otherwise indicated.

4. Contraction Joints: For concrete walks provide contraction joints at 6'0" o.c. For concrete paving provide contraction joints into 15'0" squares maximum, unless otherwise shown on the plans or details. All contraction joints should be constructed to a minimum depth of 25% of the slab thickness. For curb and gutter, joints shall be in accordance with the construction detail on the plans. Joints may be formed by the following methods:

5. Tooled Joints: Form in fresh concrete by grooving top portion with a recommended cutting tool and finishing edges with a jointer.

6. Sawed Joints: Use powered saws equipped with shatterproof abrasive or diamond rimmed blades. Cut joints into hardened concrete as soon as surface will not be torn, abraded or otherwise damaged by cutting action.

7. Inserts: Use embedded strips of metal, plastic zip strip or sealed wood. Set strips into plastic concrete and carefully remove strips after concrete has hardened.

8. Planned Construction Joints: Place construction joints where placement operations will be stopped for more than 1/2 hour except where such pours terminate at expansion joints.

9. Construction joints shall be doweled, saw cut at butt joint face to 1- 1/4" depth minimum, and sealed in accordance with these specifications and the detailed drawings.

10. Emergency Construction Joints: Place emergency construction joints where concrete placement operations will be stopped for more than 1/2 hour at locations, which as a minimum, are 5 feet away from planned contraction joints. If placement operations are interrupted for more than 1/2 hour within 5 feet of a planned contraction joint, remove placed concrete back to nearest joint and repour section. If an emergency construction joint is required, allow concrete and required bars to set for 24 hours before placement operations are resumed at joint face. Contractor may resume placement operations at next planned construction joint and infill emergency construction joint after the 24 hour period.

11. Joint Sealing: All joints shall be sealed with a silicone sealant, Model 888 by Dow Corning or equivalent. All joints shall be thoroughly cleaned with jet of water and sand blasted prior to sealing in accordance with the requirements of NCDOT Section 700. All excess joint sealer shall be removed from pavement as soon as possible after joint sealing. Traffic shall not be allowed on pavement until excess joint sealer has been removed and the joints have been allowed to cure in accordance with manufacturer's recommendations.

C. Expansion Joints (Concrete Walks and Paving)

1. Expansion joints shall be 1/2" asphalt saturated felt expansion joint filler and will be placed flush with finished surface. Provide expansion joints for concrete abutting concrete curbs, catch basins, manholes structures, walks or other fixed objects. Place joints at 18' intervals in all walks with kerfs at 6’ intervals. Joint fillers shall be furnished in one-piece lengths where possible and where more than one piece is required, joint fillers shall be clipped together. Protect top edge of joint filler during concrete placement with metal cap or other temporary material. Remove protection after concrete has been placed on both sides of joint.

2. Curb and Gutter: In accordance with the construction drawing Plan Sheet C106.

3. Removal of Forms: Remove forms carefully. Do not damage concrete. Concrete forms shall remain in place for a minimum of 24 hours or until concrete is secure.

4. Cutting and Patching: When cutting and patching existing concrete paving, remove pavement to an existing control or expansion joint and re-pour the section to avoid small or linear patches through existing expanse of pavement.

5. Brick Pavers: Match existing brick unless otherwise directed. Contractor shall provide brick samples to Owner and Engineer for approval.

   a. Widths of walks are nominal and do not require the cutting of brick to comply. Actual brick width of walk must be within one brick width, plus or minus.
   b. Brick pavers shall be set 1/8” to 1/4” above finished grade.
   c. Pavers shall be laid with a maximum 1/8” joint between pavers.
   d. All pavers to be cut with a diamond-bladed brick saw or brick snapping tool specifically designed to produce an accurate clean straight cut. Broken edges caused by masonry hammers will not be acceptable. Do not use less than ½ brick in any pavement area.
   e. The edges of adjacent pavers shall be flush.
   f. Standing water in any brick area is unacceptable.
   g. Where sidewalk abuts curb and gutter, no edge restraint is required.
   h. Edge restraints consist of a brick sailor course, either level with adjacent sidewalk where lawn abuts sidewalk, or 2” above adjacent sidewalk where a mulched area abuts the sidewalk, set in a bed of mortar.
   i. Edge restraints shall not restrict flow of water off the walk.
   j. Edge restraints shall be installed before pavers are installed.
   k. Irregular lines inconsistent with specified pattern will not be permitted.
   l. Where existing brick pavers are to be reused, the bricks are to be carefully removed,

stored on pallets, and reinstalled as needed. Bricks that are chipped, cracked, broken, or otherwise marred are not to be reused.

3.4 CONCRETE FINISHING

A. Concrete Walks and Concrete Paving:

Install concrete walks and paving to thicknesses indicated on plans where shown on Drawings in widths indicated on carefully graded, well compacted base, using sound forming, true to lines shown. Wood float to indicated levels and planes and test surface trueness with a 10 foot straightedge. Inspect surface and remove any irregularities and refloat repaired areas to provide continuous smooth finish. Surface shall conform to a 1/8" smoothness tolerance from any two contact points on the straight edge. Apply broom finish and tool-finish edges to 1/2" radius. No water shall be added to concrete surface to facilitate finishing. No finishing shall be conducted while bleedwater is on surface. Finishing operations shall conform to the requirements of NCDOT Section 710.

B. Curing: Immediately after finishing operations, cure exposed concrete surfaces in accordance with NCDOT Section 700.

C. Protection: After curing, remove debris and backfill area adjoining sidewalk and paving. Grade and compact to conform to surrounding area in accordance with lines and grades indicated. Remove damaged concrete or concrete that does not drain properly and reconstruct at no additional cost to Owner.

3.5 REPAIR AND PROTECTION

A. Repair or replace broken or defective walks and paving, as directed by the Engineer.

Sweep concrete walks and paving, and wash free of stains, discolorations, dirt and other foreign material just prior to final inspection.

END OF SECTION 321313

SECTION 323113 - CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Chain-link fences.
2. Gates: Motor operated sliding gate.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design chain-link fences and gates, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Chain-link fence and gate framework shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to industry standards.

1. Minimum Post Size: Determine according to ASTM F 1043 for framework up to 12 feet high, and post spacing not to exceed 10 feet.
2. Minimum Post Size and Maximum Spacing: Determine according to CLFMI WLG 2445, based on mesh size and pattern specified and on the following:

   a. Wind Loads: Regional
   b. Fence Height: 8 feet
   c. Material Group: Resistance-welded round steel pipe.

C. Lightning Protection System: Maximum grounding-resistance value of 25 ohms under normal dry conditions.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for chain-link fences and gates.

1. Fence and gate posts, rails, and fittings.
2. Chain-link fabric, reinforcements, and attachments.
3. Accessories: Barbed wire
4. Gates and hardware.
5. Gate operators, including operating instructions.
6. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show accessories, hardware, gate operation, and operational clearances.

1. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Samples for Initial Selection: For components with factory-applied color finishes.

D. Samples for Verification: Prepared on Samples of size indicated below:

1. Polymer-Coated Components: In 6-inch lengths for components and on full-sized units for accessories.

E. Delegated-Design Submittal: For chain-link fences and gate framework indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified factory-authorized service representative.

B. Product Certificates: For each type of chain-link fence, operator, and gate, from manufacturer.

C. Product Test Reports: For framing strength according to ASTM F 1043.

D. Field quality-control reports.

E. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For the following to include in emergency, operation, and maintenance manuals:

1. Polymer finishes.
2. Gate hardware.
3. Gate operator.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing fence grounding. Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction for gates with automatic gate operators serving as a required means of access.

D. Preinstallation Conference: Conduct conference at Project site.

1. Inspect and discuss electrical roughing-in, equipment bases, and other preparatory work specified elsewhere.
2. Review sequence of operation for each type of gate operator.
3. Review coordination of interlocked equipment specified in this Section and elsewhere.
4. Review required testing, inspecting, and certifying procedures.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which Installer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Faulty operation of gate operators and controls.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

PART 2 - PRODUCTS

2.1 CHAIN-LINK FENCE FABRIC

A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist. Comply with CLFMI Product Manual and with requirements indicated below:

1. Fabric Height: As indicated on Drawings
2. Steel Wire Fabric: 0.148 inch

a. Mesh Size: 2 inches.

b. Coat selvage ends of fabric that is metallic coated before the weaving process with manufacturer's standard clear protective coating.

3. Aluminum Wire Fabric: ASTM F 1183, with [mill] [caustic-cleaned or etched] finish, and wire diameter of [0.148 inch (3.76 mm)] [0.192 inch (4.88 mm)].

a. Mesh Size: [2 inches (50 mm)] [1 inch (25 mm)].

2.2 FENCE FRAMING

A. Posts and Rails: Comply with ASTM F 1043 for framing, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F 1043 based on the following:

1. Fence Height: 96 inches
2. Light Industrial Strength: Material Group II-L, roll-formed steel C-section shapes.

    a. Line Post: 2.375 inches in diameter.
    b. End, Corner and Pull Post: 2.875 inches.

3. Horizontal Framework Members: Intermediate, top and bottom rails complying with ASTM F 1043.

    a. Rail: 1.66 inches in diameter.

4. Brace Rails: Comply with ASTM F 1043.
5. Metallic Coating for Steel Framing:

    a. Type A, consisting of not less than minimum 2.0-oz./sq. ft. (0.61-kg/sq. m) average zinc coating per ASTM A 123/A 123M or 4.0-oz./sq. ft. (1.22-kg/sq. m) zinc coating per ASTM A 653/A 653M.
    b. Type B, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. (0.27 kg/sq. m) of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film.
    c. External, Type B, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. (0.27 kg/sq. m) of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film. Internal, Type D, consisting of 81 percent, not less than 0.3-mil- (0.0076-mm-) thick, zinc-pigmented coating.
    d. Type C, Zn-5-Al-MM alloy, consisting of not less than 1.8-oz./sq. ft. (0.55-kg/sq. m) coating.
    e. Coatings: Any coating above.

6. Polymer coating over metallic coating.

    a. Color: [Match chain-link fabric] [Dark green] [Olive green] [Brown] [Black] [As selected by Architect from manufacturer's full range], complying with ASTM F 934.

2.3 TENSION WIRE

A. Metallic-Coated Steel Wire: 0.177-inch- (4.5-mm-) diameter, marcelled tension wire complying with ASTM A 817 and ASTM A 824, with the following metallic coating:

1. Type I, aluminum coated (aluminized).
2. Type II, zinc coated (galvanized) by [hot-dip] [electrolytic] process, with the following minimum coating weight:

    a. Class 3: Not less than 0.8 oz./sq. ft. (244 g/sq. m) of uncoated wire surface.
    b. Class 4: Not less than 1.2 oz./sq. ft. (366 g/sq. m) of uncoated wire surface.
    c. Class 5: Not less than 2 oz./sq. ft. (610 g/sq. m) of uncoated wire surface.
    d. Matching chain-link fabric coating weight.

3. Type III, Zn-5-Al-MM alloy with the following minimum coating weight:

    a. Class 60: Not less than 0.6 oz./sq. ft. (183 g/sq. m) of uncoated wire surface.
    b. Class 100: Not less than 1 oz./sq. ft. (305 g/sq. m) of uncoated wire surface.
    c. Matching chain-link fabric coating weight.

2.4 HORIZONTAL-SLIDE GATES

A. General: Comply with ASTM F 1184 for gate posts and single sliding gate types. Provide automated vehicular gates that comply with ASTM F 2200.

1. Classification: Type I Overhead Slide.

a. Gate Leaf Width: 18’
b. Gate Fabric Height: 8’

B. Pipe and Tubing:

1. Zinc-Coated Steel: [Protective coating and finish to match fence framing] [Manufacturer's standard protective coating and finish] <Insert finish>.
2. Aluminum: Comply with ASTM B 429/B 429M; [mill] [manufacturer's standard] <Insert finish> finish.
3. Gate Posts: Comply with ASTM F 1184. Provide [round tubular steel] [rectangular tubular steel] [round tubular aluminum] [rectangular tubular aluminum] posts.
4. Gate Frames and Bracing: [Round tubular steel] [Rectangular tubular steel] [Round tubular aluminum] [Rectangular tubular aluminum].

C. Frame Corner Construction: [Welded] [or] [assembled with corner fittings].

D. Extended Gate Posts and Frame Members: Extend gate posts and frame end members above top of chain-link fabric at both ends of gate frame 12 inches required to attach barbed wire assemblies.

E. Overhead Track Assembly: Manufacturer's standard track, with overhead framing supports, bracing, and accessories, engineered to support size, weight, width, operation, and design of gate and roller assemblies.

F. Hardware:

1. Latches permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
2. Hangers, roller assemblies, and stops fabricated from per manufacture recommendations.

2.5 FITTINGS

A. General: Comply with ASTM F 626.

B. Post Caps: Provide for each post.

1. Provide line post caps with loop to receive tension wire or top rail.

C. Rail and Brace Ends: For each gate, corner, pull, and end post.

D. Rail Fittings: Provide the following:

1. Top Rail Sleeves: Round-steel tubing not less than 6 inches (152 mm) long.
2. Rail Clamps: Line and corner boulevard clamps for connecting intermediate and bottom rails in the fence line-to-line posts.

E. Tension and Brace Bands: Pressed steel

F. Tension Bars: Steel length not less than 2 inches (50 mm) shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.

G. Truss Rod Assemblies: Steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment.

H. Barbed Wire Arms: Pressed steel or cast iron, with clips, slots, or other means for attaching strands of barbed wire, and means for attaching to posts , integral with post cap; for each post unless otherwise indicated, and as follows:

1. Provide line posts with arms that accommodate top rail or tension wire.
2. Provide corner arms at fence corner posts, unless extended posts are indicated.
3. Type I, single slanted arm.
4. Type II, single vertical arm.
5. Type III, V-shaped arm.
6. Type IV, A-shaped arm.

I. Tie Wires, Clips, and Fasteners: According to ASTM F 626.

1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, complying with the following:

a. Hot-Dip Galvanized Steel: 0.148-inch diameter wire[; galvanized coating thickness matching coating thickness of chain-link fence fabric.
b. Aluminum: ASTM B 211; Alloy 1350-H19; 0.148-inch diameter, mill-finished wire.

J. Finish:

1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz. /sq. ft. zinc.

a. Polymer coating over metallic coating.

2. Aluminum: Mill finish.

2.6 BARBED WIRE

A. Steel Barbed Wire: Comply with ASTM A 121, for two-strand barbed wire, 0.099-inch diameter line wire with 0.080-inch diameter, four-point round barbs spaced not more than 5 inches o.c.

1. Aluminum Coating: Type A.
2. Zinc Coating: Type Z, Class 3.

2.7 GATE OPERATORS

A. General: Provide factory-assembled automatic operating system designed for gate size, type, weight, and operation frequency. Provide operation control system with characteristics suitable for Project conditions, with remote-control stations, safety devices, and weatherproof enclosures; coordinate electrical requirements with building electrical system.

1. Provide operator designed so motor may be removed without disturbing limit-switch adjustment and without affecting auxiliary emergency operator.
2. Provide operator with UL [approval] [-approved components].

3. Provide electronic components with built-in troubleshooting diagnostic feature.
4. Provide unit designed and wired for both right-hand/left-hand opening, permitting universal installation.

B. Comply with NFPA 70.

C. UL Standard: Fabricate and label gate operators to comply with UL 325.

D. Motor Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, within installed environment, with indicated operating sequence, and without exceeding nameplate rating or considering service factor. Comply with NEMA MG 1 and the following:

1. Voltage: [12-V dc] [120 V] [208-220 V] [NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected] <Insert voltage>.
2. Horsepower: [1/4] [1/3] [3/4] <Insert value>.
3. Enclosure: [Open dripproof] [Totally enclosed] [Manufacturer's standard].
4. Duty: Continuous duty at ambient temperature of 105 deg F (40 deg C) and at altitude of 3300 feet (1005 m) above sea level.
5. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
6. Phase: [One] [Polyphase].

2.8 GROUT AND ANCHORING CEMENT

A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.

B. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer, for exterior applications.

2.9 FENCE GROUNDING

A. Conductors: Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.

1. Material above Finished Grade: [Copper.
2. Material on or below Finished Grade: Copper.
3. Bonding Jumpers: Braided copper tape, 1 inc wide, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.

B. Connectors and Grounding Rods: Comply with UL 467.

1. Connectors for Below-Grade Use: Exothermic welded type.
2. Grounding Rods: Copper-clad steel, 5/8 by 96 inches.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for[a verified survey of property lines and legal boundaries,] site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.

1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet (152.5 m) or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 INSTALLATION, GENERAL

A. Install chain-link fencing to comply with ASTM F 567 and more stringent requirements indicated.

1. Install fencing on established boundary lines inside property line.

3.4 CHAIN-LINK FENCE INSTALLATION

A. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.

B. Post Setting: Set posts [in concrete] [with mechanical anchors] [by mechanically driving into soil] at indicated spacing into firm, undisturbed soil.

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.

a. Exposed Concrete: Extend 2 inches (50 mm) above grade; shape and smooth to shed water.
b. Concealed Concrete: Top [2 inches (50 mm) below grade [as indicated on Drawings]to allow covering with surface material.
c. Posts Set into Concrete in Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink,, mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.
d. Posts Set into Voids in Concrete: Form or core drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with anchoring cement, mixed and

placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.

3. Mechanically Driven Posts: Drive into soil to depth of 42 inches. Protect post top to prevent distortion.

C. Terminal Posts: Locate terminal end, corner, and gate post per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of 30 degrees or more]

D. Line Posts: Space line posts uniformly at 96 inches o.c.

E. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.

1. Locate horizontal braces at midheight of fabric 72 inches (1830 mm) or higher, on fences with top rail and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.

F. Tension Wire: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch- (3.05-mm-) diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches (610 mm) o.c. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:

1. Extended along [top] [and] [bottom] of fence fabric. Install top tension wire through post cap loops. Install bottom tension wire within 6 inches (152 mm) of bottom of fabric and tie to each post with not less than same diameter and type of wire.
2. Extended along top of [barbed wire arms] [extended posts] and top of fence fabric for supporting barbed tape.
3. [As indicated] <Insert requirements>.

G. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.

H. Intermediate and Bottom Rails: Install and secure to posts with fittings.

I. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 1 inch (25.4 mm)]mm)] between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

J. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches (380 mm) o.c.

K. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric per ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.

1. Maximum Spacing: Tie fabric to line posts at 12 inches (300 mm) o.c. and to braces at 24 inches (610 mm) o.c.

L. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side.

M. Barbed Wire: Install barbed wire uniformly spaced angled toward security side of fence. Pull wire taut, install securely to extension arms, and secure to end post or terminal arms.

N. Barbed Tape: Comply with ASTM F 1911. Install barbed tape uniformly in configurations indicated and fasten securely to prevent movement or displacement.

3.5 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.6 GATE OPERATOR INSTALLATION

A. General: Install gate operators according to manufacturer's written instructions, aligned and true to fence line and grade.

B. Comply with NFPA 70 and manufacturer's written instructions for grounding of electric-powered motors, controls, and other devices.

3.7 FIELD QUALITY CONTROL

A. Grounding-Resistance Testing: Engage a qualified testing agency to perform tests and inspections.

1. Grounding-Resistance Tests: Subject completed grounding system to a megger test at each grounding location. Measure grounding resistance no fewer than two full days after last trace of precipitation, without soil having been moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural grounding resistance. Perform tests by two-point method according to IEEE 81.
2. Excessive Grounding Resistance: If resistance to grounding exceeds specified value, notify Architect promptly. Include recommendations for reducing grounding resistance and a proposal to accomplish recommended work.
3. Report: Prepare test reports certified by a testing agency of grounding resistance at each test location. Include observations of weather and other phenomena that may affect test results.

3.8 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Automatic Gate Operator: Energize circuits to electrical equipment and devices. Adjust operators, controls, safety devices, alarms, and limit switches.

1. Hydraulic Operator: Purge operating system, adjust pressure and fluid levels, and check for leaks.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

3. Test and adjust controls, alarms, and safeties. Replace damaged and malfunctioning controls and equipment.

C. Lubricate hardware, gate operator, and other moving parts.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's personnel to adjust, operate, and maintain chain-link fences and gates.

END OF SECTION 323113

SECTION 329200 - TURF AND GRASSES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Work shall include, but not be limited to, the following:

1. Surface preparation of subsoil.
2. Placing topsoil.
3. Addition of lime and fertilizer.
4. Seeding.
5. Maintenance to produce a permanent stand of grass.

1.2 PAYMENT PROCEDURES

A. Base bid for the work on the specified quantities of lime, fertilizer, and seed. After the specified soil tests have been made, Engineer may vary specified quantities. Should the actual quantities applied in the field vary appreciably from those specified, an adjustment in the contract price may be made.

1.3 RELATED SECTIONS

A. The following Sections have work that is directly related to this Section. This does not relieve the Contractor of his responsibility of proper coordination of all the work:

1. Section 311000 Site Clearing
2. Section 312000 Earth Moving
3. Section 330500 Reclaimed Utility Piping

1.4 REFERENCES

A. N.C. Department of Agriculture – NCDA

B. U.S. Department of Agriculture – USDA

1.5 PERFORMANCE REQUIREMENT

A. Grassed area shall be considered established when it presents a green appearance from eye level 50 feet away and the grass is vigorous and growing well in each square foot of seeded area. It is not required that the seeded area be thick and heavy as an old established lawn.

B. Should the permanent seed not germinate and produce a strand of grass, reseed affected areas until a permanent stand is established.

1.6 SUBMITTALS

A. Not less than 6 weeks prior to seeding, obtain representative soil samples from areas to be seeded and deliver the properly packaged samples with an information sheet for each sample properly filled out to the Soils Division of the NC Department of Agriculture or a private laboratory. Based on the test results, submit to the Engineer a recommendation as to the quantity and type of lime, fertilizer and seed for the area covered by the test.

1.7 QUALITY ASSURANCE

A. Quality of fertilizer, lime, and seed, and operations in connection with the furnishing of this material, shall comply with the requirements of the N.C. Fertilizer, Lime and Seed Law; and with the requirements of the rules and, regulations adopted by the NC Department of Agriculture in accordance with the provisions of the said law.

B. Seed containers shall bear an official "Certified Seed" label as inspected by the N.C. Crop Improvement Association.

C. Packages for soil conditioners and fertilizer shall bear manufacturer's guaranteed analysis.

D. Do not apply lime, fertilizer or seed in strong wind, when the soil is extremely wet, or otherwise unworkable. No rolling shall be done if precipitation after seeding would make the operation detrimental to the seed bed.

1.8 DELIVERY, STORAGE, AND PROTECTION

A. Deliver grass seed mixture in sealed containers showing percentage of seed mix, year of production, net production, net weight, date of packaging, and location of packaging.

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

1.9 MAINTENANCE SERVICE

A. Maintain seeded areas until grass is well established and exhibits a vigorous growing condition for a minimum of two cuttings. Mow grass at regular intervals to a maximum height of 3 inches. Hand clip where necessary.

B. Control growth of weeds. Apply herbicides in accordance with manufacturer’s instructions.

C. Water areas seeded between May 1 and July 15 at such intervals as to maintain the seeded area in a moist condition until the grass is established and accepted by the Engineer. Provide equipment to transport and distribute the water to the seeded areas. Areas seeded between September 1 and November 1 need not be irrigated beyond the initial watering specified above except that the Contractor may apply water at his own discretion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds, and roots; pH value of minimum 5.4 and maximum of 7.0.

B. Lime: Ground Dolomitic agricultural limestone, not less than 85 percent total carbonates, ground so that 50 percent passes 100 mesh sieve and 90 percent passes 30 mesh sieve. Coarser material will be acceptable, provided the specified rates of application are increased proportionately on the basis of quantities passing No. 100 mesh sieve.

C. Fertilizer: Mixed, commercial, fertilizer containing 10-10-10 percentages of available nitrogen, phosphoric acid, and potash respectively, plus superphosphate with 20 percent P2O5 content. Fertilizer shall be dry, in granular (pellet) form, shall be delivered to the site in the manufacturer's original bag or container which shall be plainly marked as to formula.

D. Seed: Fresh seed guaranteed 95 percent pure with a minimum germination rate of 85 percent within one year of tests. Provide the following seed mixtures with lime and fertilizer in disturbed areas including NCDOT Rights-of-Way:

1. Permanent Seeding (Maximum slope 3:1)

Planting Dates	Grass Type	Pounds/Acre
Aug. 15 – Nov. 1	Tall Fescue	300
Nov. 1 – Mar. 1	Tall Fescue	300
&	Abruzzi Rye	25
Mar. 1 – Apr. 15	Tall Fescue	300
Apr. 15 – Jun. 30	Hulled Common Bermuda grass	25
Jul. 1 – Aug. 15**	Tall Fescue	120
&	Browntop Millet	35
&	Sorghum-Sudan Hybrids	30
Lime		4,000
Fertilizer	10-10-10	1,000
Mulch	Straw	4,000

** Temporary seeding, reseed according to optimum season for permanent seeding.

2. Permanent Seeding (Slopes from 3:1 to 2:1)

Planting Dates	Grass Type	Pounds/Acre
Mar 1 – June 1	Sericea Lespedeza	50
	&	
Mar. 1 – Apr. 15	Add Tall Fescue	120
Mar. 1 – Jun. 30	or Add Weeping Lovegrass	10
Mar. 1 Mar. 1 – Jun. 30	or Add Hulled Common Bermudagrass	25
Jun. 1 – Sept. 1**	Tall Fescue	120
&	Browntop Millet	35
&	Sorghum -Sudan Hybrids	30
Sept. 1 – Mar. 1	Sericea Lespedeza (unhulled - unscarified)	70
&	Tall Fescue	120
	&	
Nov. 1 – Mar. 1	Add Abruzzi Rye	25
Lime		4,000
Fertilizer	10-10-10	1,000
Mulch	Straw	4,000

** Temporary seeding, reseed according to optimum season for permanent seeding.

3. The Contractor shall provide seeding and follow fertilizing methods as required by the U.S. Army Corps of Engineers to reestablish disturbed areas in designated wetlands.

E. Matting / Erosion Control Fabric (ECF): Matting and ECF shall be a 100% straw mulch encased in a medium weight plastic netting (both sides) with a minimum permissible shear stress of 1.75 lbs/ft2. Matting shall be fully degradable but suitable until vegetation has been established. Installation of ECF shall be done with staples per temporary liner detail in the Drawings. Commercially available ECFs may be used upon approval of the engineer. Approval of fabrics will require manufacturer's design data regarding velocity, shear strength, ditch slopes, method of installation, decay cycle, repair techniques, and grass growth enhancement characteristics.

F. Wire Staples: 16 gauge steel wire, with minimum of 3" top and 4" long legs.

G. Mulch: Threshed straw of oats, wheat, or rye; free from seed of obnoxious weeds; or clean salt hay. Straw which is fresh and excessively brittle or straw which is in such an advanced stage of decomposition as to smother or retard growth of grass will not be acceptable.

H. Water: Water shall be free from substances harmful to growth of grass.

PART 3 - EXECUTION

3.1 PREPARATION OF SUBSOIL

A. Complete operations in the area to be seeded and prepare subsoil to eliminate uneven areas and low spots. Bring surface to the approximate design contours.

B. Scarify subsoil to a depth of 3 inches. Remove weeds, roots, stones and foreign materials 1-1/2 inches in diameter and larger.

3.2 PLACING TOPSOIL

A. Place topsoil during dry weather and on dry unfrozen subsoil where indicated on Drawings.

B. Spread topsoil to a minimum depth of 4 inches. Remove vegetable matter and foreign non-organic material from topsoil while spreading. Grade surface to provide positive drainage and prevent water ponding. Lightly compact topsoil with at least one pass of a cultipacker or similar equipment

C. Maintain the finished surfaces by protecting, and replacing topsoil and subsoil as necessary until the area is accepted under the contract.

3.3 APPLICATION OF LIME

A. Liming shall be done immediately after grading has reached the fine grading stage, even though actual seeding may not be done until several months later.

B. Spread lime evenly by means of a mechanical distributor.

C. When lime is distributed by commercial liming dealers, sales slips showing the tonnage delivered shall be filed with the Engineer and shall show the full tonnage required for the acres treated.

D. Incorporate lime in the top 2 to 3 inches of soil by harrowing, disking, or other approved means.

3.4 APPLICATION OF FERTILIZER

A. Spread fertilizer not more than 2 weeks in advance of seeding.

B. To verify application rate, determine acreage to be fertilized and provide Engineer with total weight of fertilizer applied to the area.

C. Provide mechanical spreader for even distribution and spread half of the rate in one direction, and the other half at right angles to the first. Mix thoroughly into upper 2 to 3 inches of soil by disking, harrowing or other approved methods.

3.5 SEEDING

A. Accomplish seeding by means of an approved power-drawn seed drill, combination corrugated roller-seeder, approved hand operated mechanical seeder, or other approved methods to provide even distribution of seed.

B. Do not seed when ground is excessively wet or excessively dry. After seeding, roll area with a roller, not less than 18 inches in diameter and weighing not more than 210 pounds per foot of width. Upon completion of rolling, water area with a fine spray.

C. Immediately following seeding apply mulch or matting as listed below. Do not seed areas in excess of that which can be mulched on same day.

D. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil depth

3.6 MULCHING AND MATTING

A. Apply mulch or matting as required to retain soil and grass, but no less then the following:

1. Slopes from 0 to 20 percent by spreading a light cover of mulch over seeded area at the rate of not less than 85 lbs. per 1000 sq. ft. Use tack to prevent disruption of mulch.
2. Slopes greater than 20 percent mulch with matting. Pin matting to the ground with wire staples at 5 foot intervals, immediately after seeding.

B. For tack use an asphalt tie-down of emulsified asphalt grade AE-3 or cut-back asphalt grade RC-2 or other approved equal. The application rate shall be 0.10 gal/sy (11 gal / 1000 sq ft). An approved jute mesh or net may be used in lieu of tacking straw mulch.

C. Other types of mulch and anchoring methods may be used upon approval by the Engineer.

3.7 PROTECTION

A. Protect seeded areas from damage by barricades, signs, and other appropriate means. Maintain and protect slopes from weather damage.

3.8 STABILIZATION TIMELINE

A. All disturbed areas must be vegetated or otherwise stabilized after being disturbed in accordance with the table below:

GROUND STABILIZATION*		
SITE AREA DESCRIPTION	STABILIZATION TIME FRAME	STABILIZATION TIME FRAME EXCEPTIONS
Perimeter Dikes, Swales, Ditches and Slopes	7 Days	None
High Quality Water (HQW) Zones	7 Days	None
Slopes Steeper than 3:1	7 Days	If slopes are 10’ or less in length and are not steeper than 2:1, 14 days are allowed
Slopes 3:1 or Flatter	14 Days	7 days for slopes greater than 50 feet in length
All Other Areas with Slopes Flatter than 4:1	14 Days	None (except for perimeters and HQW zones)
*”EXTENSIONS OF TIME MAY BE APPROVED BY THE PERMITTING AUTHORITY BASED ON WEATHER OR OTHER SITE-SPECIFIC CONDITIONS THAT MAKE COMPLIANCE IMPRACTICABLE.” (SECTION II.B (2)(B))		

END OF SECTION

SECTION 333100 – SANITARY UTILITY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Work consists of furnishing all materials, equipment, and labor for the installation of sewer lateral and cleanouts. All construction shall conform to requirements of these Specifications and construction drawing details.

1.3 SUBMITTALS

A. Provide manufacturer's data on all pipe material, manholes and cleanouts. Only information completely checked by the manufacturer and the General Contractor will be considered by the Designer.

1.4 PROTECTION

A. Existing Utilities: Locate existing underground utilities in the areas of work. If utilities are to remain in place, provide adequate means of protecting during excavation operations.
   1. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, notify the Designer and consult the utility representatives immediately for directions. Cooperate with the Owner and public and private utility companies in keeping their respective services and facilities in operation. Repair damaged utilities to the satisfaction of the Owner and the utility owner.
   2. Do not interrupt existing utilities servicing facilities occupied and used by the Owner or others, except when permitted in writing by the Designer and then only after acceptable temporary utility services have been provided.

PART 2 PRODUCTS

2.1 MATERIALS

A. Sewer Laterals and Cleanouts: Pipe for sewer laterals and cleanouts shall be Schedule 40 PVC unless otherwise shown on the plans. A minimum grade as specified by the North Carolina Plumbing Code, plumbing shall be maintained. Each lateral shall be sealed at the end with an approved watertight plug. Cleanout stack and cap shall be in accordance with the Construction Detail Drawings.

B. Manholes shall be standard precast concrete reinforced at depth indicated on plans. Manholes shall be in conformance with ASTM C478. Manhole shall be 48" diameter unless otherwise indicated. Contractor to add concrete to case section as needed to prevent flotation.

C. Trench support, bedding and backfill for laterals shall be in accordance with the Construction Detail Drawings. The Contractor shall properly backfill under the WYE and lateral connections.

D. Underground – Markers:

   1. Identification Tape (non-detectable warning tape): The 1st stage of identification shall be a buried non-detectable warning tape. This tape shall provide an early warning at shallow depth excavation. The tape shall be 6" wide, and buried approximately 18" to 30" above the service pipe, but a minimum of 10" below finished grade. It shall consist of multiple layers of polyethylene with an

overall thickness of 3 to 5 mils. It shall be installed continuous from valve box to valve box or manhole to manhole, and shall terminate just outside of valve box or manhole wall. The black colored lettering on the warning tape shall be abrasion resistant and be imprinted on a color-coded background that conforms to APWA color code standards.

2. Warning Tape (detectable warning tape): The 2nd stage of identification shall be a detectable warning tape. This tape shall provide pipeline identification, be fully detectable from above grade utility locators, and be able to provide a depth reference point to top of pipe. It shall be 6" wide, installed directly on top of the pipeline and permanently secured to the pipeline at 10' intervals. The tape shall consist of aluminum foil core or stainless steel tracer wires laminated between multiple layers of polyethylene tape with an overall thickness of 4 to 6 mils. Detectable core or tracer wire "circuit" shall be continuous from valve box to valve box or manhole to manhole for complete pipeline detection and location. Tape manufacturers' approved splice kits shall be used for long runs. Warning tape shall terminate just inside of valve box cover or manhole ring cover and be easily accessible for "clip-on" type utility location meters. The black colored lettering on the warning tape shall be abrasion resistant and be imprinted on a color-coded background that conforms to APWA color code standards.

PART 3 EXECUTION

3.1 TRENCH PREPARATION

A. Trench excavation shall conform to the line and depth shown on the plans. Maintenance of a safe trench shall be the sole responsibility of the Contractor.

B. Maintain a minimum of 10 feet horizontal and 18 inches vertical separation between waste and sewer mains at all times. A minimum of 24 inches vertical separation between storm and sewer mains is to be maintained at all times.

C. The width and type of trench may vary with the depth of cut, and the trench shall be constructed in accordance with the dimensions and other information shown on the construction drawing details.

3.2 BACKFILLING

A. Backfilling: The backfilling of the trench after the pipe installation and testing shall be in accordance with the standard construction drawing detail.

B. The initial and final backfill shall be with suitable native material. No rocks, boulders or stones four inches or larger shall be included in the backfill for at least two feet above the top of the pipe.

C. The bedding and backfilling shall be in conformance with ASTM D-2321 and the various soil classes are defined below:

1. Class I – Angular 6 to 40 mm (¼ to 1-½ inch), graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone and crushed shells.

2. Class II – Coarse sands and gravels with maximum particle size of 40 mm (1-½ inch), including variously graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW and SP are included in this class.

3. Class III – Fine sand and clayey gravels, including fine sands, sand clay mixtures and gravel-clay mixtures. Soil Types GM, GC, SM and SC are included in this class.

4. Class IV – Silt, silty clays and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil Types MH, ML, CH and CL are included in this class. These materials are not recommended for bedding, hunching or initial backfill on PVC pipes.

END OF SECTION 333100

SECTION 334100 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe and fittings.
2. Catch basins.
3. Stormwater inlets.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:
1. Catch basins and stormwater inlets. Include plans, elevations, sections, details, frame, covers, and grates.

1.3 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Engineer and Owner no fewer than two (2) days in advance of proposed interruption of service.

PART 2 - PRODUCTS

2.1 CONCRETE PIPE AND FITTINGS

A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76 (ASTM C 76M).

1. Bell-and-spigot ends and sealant joints with ASTM C 990 (ASTM C 990M), bitumen or butyl-rubber sealant.
   a. Class III

2.2 CATCH BASINS

A. Standard Precast Concrete Catch Basins:

1. Description: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Base Section: 6-inch minimum thickness for floor slab and 6-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.

3. Joint Sealant: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.

B. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include flat grate with small square or short-slotted drainage openings.

1. Size: 24 by 24 inches minimum unless otherwise indicated.
2. Grate Free Area: Approximately 50 percent unless otherwise indicated.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow.
2. Install piping with 24-inch minimum cover.
3. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping according to the following:

1. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.

3.4 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

3.5 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.6 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:

a. Alignment: Less than full diameter of inside of pipe is visible between structures.
b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
d. Infiltration: Water leakage into piping.
e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

3.7 CLEANING

A. Clean interior of piping of dirt and superfluous materials.

END OF SECTION 334100

SECTION 32 3223
SEGMENTAL RETAINING WALLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Segmental retaining walls made of modular concrete units.

B. Engineering design.

1.02 RELATED REQUIREMENTS

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

B. Section 31 2200 - Grading: Rough and finish grading.

C. Section 31 2316 - Excavation.

D. Section 31 2323 - Fill.

E. Section 33 4600 - Subdrainage.

1.03 SUBMITTALS

A. See Section 01 6000 - Product Requirements for submittal procedures.

B. Product Data: Materials description and installation instructions for concrete units and soil reinforcement indicating compliance with requirements.

C. Qualification Data: Indicating compliance with Quality Assurance Article.

D. Shop Drawings: Engineering drawings for installation, including elevations, large-scale details of elevations, typical sections, details, and connections, soil reinforcement, and drainage provisions.
   1. Include design data: Structural analysis data performed in accordance with specified design standard, signed and sealed by the qualified North Carolina professional engineer who was responsible for its preparation.

E. Preconstruction Soil Test Reports.

F. Unit Sample for Selection: Minimum 3 inch square pieces of actual units showing colors and finish textures available.

1.04 QUALITY ASSURANCE

A. Engineering Responsibility: Engage a manufacturer/supplier who assumes undivided responsibility for engineering landscape block retaining walls by employing a qualified geotechnical engineer legally authorized to practice in the state of North Carolina to prepare design calculations, shop drawings and other structural data for loose laid engineered masonry retaining walls.

B. Manufacturer Qualifications -- Concrete Units: Firm specializing in manufacturing products specified in this section and:
   1. With not less than 5 years documented experience.
   2. Whose products have been used on a minimum of five successfully completed projects similar in scope and size.

C. Installer Qualifications: Firm specializing in design and installation of segmental retaining walls and:
   1. With not less than 2 years documented experience.
   2. With a minimum of five previously constructed successful projects, similar in size and magnitude, using specified retaining wall system; provide contact names and numbers.
   3. The installer shall be capable of providing for all aspects of construction related to the system, including, but not limited to; excavation, trenching, drainage, placement of materials and backfilling of the wall.

1.05 MOCK-UP

A. Prior to erection of retaining walls, provide mock-up for evaluation of installation workmanship.

B. Erect 4 by 4 ft sample wall using materials specified.

C. Locate mock-up where directed by Architect.

D. Do not start masonry work until mock-up has been approved by Architect.

E. Retain mock-up during construction as standard for judging completed work. Do not alter or destroy mock-up until work is completed.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products above ground on wood pallets or blocking, in manufacturer's unopened packaging, until ready for installation.

B. Prevent excessive soil and mud from coming in contact with face of concrete units.

C. Polymeric Materials: Store at temperatures above minus 20 degrees F; rolled materials may be laid flat or stood on end.

D. Protect material from damage. Do not use damaged material. Remove damaged material from the site.

E. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Segmental Concrete Units: Subject to compliance with requirements, manufacturers include, but are not limited to:
   1. Anchor Wall Systems, Inc.
   2. Keystone Retaining Wall Systems, Inc.
   3. Rockwood Retaining Walls.

B. Soil Reinforcement:
   1. Concrete unit licensor.

2.02 RETAINING WALLS

A. Contractor is responsible for design of the retaining walls.

B. Design Standard: Design retaining walls to be capable of withstanding the effects of gravity loads due to soil pressures resulting from grades indicated, determined in accordance with NCMA TR 127 Design Manual for Segmental Retaining Walls; perform all stability analyses specified in this standard.
   1. In addition, comply with applicable local, state, and federal codes and regulations.
   2. Seismic Stability: Perform analysis in accordance with ASCE 7.
   3. Provide engineering services as required for analysis for all modes of stability.
   4. Use of design software for calculations is permitted.
   5. Submit complete shop drawings showing all features of the design.

2.03 MATERIALS

A. Retaining Wall Units: Machine-formed concrete blocks of shapes and sizes suitable for the retaining wall configuration required and complying with ASTM C 1372 and the following:
   1. Face Color: To be selected from manufacturer’s available standards.
   2. Texture: Split face, on all exposed surfaces.
   3. Face Shape: Straight (flat).
   4. Curved Walls: Provide unit shapes that accommodate the required curves without cutting and with gaps between faces of adjacent units of not more than 1/8 inch.
   5. Acute Corners: Provide special shapes to form corners without cutting; exposed faces finished to match.

6. Unit Size: Nominal 8 x 18 x 12 inches with 3° setback.
7. Face Wall Thickness: 2 inches, minimum.
8. Batter Dimensional Control: Provide integral positive control to maintain consistent batter dimension.
9. Shear Resistance Mechanism: Manufacturer's standard.
10. Moisture Absorption: 7 percent, maximum.
11. Freeze-Thaw Resistance: Maximum of 1 percent or less weight loss after 100 cycles for each of 5 specimens, or maximum of 1.5 percent or less weight loss after 150 cycles for 4 of 5 specimens, when tested in accordance with ASTM C 1262
12. Compressive Strength, 28 Day: 3000 psi, minimum.
13. Concrete Density: 125 pounds per cubic ft, minimum, oven dry.
14. Dimensional Tolerances: Plus/minus 1/16 inch from specified dimension.
15. Appearance: No visible chips, cracks, or other imperfections when viewed from 10 feet under diffuse lighting.

B. Cap Units: Portland cement concrete machine-formed solid blocks, matching segmental concrete units, complying with ASTM C 1372, with abutting edges saw cut or formed to provide tight fitting, flush end-to-end joints.
   1. Height: 4 inches, minimum.
   2. Width: Same as wall units.
   3. Depth: To fully cover wall units.
   4. Masonry Adhesive: To secure cap units as top course of wall.
      a. Expected Life Span: 30 years.
      b. Provide adhesive conforming to ASTM C 920, Type S, Grade NS, Class 25, and as approved by unit manufacturer.

C. Shear Connectors: Specific type warranted by wall manufacturer for use under required design conditions. Connection method to withstand design stresses and prevent movement of segmental units, and to hold soil reinforcement in proper design position during grid pre-tensioning and backfilling.

D. Soil Reinforcement: Polymeric geosynthetic specifically fabricated for use as soil reinforcement, dimensionally stable and able to retain geometry under manufacture, transport, and installation. Specific type warranted by wall manufacturer for use under required design conditions.
   1. Polymeric Material: 100 percent virgin resin with maximum of 5 percent in-plant regrind material; polypropylene, polyethylene, or polyester.
   2. Construction: Woven.

E. Aggregate for Leveling Pad: Compacted sand, gravel, or crushed rock complying with one of the following:
   1. As specified in Section 31 2323.

F. Concrete for Leveling Pad: Unreinforced concrete with compressive strength of 3,000 psi. Comply with Section 03 3000.

G. Drainage Fill: As specified in Section 31 2323.

H. Backfill: As specified in Section 31 2323.

I. Drainage Pipe: As specified in Section 33 4600. Perforated PVC or corrugated HDPE.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify location of existing structures and utilities prior to excavation.

B. Protect adjacent structures from the effects of excavation.

C. Verify that layout dimensions are correct and substrate is in proper condition for installation.

D. Notify Architect of unsatisfactory conditions.

E. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Excavation: Refer to Section 31 2316. Excavate as required for footing or base dimensions shown on the approved shop drawings.

B. Leveling Pad: Place base material as required by the wall design and soil conditions.
   1. Depth: As shown on approved shop drawings.
   2. Use only hand-operated compaction equipment within 36 inches of back of wall.

C. Verify level grade before proceeding.

D. Install drainage collection pipe with a continuous fall in the direction of flow. Cap open ends as necessary to prevent soil and debris from entering.

3.03 INSTALLATION

A. Install in accordance with drawings, manufacturer instructions, and applicable codes and regulations.

B. Segmental Concrete Units:
   1. Place first course of units on leveling pad; check alignment and level. Check for full contact with base and for stability.
   2. Place units side by side for full length of wall, aligning back face of straight walls using string line or offset from base line and back face of curved walls using flexible pipe or other method recommended by manufacturer
   3. Do not leave gaps between units.
   4. Lay out corners and curves in accordance with manufacturer's instructions. Do not leave gaps to produce wall batter or curvature.
   5. Cut blocks with saw; do not split units.
   6. Sweep excess material from tops of units before laying succeeding courses.
   7. Place succeeding courses. Check for proper alignment and batter.
   8. Where top of wall changes elevation, step units to match grade or turn top course into embankment.
   9. Where bottom of wall changes elevation, step base leveling pad and extend lowest course a minimum of two units into slope.

C. Soil Reinforcement: Install each layer on fully compacted fill.
   1. Orient soil reinforcement material with highest strength axis perpendicular to wall alignment.
   2. Attach to top of wall units and extend horizontally, full length, over compacted backfill.
   3. Install in one piece lengths with 100 percent coverage in each layer at each level. Do not splice or leave gaps between panels or ends of pieces.

D. Drainage Fill: Place drainage fill in, between, and behind units.
   1. Compact to lines and grades on drawings, in lifts 6 inches thick, maximum; decrease lift thickness where necessary to achieve required density.
   2. Extend drainage fill 6 inches beyond back face of units.

E. Backfill: Place, spread, and compact backfill from behind drainage fill to undisturbed soil.
   1. Use only lightweight hand-operated compaction equipment within 3 ft from back wall face, or one half of wall height, whichever is greater.
   2. Place backfill in lifts of maximum 6 inches to 8 inches loose thickness
   3. Compact backfill to 95 percent of maximum density, standard Proctor, as determined in accordance with ASTM D 698, or as recommended by Geotechnical Engineer.
   4. Moisture content of backfill prior to and during compaction to be within plus 1 or minus 3 percentage points dry of optimum and uniform throughout each layer.
   5. Do not operate tracked construction equipment directly upon soil reinforcement.
   6. At end of each day, slope top of backfill away from wall to direct runoff away from wall face. Prevent runoff from adjacent areas from entering wall site.

7. At completion, if other work adjacent to wall is not to be done immediately (paving, landscaping, etc), grade top of backfill and provide temporary drainage to prevent water runoff toward the wall.

F. Cap Units: Install and top two courses of units with masonry adhesive.
1. Clear cap units and top course of segmental concrete units of debris and standing water before applying adhesive.
2. Apply masonry adhesive to top surface of top unit and place cap into position over projecting pins. Protect wall face from masonry adhesive.

3.04 FIELD QUALITY CONTROL

A. Owner will engage inspection and testing services to provide quality assurance and testing services during construction. Contractor will secure necessary construction control testing during construction.

B. Correct work found deficient and not in accordance with drawings and specifications.

3.05 CLEANING

A. Clean wall face to remove debris and stains.

B. Leave adjacent paved areas broom clean.

3.06 PROTECTION

A. Prevent damage to wall and earthwork by subsequent construction and uncontrolled runoff until substantial completion; repair damage due to failure to protect wall or earthwork.

B. Do not operate heavy paving or grading equipment within 36 inches from the back of the wall face.

C. Do not operate equipment with wheel loads in excess of 150 psf live load within 10 feet from the wall face.

D. Do not place temporary soil or fill stockpiles adjacent to wall.

E. Replace damaged units prior to substantial completion.

END OF SECTION

F O R M O F P R O P O S A L

Division 13 Maintenance/Bridge Maintenance Assembly Office Contract: **SINGLE PRIME**
NC Department of Transportation
SCO #14-11263-01A

Bidder:_____License #:_____

Date:_____

The undersigned, as bidder, hereby declares that the only person or persons interested in this proposal as principal or principals is or are named herein and that no other person than herein mentioned has any interest in this proposal or in the contract to be entered into; that this proposal is made without connection with any other person, company or parties making a bid or proposal; and that it is in all respects fair and in good faith without collusion or fraud. The bidder further declares that he has examined the site of the work and the contract documents relative thereto, and has read all special provisions furnished prior to the opening of bids; that he has satisfied himself relative to the work to be performed. The bidder further declares that he and his subcontractors have fully complied with NCGS 64, Article 2 in regards to E-Verification as required by Section 2.(c) of Session Law 2013-418, codified as N.C. Gen. Stat. § 143-129(j).

The Bidder proposes and agrees if this proposal is accepted to contract with the State of North Carolina, through the **NC Department of Transportation** in the form of contract specified below, to furnish all necessary materials, equipment, machinery, tools, apparatus, means of transportation and labor necessary to complete the construction of **The Division 13 Maintenance/Bridge Maintenance Assembly Office** in full in complete accordance with the plans, specifications and contract documents, to the full and entire satisfaction of **the State of North Carolina, the North Carolina Department of Transportation and Architectural Design Studio, PA** with a definite understanding that no money will be allowed for extra work except as set forth in the General Conditions and the contract documents, for the sum of:

SINGLE PRIME CONTRACT:_____

Base Bid:

_____Dollars($)_____

General Contractor: _____

License: _____ Phone:_____

ALTERNATES:

Should any of the alternates as described in the contract documents be accepted, the amount written below shall be the amount to be "added to" the base bid.

Alternate No. 1: Concrete Steps and Rails.

(Add) _____ Dollars($) _____

Alternate No. 2: Fence and Gates.

(Add) _____ Dollars($) _____

Alternate No. 3: Fire Department Lock Box Preferred Brand

(Add) _____ Dollars($) _____

UNIT PRICES

Unit prices quoted and accepted shall apply throughout the life of the contract, except as otherwise specifically noted. Unit prices shall be applied, as appropriate, to compute the total value of changes in the base bid quantity of the work all in accordance with the contract documents.

No. 1: Removal & Replacement of Unsuitable Soils, per Cu. Yd. Unit Price ($)_____

The bidder further proposes and agrees hereby to commence work under this contract on a date to be specified in a written order of the designer and shall fully complete all work thereunder within the time specified in the Supplementary General Conditions Article 23. Applicable liquidated damages amount is also stated in the Supplementary General Conditions Article 23.

MINORITY BUSINESS PARTICIPATION REQUIREMENTS

Provide with the bid - Under GS 143-128.2(c) the undersigned bidder shall identify **on its bid** (Identification of Minority Business Participation Form) the minority businesses that it will use on the project with the total dollar value of the bids that will be performed by the minority businesses. **Also** list the good faith efforts (Affidavit **A**) made to solicit minority participation in the bid effort.

NOTE: A contractor that performs all of the work with its own workforce may submit an Affidavit (**B)** to that effect in lieu of Affidavit (**A)** required above. The MB Participation Form must still be submitted even if there is zero participation.

After the bid opening - The Owner will consider all bids and alternates and determine the lowest responsible, responsive bidder. Upon notification of being the apparent low bidder, the bidder shall then file within 72 hours of the notification of being the apparent lowest bidder, the following:

An Affidavit (**C**) that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, which is equal to or more than the 10% goal established. This affidavit shall give rise to the presumption that the bidder has made the required good faith effort and Affidavit **D** is not necessary;

*** OR ***

If less than the 10% goal, Affidavit (**D**) of its good faith effort to meet the goal shall be provided. The document must include evidence of all good faith efforts that were implemented, including any advertisements, solicitations and other specific actions demonstrating recruitment and selection of minority businesses for participation in the contract.

Note: Bidders must always submit **with their bid** the Identification of Minority Business Participation Form listing all MB contractors, vendors and suppliers that will be used. If there is no MB participation, then enter none or zero on the form. Affidavit A **or** Affidavit B, as applicable, also must be submitted with the bid. Failure to file a required affidavit or documentation with the bid or after being notified apparent low bidder is grounds for rejection of the bid.

Proposal Signature Page

The undersigned further agrees that in the case of failure on his part to execute the said contract and the bonds within ten (10) consecutive calendar days after being given written notice of the award of contract, the certified check, cash or bid bond accompanying this bid shall be paid into the funds of the owner's account set aside for the project, as liquidated damages for such failure; otherwise the certified check, cash or bid bond accompanying this proposal shall be returned to the undersigned.

Respectfully submitted this day of _____

_____
(Name of firm or corporation making bid)

WITNESS:

_____
(Proprietorship or Partnership)

By:_____
Signature

Name: _____
Print or type

Title_____
(Owner/Partner/Pres./V.Pres)

Address_____

_____

License No._____

Federal I.D. No. _____

Email Address: _____

ATTEST:

By:_____

Title:_____
(Corp. Sec. or Asst. Sec. only)

(CORPORATE SEAL)

Addendum received and used in computing bid:

Addendum No. 1 _____ Addendum No. 3 _____ Addendum No. 5_____ Addendum No. 6_____

Addendum No. 2 _____ Addendum No. 4 _____ Addendum No. 6 _____ Addendum No. 7 _____

FORM 1

Attach to Bid Attach to Bid Attach to Bid Attach to Bid Attach to Bid Attach to Bid Attach to Bid Attach to Bid

Identification of HUB Certified/ Minority Business Participation

I,_____,
(Name of Bidder)

do hereby certify that on this project, we will use the following HUB Certified/ minority business as construction subcontractors, vendors, suppliers or providers of professional services.

Firm Name, Address and Phone #	Work Type	*Minority Category	**HUB Certified (Y/N)

*Minority categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**) Socially and Economically Disadvantaged (**D**)

**** HUB Certification with the state HUB Office required to be counted toward state participation goals.**

The total value of minority business contracting will be ($)_____.

MBForms 2002-Revised July 2010

State of North Carolina AFFIDAVIT A – Listing of Good Faith Efforts

County of _____

(Name of Bidder)

Affidavit of_____

I have made a good faith effort to comply under the following areas checked:

Bidders must earn at least 50 points from the good faith efforts listed for their bid to be considered responsive. (1 NC Administrative Code 30 I.0101)

- ❑ **1 – (10 pts)** Contacted minority businesses that reasonably could have been expected to submit a quote and that were known to the contractor, or available on State or local government maintained lists, at least 10 days before the bid date and notified them of the nature and scope of the work to be performed.
- ❑ **2 --(10 pts)** Made the construction plans, specifications and requirements available for review by prospective minority businesses, or providing these documents to them at least 10 days before the bids are due.
- ❑ **3 – (15 pts)** Broken down or combined elements of work into economically feasible units to facilitate minority participation.
- ❑ **4 – (10 pts)** Worked with minority trade, community, or contractor organizations identified by the Office of Historically Underutilized Businesses and included in the bid documents that provide assistance in recruitment of minority businesses.
- ❑ **5 – (10 pts)** Attended prebid meetings scheduled by the public owner.
- ❑ **6 – (20 pts)** Provided assistance in getting required bonding or insurance or provided alternatives to bonding or insurance for subcontractors.
- ❑ **7 – (15 pts)** Negotiated in good faith with interested minority businesses and did not reject them as unqualified without sound reasons based on their capabilities. Any rejection of a minority business based on lack of qualification should have the reasons documented in writing.
- ❑ **8 – (25 pts)** Provided assistance to an otherwise qualified minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letters of credit, including waiving credit that is ordinarily required. Assisted minority businesses in obtaining the same unit pricing with the bidder's suppliers in order to help minority businesses in establishing credit.
- ❑ **9 – (20 pts)** Negotiated joint venture and partnership arrangements with minority businesses in order to increase opportunities for minority business participation on a public construction or repair project when possible.
- ❑ **10 - (20 pts)** Provided quick pay agreements and policies to enable minority contractors and suppliers to meet cash-flow demands.

The undersigned, if apparent low bidder, will enter into a formal agreement with the firms listed in the Identification of Minority Business Participation schedule conditional upon scope of contract to be executed with the Owner. Substitution of contractors must be in accordance with GS143-128.2(d) Failure to abide by this statutory provision will constitute a breach of the contract.

The undersigned hereby certifies that he or she has read the terms of the minority business commitment and is authorized to bind the bidder to the commitment herein set forth.

Date:_____ Name of Authorized Officer:_____

Signature:_____

Title:_____

SEAL

State of_____, County of_____

Subscribed and sworn to before me this _____day of _____20_____

Notary Public_____

My commission expires _____

State of North Carolina --AFFIDAVIT B-- Intent to Perform Contract with Own Workforce.

County of _____

Affidavit of_____
(Name of Bidder)

I hereby certify that it is our intent to perform 100% of the work required for the _____

_____contract.
(Name of Project)

In making this certification, the Bidder states that the Bidder does not customarily subcontract elements of this type project, and normally performs and has the capability to perform and will perform all elements of the work on this project with his/her own current work forces; and

The Bidder agrees to provide any additional information or documentation requested by the owner in support of the above statement. The Bidder agrees to make a Good Faith Effort to utilize minority suppliers where possible.

The undersigned hereby certifies that he or she has read this certification and is authorized to bind the Bidder to the commitments herein contained.

Date:_____Name of Authorized Officer:_____

Signature:_____

Title:_____

SEAL

State of _____, County of_____

Subscribed and sworn to before me this _____day of _____20___

Notary Public _____

My commission expires_____

State of North Carolina - AFFIDAVIT C - Portion of the Work to be Performed by HUB Certified/Minority Businesses

County of _____

(Note this form is to be submitted only by the apparent lowest responsible, responsive bidder.)

If the portion of the work to be executed by HUB certified/minority businesses as defined in GS143-128.2(g) and 128.4(a),(b),(e) is equal to or greater than 10% of the bidders total contract price, then the bidder must complete this affidavit.
This affidavit shall be provided by the apparent lowest responsible, responsive bidder within **72 hours** after notification of being low bidder.

Affidavit of _____ I do hereby certify that on the
(Name of Bidder)

_____
(Project Name)

Project ID#_____ Amount of Bid $_____

I will expend a minimum of _____% of the total dollar amount of the contract with minority business enterprises. Minority businesses will be employed as construction subcontractors, vendors, suppliers or providers of professional services. Such work will be subcontracted to the following firms listed below.
Attach additional sheets if required

Name and Phone Number	*Minority Category	**HUB Certified Y/N	Work Description	Dollar Value

*Minority categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**) Socially and Economically Disadvantaged (**D**)

**** HUB Certification with the state HUB Office required to be counted toward state participation goals.**

Pursuant to GS143-128.2(d), the undersigned will enter into a formal agreement with Minority Firms for work listed in this schedule conditional upon execution of a contract with the Owner. Failure to fulfill this commitment may constitute a breach of the contract.

The undersigned hereby certifies that he or she has read the terms of this commitment and is authorized to bind the bidder to the commitment herein set forth.

Date:_____ Name of Authorized Officer:_____

Signature:_____

Title:_____

SEAL

State of _____, County of _____
Subscribed and sworn to before me this _____day of _____20_____
Notary Public_____
My commission expires_____

State of North Carolina AFFIDAVIT D – Good Faith Efforts

County of _____

(Note this form is to be submitted only by the apparent lowest responsible, responsive bidder.)

If the goal of 10% participation by HUB Certified/ minority business **is not** achieved, the Bidder shall provide the following documentation to the Owner of his good faith efforts:

Affidavit of _____ I do hereby certify that on the
(Name of Bidder)

_____
(Project Name)

Project ID#_____ Amount of Bid $_____

I will expend a minimum of _____% of the total dollar amount of the contract with HUB certified/ minority business enterprises. Minority businesses will be employed as construction subcontractors, vendors, suppliers or providers of professional services. Such work will be subcontracted to the following firms listed below. (Attach additional sheets if required)

Name and Phone Number	*Minority Category	**HUB Certified Y/N	Work Description	Dollar Value

*Minority categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**) Socially and Economically Disadvantaged (**D**)

**** HUB Certification with the state HUB Office required to be counted toward state participation goals.**

Examples of documentation that may be required to demonstrate the Bidder's good faith efforts to meet the goals set forth in these provisions include, but are not necessarily limited to, the following:

A. Copies of solicitations for quotes to at least three (3) minority business firms from the source list provided by the State for each subcontract to be let under this contract (if 3 or more firms are shown on the source list). Each solicitation shall contain a specific description of the work to be subcontracted, location where bid documents can be reviewed, representative of the Prime Bidder to contact, and location, date and time when quotes must be received.

B. Copies of quotes or responses received from each firm responding to the solicitation.

C. A telephone log of follow-up calls to each firm sent a solicitation.

D. For subcontracts where a minority business firm is not considered the lowest responsible sub-bidder, copies of quotes received from all firms submitting quotes for that particular subcontract.

E. Documentation of any contacts or correspondence to minority business, community, or contractor organizations in an attempt to meet the goal.

F. Copy of pre-bid roster

G. Letter documenting efforts to provide assistance in obtaining required bonding or insurance for minority business.

H. Letter detailing reasons for rejection of minority business due to lack of qualification.

I. Letter documenting proposed assistance offered to minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letter of credit, including waiving credit that is ordinarily required.

Failure to provide the documentation as listed in these provisions may result in rejection of the bid and award to the next lowest responsible and responsive bidder.

Pursuant to GS143-128.2(d), the undersigned will enter into a formal agreement with Minority Firms for work listed in this schedule conditional upon execution of a contract with the Owner. Failure to fulfill this commitment may constitute a breach of the contract.

SEAL Do not submit with the bid Do not submit with the bid Do not submit with the bid Do not submit with the bid Do not submit with the bid

The undersigned hereby certifies that he or she has read the terms of this commitment and is authorized to bind the bidder to the commitment herein set forth.

Date:_____Name of Authorized Officer:_____

Signature:_____

Title:_____

State of _____, County of _____

Subscribed and sworn to before me this _____day of _____20_____

Notary Public_____

My commission expires _____

APPENDIX E
MBE DOCUMENTATION FOR CONTRACT PAYMENTS

Prime Contractor/Architect:
_____

Address & Phone:
_____

Project Name:_____

SCO Project ID: _____

Pay Application #: _____ Period: _____

The following is a list of payments made to Minority Business Enterprises on this project for the above-mentioned period.

MBE FIRM NAME	* TYPE OF MBE	AMOUNT PAID THIS MONTH (With This Pay App)	TOTAL PAYMENTS TO DATE	TOTAL AMOUNT COMMITTED

*Minority categories: Black (B), Hispanic (H), Asian American (AA), American Indian (AI), White Female (WF), Socially and Economically Disadvantaged (SED), Disabled (D)

Approved/Certified By:

_____ _____
Name Title

_____ _____
Date Signature

SUBMIT WITH EACH PAY REQUEST - FINAL PAYMENT - FINAL REPORT

(Revised on 2/5/2008)

FORM OF BID BOND

KNOW ALL MEN BY THESE PRESENTS THAT _____ _____ as principal, and _____, as surety, who is duly licensed to act as surety in North Carolina, are held and firmly bound unto the State of North Carolina* through North Carolina Department of Transportation as obligee, in the penal sum of _____ DOLLARS, lawful money of the United States of America, for the payment of which, well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

Signed, sealed and dated this ____ day of _____20___

WHEREAS, the said principal is herewith submitting proposal for
and the principal desires to file this bid bond in lieu of making
the cash deposit as required by G.S. 143-129.

NOW, THEREFORE, THE CONDITION OF THE ABOVE OBLIGATION is such, that if the principal shall be awarded the contract for which the bid is submitted and shall execute the contract and give bond for the faithful performance thereof within ten days after the award of same to the principal, then this obligation shall be null and void; but if the principal fails to so execute such contract and give performance bond as required by G.S. 143-129, the surety shall, upon demand, forthwith pay to the obligee the amount set forth in the first paragraph hereof. Provided further, that the bid may be withdrawn as provided by G.S. 143-129.1

_____(SEAL)

_____(SEAL)

_____(SEAL)

_____(SEAL)

_____(SEAL)

FORM OF CONSTRUCTION CONTRACT

(ALL PRIME CONTRACTS)

THIS AGREEMENT, made the _____ day of _____ in the year of 20__ by and between _____ hereinafter called the Party of the First Part and the *State of North Carolina, through the North Carolina Department of Transportation, hereinafter called the Party of the Second Part.

WITNESSETH:

That the Party of the First Part and the Party of the Second Part for the consideration herein named agree as follows:

1. Scope of Work: The Party of the First Part shall furnish and deliver all of the materials, and perform all of the work in the manner and form as provided by the following enumerated plans, specifications and documents, which are attached hereto and made a part thereof as if fully contained herein: advertisement; Instructions to Bidders; General Conditions; Supplementary General Conditions; specifications; accepted proposal; contract; performance bond; payment bond; power of attorney; workmen's compensation; public liability; property damage and builder's risk insurance certificates; approval of attorney general; certificate by the Office of State Budget and Management, and drawings, titled:

_____

_____

_____

Consisting of the following sheets: _____

_____

_____

_____

Dated: _____ and the following addenda:

Addendum No _____ Dated: _____ Addendum No. _____ Dated: _____

Addendum No _____ Dated: _____ Addendum No. _____ Dated: _____

Addendum No _____ Dated: _____ Addendum No. _____ Dated: _____

Addendum No _____ Dated: _____ Addendum No. _____ Dated: _____

2. That the Party of the First Part shall commence work to be performed under this agreement on a date to be specified in a written order of the Party of the Second Part and shall fully complete all work hereunder within _____ consecutive calendar days from said date. For each day in excess thereof, liquidated damages shall be as stated in Supplementary General Conditions. The Party of the First Part, as one of the considerations for the awarding of this contract, shall furnish to the Party of the Second Part a construction schedule setting forth planned progress of the project broken down by

the various divisions or part of the work and by calendar days as outlined in Article 14 of the General Conditions of the Contract.

3. The Party of the Second Part hereby agrees to pay to the Party of the First Part for the faithful performance of this agreement, subject to additions and deductions as provided in the specifications or proposal, in lawful money of the United States as follows: _____

_____ ($ _____).

Summary of Contract Award:

4. In accordance with Article 31 and Article 32 of the General Conditions of the Contract, the Party of the Second Part shall review, and if approved, process the Party of the First Party's pay request within 30 days upon receipt from the Designer. The Party of the Second Part, after reviewing and approving said pay request, shall make payments to the Party of the First Part on the basis of a duly certified and approved estimate of work performed during the preceding calendar month by the First Party, less five percent (5%) of the amount of such estimate which is to be retained by the Second Party until all work has been performed strictly in accordance with this agreement and until such work has been accepted by the Second Party. The Second Party may elect to waive retainage requirements after 50 percent of the work has been satisfactorily completed on schedule as referred to in Article 31 of the General Conditions.

5. Upon submission by the First Party of evidence satisfactory to the Second Party that all payrolls, material bills and other costs incurred by the First Party in connection with the construction of the work have been paid in full, final payment on account of this agreement shall be made within thirty (30) days after the completion by the First Party of all work covered by this agreement and the acceptance of such work by the Second Party.

6. It is further mutually agreed between the parties hereto that if at any time after the execution of this agreement and the surety bonds hereto attached for its faithful performance, the Second Party shall deem the surety or sureties upon such bonds to be unsatisfactory, or if, for any reason, such bonds cease to be adequate to cover the performance of the work, the First Party shall, at its expense, within five (5) days after the receipt of notice from the Second Party so to do, furnish an additional bond or bonds in such form and amount, and with such surety or sureties as shall be satisfactory to the Second Party. In such event no further payment to the First Party shall be deemed to be due under this agreement until such new or additional security for the faithful performance of the work shall be furnished in manner and form satisfactory to the Second Party.

7. The Party of the First Part attest that it and all of its subcontractors have fully complied with all requirements of NCGS 64 Article 2 in regards to E-Verification as required by Section 2.(c) of Session Law 2013-418, codified as N.C. Gen. Stat. § 143-129(j).

IN WITNESS WHEREOF, the Parties hereto have executed this agreement on the day and date first above written in _____ counterparts, each of which shall without proof or accounting for other counterparts, be deemed an original contract.

Witness:

_____
Contractor: (Trade or Corporate Name)

_____
(Proprietorship or Partnership)

By: _____

Title: _____
(Owner, Partner, or Corp. Pres. or Vice Pres. only)

Attest: (Corporation)

By: _____

Title: _____
(Corp. Sec. or Asst. Sec. only)

(CORPORATE SEAL)

The State of North Carolina through*

_____
(Agency, Department or Institution)

Witness:

_____

By:_____

Title: _____

FORM OF PERFORMANCE BOND

Date of Contract _____

Date of Execution: _____

Name of Principal: _____
(Contractor)

Name of Surety: _____

Name of Contracting Body: _____

Amount of Bond: _____

Project: _____

KNOW ALL MEN BY THESE PRESENTS, that we, the principal and surety above named, are held and firmly bound unto the above named contracting body, hereinafter called the contracting body, in the penal sum of the amount stated above for the payment of which sum well and truly to be made, we bind, ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the principal entered into a certain contract with the contracting body, identified as shown above and hereto attached:

NOW, THEREFORE, if the principal shall well and truly perform and fulfill all the undertakings, covenants, terms, conditions and agreements of said contract during the original term of said contract and any extensions thereof that may be granted by the contracting body, with or without notice to the surety, and during the life of any guaranty required under the contract, and shall also well and truly perform and fulfill all the undertakings, covenants, terms, conditions and agreements of any and all duly authorized modifications to the surety being hereby waived, then, this obligation to be void; otherwise to remain in full force and virtue

IN WITNESS WHEREOF, the above-bounden parties have executed this instrument under their several seals on the date indicated above, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

Executed in _____counterparts.

Witness:

_____
(Proprietorship or Partnership)

Attest: (Corporation)

By: _____

Title: _____
(Corp. Sec. or Asst. Sec. only)

(Corporate Seal)

_____
Contractor: (Trade or Corporate Name)

By: _____

Title: _____
(Owner, Partner, of Corp. Pres.or
Vice Pres. only)

_____
(Surety Company)

Witness:

_____

By:_____

Title: _____
(Attorney in Fact)

Countersigned:

_____

_____
(N.C. Licensed Resident Agent)

_____

_____
Name and Address-Surety Agency

_____

_____
Surety Company Name and N.C.
Regional or Branch Office Address

(Surety Corporate Seal)

FORM OF PAYMENT BOND

Date of Contract _____

Date of Execution: _____

Name of Principal: _____
(Contractor)

Name of Surety: _____

Name of Contracting Body: _____

Amount of Bond: _____

Project: _____

KNOW ALL MEN BY THESE PRESENTS, that we, the principal and surety above named, are held and firmly bound unto the above named contracting body, hereinafter called the contracting body, in the penal sum of the amount stated above for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the principal entered into a certain contract with the contracting body identified as shown above and hereto attached:

NOW, THEREFORE, if the principal shall promptly make payment to all persons supplying labor/material in the prosecution of the work provided for in said contract, and any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the surety being hereby waived, then this obligation to be void; otherwise to remain in full force and virtue.

IN WITNESS HEREOF, the above-bounden parties have executed this instrument under their several seals on the date indicated above, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

Executed in _____counterparts.

Witness:

_____
(Proprietorship or Partnership)

Attest: (Corporation)

By: _____

Title: _____
(Corp. Sec. or Asst. Sec. only)

(Corporate Seal)

_____
Contractor: (Trade or Corporate Name)

By: _____

Title: _____
(Owner, Partner, of Corp. Pres.or
Vice Pres. only)

_____
(Surety Company)

Witness:

_____

By:_____

Title: _____
(Attorney in Fact)

Countersigned:

_____

_____
(N.C. Licensed Resident Agent)

_____

_____
Name and Address-Surety Agency

_____

_____
Surety Company Name and N.C.
Regional or Branch Office Address

(Surety Corporate Seal)

SHEET FOR ATTACHING POWER OF ATTORNEY

SHEET FOR ATTACHING INSURANCE CERTIFICATES

APPROVAL OF THE ATTORNEY GENERAL

CERTIFICATION BY THE OFFICE OF STATE BUDGET AND MANAGEMENT

Provision for the payment of money to fall due and payable by the

_____

under this agreement has been provided for by allocation made and is available for the purpose of carrying out this agreement.

This _____ day of _____ _____ 20___.

Signed _____ _____
Budget Officer

	Owner	☐	
	Designer	☐	
CONTRACTOR'S	Contractor	☐	Code _____ Item _____
AFFIDAVIT OF PAYMENT	Surety	☐	
OF DEBTS AND CLAIMS	Other	☐	

For Use with State of North Carolina Projects

TO (OWNER)

CONTRACT FOR:

CONTRACT DATE:

PROJECT:
(name, address) _____

State of: _____

County of: _____

The undersigned, pursuant to Article 36 of the General Conditions of the Contract, hereby certifies that, he has paid in full or has otherwise satisfied all obligations for all materials and equipment furnished, for all work, labor and services performed, and for all known indebtedness and claims against the contractor for damages arising in any manner in connection with the performance of the contract referenced above for which the owner or his property might in any way be held responsible.

SUPPORTING DOCUMENTS ATTACHED HERETO:

1. Consent of Surety to Final Payment. Whenever surety is involved, Consent of Surety is required.
   Indicate attachment: (yes) (no).
   The following supporting documents should be attached hereto if required by the owner:
   a. Contractor's Release or Waiver of Liens, conditional upon receipt of final payment.
   b. Separate Releases or Waivers of Liens from subcontractors and material and equipment suppliers to the extent required by the owner, accompanied by a list thereof.
   c. Contractor's Affidavit of Release of Liens.

CONTRACTOR:
Address:

By:
Subscribed and sworn to before me this _____ day of
_____ 20__.
Notary Public:
My Commission Expires:

Owner ☐

Designer ☐

CONSENT OF SURETY Contractor ☐ PROJECT ID #07-07283-01B

COMPANY TO FINAL Surety ☐

PAYMENT Other ☐

For Use with State of North Carolina Projects

PROJECT:
(name, address)

TO (OWNER)

CONTRACT FOR:

CONTRACT DATE:

CONTRACTOR:

In accordance with the provisions of the contract between the owner and the contractor as indicated above, the (here inset name and address of surety company)

SURETY COMPANY

on bond of (here insert name and address of contractor)

CONTRACTOR

hereby approves of the final payment to the contractor, and agrees that final payment to the contractor shall not relieve the surety company of any of its obligations to (here insert name and address of owner)

OWNER

as set forth in said surety company's bond.

IN WITNESS WHEREOF,
the surety company has hereunto set its hand this day of 20

Surety Company

Signature of Authorized Representative

Title

Attest:
(Seal):

SECTION 316

CONTRACTOR'S
AFFIDAVIT OF
RELEASE OF LIENS

Owner ☐
Designer ☐
Contractor ☐ ___Code_____Item_____
Surety ☐
Other ☐

For Use with State of North Carolina Projects

TO (OWNER)

CONTRACT FOR:

CONTRACT DATE:

PROJECT:

(name, address)

State of:

County of:

The undersigned, pursuant to Article 36 of the General Conditions of the Contract, hereby certifies that to the best of his knowledge, information and belief, the Releases or Waivers of Lien attached hereto include the contractor, all subcontractors, all suppliers of materials and equipment, and all performers of work, labor or services who have or may have liens against any property of the owner arising in any manner out of the performance of the contract referenced above.

SUPPORTING DOCUMENTS
ATTACHED HERETO:

CONTRACTOR:

Address:

By

Subscribed and sworn to before me

this day of 20

Notary Public:

My Commission Expires:

STATE OF NORTH CAROLINA
COUNTY SALES AND USE TAX REPORT
SUMMARY TOTALS AND CERTIFICATION

CONTRACTOR: _____ Page _____ of _____

PROJECT: _____ FOR PERIOD: _____

	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL ALL COUNTIES
CONTRACTOR							
SUBCONTRACTOR(S)*							
COUNTY TOTAL							

* Attach subcontractor(s) report(s)
** Must balance with Detail Sheet(s)

I certify that the above figures do not include any tax paid on supplies, tools and equipment which were used to perform this contract and only includes those building materials, supplies, fixtures and equipment which actually became a part of or annexed to the building or structure. I certify that, to the best of my knowledge, the information provided here is true, correct, and complete.

Sworn to and subscribed before me,

This the _____ day of _____, 20____

_____
Signed

_____
Notary Public

_____
Print or Type Name of Above

My Commission Expires: _____

Seal

NOTE:
This certified statement may be subject to audit

STATE OF NORTH CAROLINA
SALES AND USE TAX REPORT DETAIL

CONTRACTOR: _____ Page _____ of _____

SUBCONTRACTOR _____ FOR PERIOD: _____

PROJECT: _____

PURCHASE DATE	VENDOR NAME	INVOICE NUMBER	TYPE OF PROPERTY	INVOICE TOTAL	COUNTY TAX PAID	COUNTY OF SALE *
				$	$	
				TOTAL:	$	

* If this is an out-of-state vendor, the County of Sale should be the county to which the merchandise was shipped.