2019-2020 MECHANICAL HVAC UPGRADES to
Flat Rock & Rugby Middle Schools
Henderson County Schools
Hendersonville, North Carolina
DEI Job No. 19005

SECTION 15P094 - VIBRATION ISOLATION & ACCESSORIES

1. RELATED DOCUMENTS:

The provisions of Division 1 and Sections 15P001, 15P050, 15P099 and 15P925 shall govern and/or relate to this section.

1.1 GENERAL:

1.1.1 All material and equipment for vibration isolation hangers and supports and seismic supports shall be installed and provided under this section of the specification, and shall be new, unless otherwise shown or called for I other spec. sections, and shall be furnished in accordance with the standard mentioned throughout this section.

1.1.2 Equipment, Pipe and Pipe fittings. The arrangement of equipment and general location and size of all and piping is clearly shown. Install all equipment to clear level condition and piping accurately to grade and alignment. Should structural or other conditions require installation of pipe mains or any of the piping differently from the manner shown, the Contractor shall consult with the Architect Engineer and obtain written approval for all changes before proceeding with the work. All piping shall be installed to allow for expansion using offsets, expansion bends or expansion joints as may be required, to prevent undue strain on the piping.

1.1.3 Vibration Isolation Requirements/Equipment: All piping, and equipment shall be supported to prevent undue vibration and movement within the acceptable limits for the system or equipment isolated, as specified and required by other sections of the specifications. Vibration control materials, sizes, types and models listed herein shall be as manufactured by "Vibration Mountings and Controls, Inc.," or approved equal devices. Approved equal manufacturers are "Kinetics-Peabody," "Mason Industries," or "Vibration Eliminators, Inc.." Other manufacturers may be considered for approval in accordance with "Prior-Approval" requirements of Section 15P001.

1.1.4. Seismic Supports: Seismic supports shall be installed and provided as required by the IBC Code, category – "C", all in accordance as outlined in Section 15P099; refer to Section 15P099.

2.0 REQUIRED ISOLATION:

2.1 Rotating Equipment (Air Handling Units, etc.): All rotating equipment (except pumps) shall be isolated with open-type vibration spring and/or combined spring and neoprene shear isolators either provided with the equipment as called for on the drawings or by specifications. If the isolator devices are not provided with the equipment, it shall be provided for by this section of the specification. Housed springs of Type II devices shall be used for base mounted equipment.

2.2 Heaters and Pumps: Equipment supported by integral bases and/or base- footed supports shall be provided with vibration isolators of the rubber-in- shear pad types. Isolators shall be provided with the equipment or by this section of the specification. Pump connections to piping shall be made with flexible rubber arch-type (Type XV) pipe connectors as called for on the drawings.

2.3 Piping Systems: All piping within mechanical equipment rooms shall be hung utilizing Type V or Type VII spring-flex with neoprene-in-shear hangers.

3. Products and Device Types:

3.1 Products: shall be the standard of one manufacturer and shall be provided with all parts required to meet the industry standards for "Type" numbers referred to by this specification. Product model numbers given are listed using "Vibration Mountings and Controls, Inc." model numbers for reference. Equal types of model numbers for Mason Industries, Kinetics-Peabody, or Vibration Eliminators, Inc. will be acceptable provided they meet the intent of the specification types for proper vibration isolation.

3.2 Vibration Isolation Device Types: shall be as listed herein by the industry standard Type Number, as follows:

1. Type I: shall be double deflection Neoprene-In-Shear mountings of a steel top plate and base plate completely embedded in colored oil-resistant neoprene stock. Static deflection shall be o.40" minimum. Mountings shall have ribbed neoprene surfaces on top and bottom and be provided with holes for bolting. (Equipment having severe overhang, such as domestic booster pump sets, shall be mounted on steel channel rails incorporating double deflection neoprene-in-shear mountings.) "Vibration Mountings and Controls, Inc.," Neoprene-In-Shear mountings Type "RD" and steel channel rails Type "RB."

2. Type II (Open Springs): shall be Spring-/Flex mountings, free standing, laterally stable without housing, snubbers, or guides complete with steel reinforced ribbed neoprene cups top and bottom. All mountings shall have a bolt hole in bottom cup and be provided with adjusting bolt, cap screw, and washer in top cup for leveling and attachment to equipment. Springs shall be capable of minimum additional travel to solid equal to 50% of the rated deflection. Springs shall be color coded for proper identification of rated load capacity. "Vibration Mountings and Controls Inc." Spring- Flex mountings series "AC" or "AB" series with the addition of two hole rectangular steel baseplate for bolting to the structure.

3. Type II (Housed Springs): shall be Spring-Flex mountings of a telescoping housing containing one or more steel springs as the isolation medium, shall have built-in leveling bolt, resilient inserts to act as upper and lower housing guides, and neoprene acoustical non-skid pad bonded to the bottom. Springs shall be color coded for proper identification of rated load capacity. "Vibration Mountings & Controls Inc." Spring-Flex mountings series "B" or "C."

4. Type III: shall be Spring-Flex mountings free standing, laterally stable, and incorporate resilient vertical limit stops to prevent spring extension during weight changes. Spring diameter shall not be less than 0.80" of the operating spring height. Springs shall be capable of minimum additional travel to solid equal to 50% of the rated deflection. Mountings shall be provided with adjusting bolt and neoprene acoustical non-skid pad bonded to bottom plate. Mountings shall be color coded or stamped with spring size for proper identification of rated load capacity. "Vibration Mountings & Controls, Inc." Spring-Flex mountings shall be type "AWR."

5. Type IV: shall be Spring-Flex hangers of a color-coded steel spring in series with a Neoprene-In-Shear element molded in specific colors for proper identification of rated load capacity. the minimum total static deflection shall be 1.25". "Vibration Mountings & Controls, Inc." Spring- Flex hangers series "RSH."

6. Type V: shall be Spring-Flex hangers of a color-coded steel spring in series with a Neoprene-In-Shear element molded in specific colors for proper identification of rated load capacity. Spring-Flex hanger design shall incorporate a means for supporting the suspended equipment or piping at a fixed elevation during installation regardless of load changes as well as a means for transferring the load to the spring "Vibration Mountings & Controls, Inc." Spring-Flex hangers series "RSHP."

7. Type VI: shall be double deflection Neoprene-In-Shear hangers, and shall have a minimum static deflection of 0.40". The elements shall be molded in specific colors for proper identification of rated load capacity. The hanger configuration shall be designed for direct attachment to flat iron straps. "Vibration Mountings & Controls, Inc." Neoprene-In-Shear hangers series "RHDC."

8. Type VII: shall be Spring-Flex hangers and shall consist of a color- coded steel spring in series with a Neoprene-In-Shear element molded in specific colors for proper identification of rated load capacity. Spring- Flex hanger design shall permit lower hanger rod to swing through a 30 degree arc without metal to metal contact. The minimum total static deflection shall be 1.25". Vibration Mountings & Controls, Inc." Spring- Flex hangers series "RSH-30A."

9. Type XV: shall be tin arch and/or elbow flexible connectors molded of multiple-layer neoprene and nylon reinforcing fabric. Connectors up to and including 2-1/2" diameter may have threaded ends. Connectors over 2- 1/2" diameter shall be molded with raised faces and provided with floating steel flanges. Connectors shall be rated at 150 psi at 170 degrees F, and vacuum of 26" Hg. Control rods shall be furnished when recommended by the manufacturer. "Vibration Mountings & Controls, Inc." Quiet-Flex Style "TA" (flanged ends) or "TTA" (threaded ends).

10. Type XVI: shall be expansion joints of machine molded rubber and nylon construction internally reinforced by means of steel wire. Expansion joints shall incorporated cadmium plated steel flanges tapped to mate with 150 # ASA capable of operating at a temperature of 20 degrees F through 240 degrees F and at a pressure ranging from 16" Hg vacuum through 225 psi working pressure. Expansion joints shall be capable of 15 degree angular offset. "Vibration Mountings & Controls, Inc." expansion joints shall be "Quiet-Sphere."

END OF SECTION 15P094

2019-2020 MECHANICAL HVAC UPGRADES to
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DEI Job No. 19005

SECTION 15P180 - PLUMBING SYSTEMS INSULATION

1. RELATED DOCUMENTS:

The provisions of Division 1 and Section 15P001, 15P002, 15P050, and 15P200 shall govern this section.

1.1 Fire Hazard Classification. Acceptable maximum limits shall be in accordance with the following:

	PIPE INSULATION SYSTEM	
	Hot Service	Cold Service
Flame Spread	25	25
Fuel Contributed	50	50
Smoke Developed	50	50

These ratings are for the complete system which includes composite insulation and jacket or facing, vapor barrier joint sealing tapes, mastics and fittings. Materials must be listed by UL and acceptable under applicable NBFU and NFPA Standards.

1.2 PIPE INSULATION

All new domestic cold water piping lines, including mains, run outs and risers, shall be insulated as herein-after specified. All exposed & concealed water pipes shall be insulated; Pipe insulation thickness shall comply with Table 803.3.7 in the 2003 IECC.

All new domestic cold water lines, including mains, run outs and risers specified shall have piping insulation on all the lines. And shall be labeled in accordance w/Section 15P001 piping identification labeling.

1.2.1 Interior Aboveground Domestic Cold Water Piping All of these lines, whether exposed or concealed to view, shall be insulated with Owens-Corning Fiberglass ASJ/SSL-II or equal glass fiber pipe insulation having a minimum density of 3.5 lbs. per cubic foot. The insulation shall be furnished in molded sectional pipe lengths with standard weight all service jacket with end overlaps and shall be applied to the pipe with side and end joints butted tightly. The insulation thickness shall be 1/2" for pipe sizes up to 3/4"; 1" for pipe sizes 1" to 4". AT THE CONTRACTOR'S OPTION, CONCEALED PIPING MAY BE INSULATED WITH "ARMSTRONG" - "ARMAFLEX" OR APPROVED EQUAL INSULATION IN LIEU OF ABOVE SPECIFIED, MINIMUM THICKNESS SHALL BE 3/4" THICK.

1.2.2 Insulation on lines that are concealed in the building construction shall be secured with No. 14 soft copper wire spaced 9" on centers.

1.2.3 All fittings and valve bodies in these lines shall be insulated with molded glass fiber pipe fittings insulation with a thickness equal to the adjacent pipe insulation. Insulation on concealed fittings and valve bodies shall be wired on with No. 14 soft copper wires, and covered with 8 oz. canvas, secured and sized with "Lagfas" or approved equal adhesive. The same procedures shall apply where fittings and valves occur in exposed lines.

1.2.4 Hangers on all lines shall be sufficient in size to permit the insulation to pass through unbroken. Metal shields, as herein-before specified, shall be used between hangers and bottom of insulation. Hangers shall be as specified in Section 15P050.

1.2.5 All insulation work shall be done by mechanics skilled in its application and regularly * employed by the insulation contractor who shall be a subcontractor to this Contractor. Special care shall be given to obtain an even surface resulting in a neat and workmanlike appearance. Award of this subcontract shall not be made without prior written approval of the Architect/Engineer.

1.2.6 All Pipe Lines, whether insulated or not, shall be identified by use of pre-manufactured, snap-in place, color coded plastic markers, with black or colored letters as specified in Section 15P001. The markers shall spell out the name of the service in full. Direction arrows shall be used to indicate direction of flow.

1.2.7 Sleeved Pipes @ Floors, Walls, Roofs: All piping penetrating into or passing through walls, floors or roofs where pipe sleeves, or thimbles have been provided shall be fire-stopped complete with a "U.L." No. 1479 tested and approved non-asbestos fire retardant sealant/foam, equal to "Dow Corning" - "Fire Stop" System.

1.3 Submittal Data: The Contractor shall submit to the A/E the following data:

*SUBMITTAL DATA

Paragraph No.	Description	Date Submitted By Contractor To A-E (AE use only)
1.2.5	Prior Written Approval of Insulating Contractor	

END OF SECTION 15P180

2019-2020 MECHANICAL HVAC UPGRADES to
Flat Rock & Rugby Middle Schools
Henderson County Schools
Hendersonville, North Carolina
DEI Job No. 19005

SECTION 15P210 - NATURAL GAS PIPING SYSTEM

1. RELATED DOCUMENTS

The provisions of Division 1 and Section 15P001 shall govern this section.

1.1 NATURAL GAS PIPING SYSTEMS:

1.1.1 General:

The Division 15P Contractor shall provide new natural gas piping connections above roof piping supports (per details on drawings), and extensions, fittings and valves complete for a low pressure natural gas pipe system (3-5psig and below). Div. 15P Contractor shall provide all costs for and associated with the installation of natural gas provided service to equipment..
The new interior extended natural gas piping systems shall be routed from the existing interior natural gas main piping in the building mechanical room as shown on the drawings. Piping shall be routed inside aboveground and on the new roof areas where shown on the drawings. Systems and installation shall comply to all local authorities and codes and NFPA NFC-54 Code.

1.1.2 Applications: The applications for low pressure gas piping include the following new:

Connections to Building and Equipment and Plumbing equipment Connections, and,
Extensions Overhead in Building areas and On Roof Areas to New HVAC Outside Air Ventilation Units

ANSI Code Compliance: Comply with applicable provisions of "National Fuel Gas Code," ANSI Z 223.1 (NFPA Standard No. 54) and SBCCI Standard Gas Code.

1.1.3 Gas Piping Materials & Equipment & Instructions:

General: Comply with previous Basic Materials sections for product requirements of piping materials. For each service, provide the piping materials indicated insulating pipe, tube, fittings, hangers, supports, anchors, valves and accessories. Where more than one type is indicated selection is Installer's option.

Materials: Provide products complying with "National Fuel Gas Code," ANSI Z 223.1 (NFPA Standard No. 54), where type is not indicated.

Pipe Size 3" and Smaller: Black steel pipe of the size indicated.
Pipe Weight: Schedule 40, black steel, grade B, ANSI B36.10, ASTM A53, ASTM A106
Fittings: Class 150 Malleable iron threaded
Fittings: Forged steel socket welding
Fittings: Wrought steel butt welding
Fittings: Steel flanges and flanged fittings, class 150

1.1.4 Equipment Connections:

General: Provide low pressure gas piping for equipment and comply with equipment manufacturer's instructions. All equipment final roughing of gas piping to equipment shall be verified by Contractor with equipment shop drawings and coordination of equipment installers.

1.1.5 Quality Control:

Low Pressure Gas Piping Tightness Test: Prior to initial operation, test and purge fuel gas piping in accordance with ANSI A 223.1, National Fuel Gas Code. Repair or replace gas piping as required to eliminate leaks, and retest as specified to demonstrate compliance.

1.1.6 Piping Roof Curbs & Supports:

Provide and install Roof Products, inc. (1-800-262-6669) curbs and pipe rail supports for all above roof gas piping penetrations and supports. See drawings for details. Pipe penetrations and supports shall be Roof Products, Inc. "RPVP" type insulated canted vertical pipe curbs with cover (single and multiple pipe type shall be used); Pipe rail supports shall be "RPES" canted type with minimum 16" high 18ga. galvanized horizontal pipe support rails with counter-flashing top.

END OF SECTION 15P210

2019-2020 MECHANICAL HVAC UPGRADES to
Flat Rock & Rugby Middle Schools
Henderson County Schools
Hendersonville, North Carolina
DEI Job No. 19005

SECTION 15P050 - BASIC MATERIALS AND METHODS

1. RELATED DOCUMENTS:

The provisions of Division 1 and Section 15P001 shall govern this section.

1.1 PIPE AND FITTINGS:

1.1.1 Cast Iron Soil Pipe and Fittings shall be service weight centrifugally spun cast iron – "SV" pipe equal to "Tyler Pipe Co.", Tyler, Texas, conforming to current ASTM-A74, 1992. Joints for cast iron soil pipe shall be made with hot virgin lead and white oakum, or neoprene rubber gaskets, or for aboveground only, use no-hub fittings and gasketed clamps. Pipe by "Charlotte Pipe" is also approved for use.

1.1.2 DWV Soil Pipe long sweep Fittings shall be "Charlotte Pipe and Foundry Company", "ITT Grinnell," or approved equal, Schedule 40, DWV, pipe conforming to ASTM A-74-1992 with all piping fittings, NSF listed. Fittings shall be "Charlotte", or equal. (All drainage bends and water closets, unless noted otherwise, shall be served only by long sweep bends type fittings throughout.)

1.1.3 Schedule 80- PVC Pipe and Fittings shall be allowed and used on the project for domestic water..

1.1.4 Steel Pipe shall be Schedule 40 galvanized steel pipe only conforming to current ASTM A-120-72.

Fittings for galvanized steel pipe shall be 150 lb. galvanized malleable iron banded type conforming to ANSI B16.3-66, galvanized cast iron drainage type conforming to current ANSI B16.12-65.

Unions for steel pipe shall be 300 lb. ground joint type with brass-to-iron seats, galvanized, conforming to current ANSI B16.3-66.

Steel Pipe Nipples shall be of the same material as the pipe lines in which they are installed. No all thread (close) nipples will be permitted.

Joints in steel pipe shall be made with a non-hardening pipe compound applied to the male threads only.

1.1.5 Copper Pipe and Fittings (Domestic Water and Drains Piping Only): Shall be Type "K" or "L" as required, hard drawn copper tubing conforming to current ASTM B-88-71.

Fittings for domestic water, and drains only, shall be copper tubing shall be wrought copper ("lead-free" joints) solder type conforming to current ANSI B16.22-63.

Joints in copper tubing 1-1/2" and smaller shall be made with "lead-free" only, a non-corrosive flux and solder composed of 95% tin and 5% antimony. Joints in copper tubing 2" and larger shall be made with a non-corrosive flux and either "Sil-Fos," "Easy-Flo," "Phos-Copper", lead-free solder.

Each length of copper tubing and each fitting shall be permanently marked with the trademark of the manufacturer. Each length of copper tubing shall also be permanently marked with type of tubing. No copper tubing or fittings of foreign manufacture will be permitted to be used.

Where pipe passes through walls, use galvanized iron sleeve with double layers of tar paper between pipe and sleeves to prevent electrolysis.

Furnish and install dielectric couplings at all connections of dissimilar metals as required.

1.1.6 Exterior Water Pipe and Fittings and Specialties: The following specifications for underground service for pipe, fittings, gate valves, fire hydrants and valve boxes are as follows:

1.1.6.I. Pipe: All pipe shall be made in the USA.

1.1.6.1.1 Ductile Iron Water Pipe: Manufactured and tested in accordance with ANSI A21.51 - Minimum Class 51. Cement lining per ANSI A21.4. Push-on joints per ANSI A21.11, except gaskets shall be synthetic rubber.

1.1.6.1.2 Galvanized Steel Pipe: Standard weight with threaded and coupled joints meeting the requirement of AWWA C200.

1.1.6.2 Fittings: All fittings shall be made in the USA.

1.1.6.2.1 Compact Ductile Iron Fittings: 4" through 12" fittings, shall be made from Ductile Iron Grade 70-50-05 per ANSI A21.53. Fittings and accessories shall be mechanical joint per ANSI A21.10 and A21.11. Wall thickness shall be equivalent to Ductile Iron Class 54. Exterior bituminous coating per ANSI A21.10. Cement lining per ANSI A21.4.

1.1.6.2.2 Ductile and Gray Iron Fittings - 3" through 48". All cast and ductile iron fittings shall be manufactured and tested per ANSI A21.10. The iron shall comply with ASTM A48, Class 25 for cast iron fittings and shall be Grade 70-50-05 for ductile iron fittings. Metal thickness shall conform to AWWA C100, Class D. Mechanical joints shall comply with ANSI A21.11.

1.1.6.2.3 Galvanized Fittings. All 2: fittings shall be standard weight malleable galvanized iron with standard iron pipe thread.

1.1.6.3 Gate Valves: Iron-Body Bronze-Mounted, sizes 3" - 12" inclusive. Order Specification: Double-Disc, Parallel Seats, Non-Rising Stem (NRS), Rated at 200 psi WWP, O-Ring Seals, Standard 2" Square Wrench Nut, and conforming to AWWA C-500 in all respects.

Check with the local water system engineering office for direction of opening.

APPROVED IBBM VALVES, SIZES 3" - 12", INCLUSIVE:

NAME	CATALOG #, MJ ENDS
1. American Darling	55
2. Ludlow	AWWA
3. Mueller	A-2380-20
4. Smith-Metropolitan, U.S. Pipe	3460

All 2" valves shall be bronze gate valves, solid wedge, inside screw, non-rising spindle, rated 125 psi SWP or 200 psi WOG, Open Left, screwed ends, with standard markings and complying with Fed. Spec. WW-V-54.

APPROVED BRONZE VALVES, SIZE 2":

NAME	CATALOG #
1. Crane Company	438
2. Jenkins Brothers	370
3. Kennedy Valve Mfg. Co.	427

4. Lunkenheimer Co. 2129

Check with the local water system engineering office for specifications on all valves over 12" size.

1.1.6.4 Fire Hydrants: All fire hydrants shall be 4-1/2" minimum nominal valve opening, national standard nozzle threads and operating details, two 2-1/2" nozzles and one 4" nozzle, 6" MJ inlet connection, depth of bury to suit field conditions, painted highway safety yellow, breakable ground flange and conforming to AWWA C502. Check with the local water system engineering office for direction of opening.

APPROVED FIRE HYDRANTS:

NAME	CATALOG #
1. American-Darling	B-62-B
2. American-Darling	MK 73-1
3. A.P. Smith, U.S. Pipe	H205
4. Mueller	A24007
5. Mueller "Centurion"	A-421

1.1.6.5 Valve Boxes: All valve boxes shall conform to the local water system standard (OPELIKA 107-2) and must be approved by the local water system.

1.1.7 Copper Piping for Medical Gases and Medical and Vacuum Piping Systems: See Section 15P205 - "Medical Gas Piping Systems and Accessories".

1.2 VALVES:

1.2.1 GENERAL:

Valves shall be furnished and installed as indicated on the drawings. Valves shall be of manufacturer and model as listed below:

	Crane	Jenkins	Nibco	Hammond
A. GATE VALVES:				
2" & Smaller				
Screwed Ends	1700	47	T-111	IB640
Solder Ends	1700-S	1242	S-111	IB635
B. GLOBE VALVES:				
2" & Smaller				
Screwed Ends	108	1703-A	T-211	IB413T
Solder Ends	109	1703-S	S-235	IB423
C. CHECK VALVES:				
2" & Smaller				
Screwed Ends	1707-S	92-A	T-413	IB938
Solder Ends	1707-S	1222	S-413	IB941
D. BALL VALVES:				
2" & Smaller				
Screwed Ends	9302-H	30-A	T-590-W	BV-711-T
Solder Ends	9322-H	30-A	S-580	806

NOTE: Contractor has the option to substitute Ball valves for Gate valves listed above.

1.3 Piping Specialties:

1.3.1 Escutcheons shall be heavy chrome plated brass of sufficient depth to cover any connection between chrome plated pipe or tubing, copper or steel pipe, and shall be held in place with Allen-Headset screws where applicable.

1.3.2 Floor, Wall and Ceiling Plates shall be chromium plated, either self- locking or set screw secured type, of sufficient width and depth to cover projecting sleeves and insulation, and shall be securely fastened to piping or sleeves as required. Plates shall be comparable in all respects to Beaton & Cadwell Mfg. Co. products No. 36 for floor, and No. 3A for walls and ceilings. Products of similar design manufactured by Beaton & Corbin Mfg. Co., Fee & Mason, or approved equal will be acceptable.

1.3.3 Sleeves through Walls shall be provided and shall be Schedule 40 galvanized steel pipe of sufficient size to clear pipe or, where pipe is insulated, both pipe and insulation, by a minimum of 1/4" on all sides. The sleeves shall be installed as walls are constructed. Fire-stopping of all sleeves shall be provided with "U.L." No. 1479 tested and approved non-asbestos fire retardant sealant foam, completely filling all the annular space.

1.3.4 Sleeves through floor slabs above grade or roof shall be constructed of Schedule 40 galvanized steel pipe. All sleeves shall be of sufficient size to clear pipe or, where pipe is insulated, both pipe and insulation by a minimum of 1/4" on all sides. The sleeves shall be installed before the floor is placed. All annular spaces between pipe/pipe sleeve shall be filled with a "U.L." No. 1479 tested and approved non-asbestos fire retardant sealant foam material.

1.3.5 Strainers shall be Armstrong Type ALSC, Yarway Fig. 901 Sarco Type "AT" or approved equal and shall have screen for water service.

1.3.6 Water Hammer Arresters shall be provided as specified in the specific sections of the specifications called for and shall be "Josam," "Zurn," "Amtrol," "Smith," or equal, all conforming to Plumbing and Drainage Institute, installed per the manufacturers' directions.

1.4 Mechanical Supporting Devices. Support spacing for horizontal lines of pipe shall be as follows:

Pipe Size	Support Spacing
1" & Larger.....	10" - 0" maximum
3/4" & 1/2".....	8" - 0" maximum

In locations where a number of fittings may be necessary, additional supports shall be installed so as to prevent severe strains on the connecting pipe lines.

1.4.1 Pipe Hangers and Supports:

Hangers for steel and cast iron pipe shall be for all sizes: Grinnell Fig. 260, F&S Fig. 86, Fee & Mason Fig. 239, Elcen Fig. 12, or approved equal.

Hangers for insulated copper tubing shall be Grinnell Fig. 260, Elcen Fig. 12, F & S Fig. 86, or approved equal. Hanger rods for bare copper tubing shall be Grinnell Fig. No. CT-99C (coated type) or all copper CT-269 adjustable ring type hangers.

Pipe hangers shall be supported from the building structure by the most suitable methods.

Pipe covering protectors for insulated piping shall be 18 gauge semi-cylindrical galvanized sheet steel

shields, 18" long.

Pipe Hanger rods shall be Grinnell Fig. 140 or 253, F & S Fig. 24X, Fee & Mason Fig, 267B or approved equal. Use rod couplings and straight rods to extend eye rods where needed. Hanger rods for copper tubing shall be the same as for steel, only copper plated.

Hanger spacing shall comply with Table 308.5 in the 2003 IPC.

1.5 Insulation Materials:

1.5.1 All insulation materials shall be received new, boxed, packaged, and kept dry while stored until used by the Contractor. Any damaged, crushed, broken, separated or cut damaged insulation shall not be used on any pipe or equipment.

1.5.2 All insulation materials shall be of the listed maximum fire hazard classifications for services of the type specified in Section 15P180 and as listed for the specified service on piping, equipment, etc. All materials shall be installed by insulating trade type personnel and in accordance with the manufacturers recommendations per the material used.

1.5.3 Insulation for piping services shall not be installed until piping has been tested I.A.W. Section 15P001. Insulation shall not be installed on wet, or dirty surfaces of any pipe or equipment. All materials receiving insulation shall be prepared, cleaned and surfaces prepared per the manufacturer's recommendations and/or per the specifications Section 15P180.

1.5.4 All insulated piping services and equipment shall be properly identified with pipe and material markers as specified in Section 15P001.

1.5.5 All insulated pipe penetrating through walls and floors shall not have insulation continuous through sleeves but insulation shall be omitted within the sleeved annular spaces and filled with "U.L." No. 1479 approved fire-stopping sealant foam, equal to "Dow Corning" - "Firestop System."

1.5.6 Gauges: Pressure gauges shall be of the stainless steel polished case, stainless closed type ring, white background dial with embossed jet black numbers and markings, clear glass face cover, stainless steel black finished red tipped adjustable pointer 3 1/2" diameter (minimum) utilizing the Bourdon type bronze system and shall be all bronze movement and pipe fitting socket connection with standard tapered or fine threaded connection, 1% over mid-half scale and 1-1/2 percent accuracy over balance of scale (0-100 psig): "Trerice No. 890 Series" or approved equal by "Weksler", "Palmer", "Marshalltowne", "Hersey", "Uehling", "Ashcroft", or "Powers". Temperature thermometer gauges shall be all angle type 12" die cast aluminum with metallic black finish case, clear acrylic plastic window & s/s cap, tube glass lens of red appearing mercury on a white background scale with jet black embossed figures/markings, brass stems with union connection, with bulb chambers of tapered fit sockets, temp. range of: (HW 30 - 240 degrees F.; CHW 0 - 100 degrees F). "Trerice" EDP No. A009 or approved equal by "Weksler", "Palmer", "Marshalltowne", "Hersey", "Uehling", "Ashcroft", or "Powers". Thermometer wells shall be by same manufacturer as gauge of length and material to suit service and gauge.

END OF SECTION 15P050

2019-2020 MECHANICAL HVAC UPGRADES to
Flat Rock & Rugby Middle Schools
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Hendersonville, North Carolina
DEI Job No. 19005

SECTION 15P200 - WATER SUPPLY PIPING SYSTEM

1. RELATED DOCUMENTS

The Provisions of Division 1 and Section 15P001, 15P002, 15P050 and 15P400 shall govern this section.

1.1 Water Supply Piping: (Domestic Water Replacement Piping)

1.1.1 Domestic Cold Water, ABOVE GROUND Piping within the Building shall be Schedule 80 PVC Pressure Pipe & fittings OR type "L" hard copper tubing, ASTM B88 as listed in Section 15P050 and shall be assembled with Schedule-80 Fittings of Glued-type PVC matching fittings OR for copper piping using sweat-soldered type wrought copper fittings. NOTE: Roll copper shall not be permitted or used anywhere on the project.

Branch piping shall run to all parts of the building as required, and pressure tested in accordance with Section 15P001.

In general, unless indicated otherwise, all cold water shall be run in ceiling spaces and in pipe chases with mains pitched to drain to fixtures or drain points as indicated on the drawings. For the copper piping, the Soldered joints and flux shall be lead free per Para. 605.14.3 in the 2003 IPC.

1.1.2 Water Hammer Arresters shall be installed in cold and hot water lines and shall be Amtrol "Diatrol," Josam "Absorbotron," Zurn "Shoktrol" or Ancon "Shok-Gard" and shall conform to Plumbing and Drainage Institute PDI-WH-201-65, and installed accordingly.

1.1.3 STERILIZATION. THE CONTRACTOR SHALL FURNISH A NOTARIZED CERTIFICATE IN * TRIPLICATE TO THE ARCHITECT/ENGINEER PRIOR TO THE DATE FOR FINAL INSPECTION STATING THAT THE NEW ABOVEGROUND AND OVERHEAD DOMESTIC WATER LINES EXTENSIONS, AND ALL NEW CONNECTIONS, TO THE EXISTING UNDERGROUND MAIN WATER LINES IN THE BUILDING, HAS BEEN STERILIZED BY CHLORINATION TO A RESIDUAL AMOUNT OF 50 PARTS PER MILLION FOR A 24-HOUR PERIOD BEFORE WATER IS USED IN THE BUILDING, AFTER WHICH THE MAIN WATER LINE SHALL BE PROPERLY FLUSHED OUT, VALVES OPENED AND CLOSED SEVERAL TIMES BEFORE WATER IS USED IN THE BUILDING.

1.1.4 Piping Supports in Walls: All piping installed in walls shall be securely attached to wall support studs etc. with rigid angles, or "U"-bolts and clamps to prevent vertical or horizontal movement of piping. Special care shall be taken to support all piping, especially at termination points connecting to plumbing fixtures.

1.2 Submittal Data: The Contractor shall submit to the A/E the following data:

*SUBMITTAL DATA REQUIRED

Referenced Paragraph No.	Description	Date Submitted By Contractor To AE (AE use only)
1.1.3	Water Sterilization Notarized Certificate	

END OF SECTION 15P200

2019-2020 MECHANICAL HVAC UPGRADES to
Flat Rock & Rugby Middle Schools
Henderson County Schools
Hendersonville, North Carolina
DEI Job No. 19005

SECTION 15P002 - SCOPE OF WORK - PLUMBING SYSTEMS

1. RELATED DOCUMENTS:

The provisions of Division 1 and Section 15P001 shall govern this section.

2. GENERAL:

2.0 The facilities and systems of the plumbing work for the project can be described, but not by way of limitation, to be as follows:
1) Provide for the plumbing demolition and disposal of all existing remaining interior building aboveground plumbing and piping systems inclusive of:
General Outline: The facilities and systems of the plumbing work for the project can be described, but not by way of limitation, to be as follows:

a) Provide for the selective plumbing demolition and disposal of all existing interior building aboveground plumbing domestic water piping systems and exterior and interior natural gas piping inclusive of:

- Pressurized overhead domestic water piping, and,
- all designated domestic cold water piping branch with new line sized all-bronze ball valves , and,
- all new extensions of natural gas piping, and,

b) Provide all designated new plumbing natural gas piping extensions and new replacement water piping systems installations with all replacement aboveground, portions of:

- new replacement domestic cold water piping and new extended interior and exterior natural gas piping, and
- natural gas piping to new rooftop mechanical HVAC equipment systems with new natural gas pressure regulators for each natural gas connected pieces of equipment, and all roof piping supports, and,
- new one-piece 3/4' piping insulation of closed cell type flexible pipe insulation or 3/4" one-piece fiberous glass piping insulation with ASJ type reinforced self-sealing type exterior jacket for all new replaced overhead domestic cold water piping & valves.

3) Provide all new replacements connections of domestic water to existing overhead piping and new all-bronze ball shut-off valves connected to all remaining and re-used existing above floor domestic water piping.

4) Providing all materials and labor complete for all items (1) thru (3) above.

5) Providing all piping insulation materials and labor for items (2) and (3) interior domestic cold water piping systems listed above.

2.1 This specification serves to supplement Divisions and Sections listed in "Related Documents" above and to describe the materials and installation procedures to be followed for furnishing and installing the Plumbing as outlined and described by the descriptive contract drawings provided to the Contractor and as noted in this part of the specification, for the Contract. Where any discrepancy or conflict occurs in this section with the referenced "Related Document," the "Related Documents" shall govern.

2.2 Where the word Contractor appears in these specifications, it applies to the Div-15P Plumbing Contractor performing the Div-15P Plumbing portion of the work.

2.3 The Contractor shall install multiple systems as may be specified herein and/or stipulated on the

drawings and furnish all labor, material, tools, scaffolds, erection equipment, services, and other items of expense as specified as a part of this Contract. It further includes placing the systems into operation and proper balance and adjustment on all items of equipment as approved by the Architects-Engineers.

2.4 The installation shall conform to all codes, laws, and requirements in force at the jobsite, and the Contractor at his expense shall obtain all licenses and inspection certificates required.

2.5 IN THE EVENT ADDITIONAL DRAWINGS OR SPECIFICATIONS ARE FURNISHED, SUCH DRAWINGS SHALL BE OF EQUAL FORCE WITH THOSE FIRST FURNISHED WITH THESE SPECIFICATIONS.

2.6 The Contractor shall give his personal superintendence and direction to the work and maintain and supply complete supervision over all subcontractors that may be employed by him. He shall be held responsible for all legal violations, and shall give the proper authorities all notices required by law, paying at his expense all proper legal fees and charges. He shall hold the Owner harmless for any damage or expense arising from the fulfillment of the Contract and at the completion of the work he shall repair at his expense all damages done. He shall be removed from the premises all rubbish and waste materials resulting from his work.

2.7 This specification shall apply to any Contract or subcontract that the Contractor may enter into for the supplying of equipment, materials, or construction for various parts of the work as shown on the drawings or specified herein, and it shall hereby be understood that the Contractor shall inform all sub-contractors of same requirements.

2.8 The Contractor shall receive and unload all equipment and material furnished by and to him. He shall further be responsible for the equipment and material from the standpoint of moving in and out of storage to the point of usage.

3. CODES AND STANDARDS

3.1 Various nationally recognized codes and standards shall be referred to by their abbreviated names as listed below. Reference to these standards shall be understood to mean the latest published edition:

AGA	- American Gas Association
AGMA	- The American Gear Manufacturer's Association
AIA	- American Institute of Architects
AMCA	- Air Moving and Conditioning Association
ANSI	- American National Standards Institute
ASHRAE	- American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	- American Society of Mechanical Engineers
ASTM	- American Society of Testing and Materials
FIA	- Factory Insurance Association
FM	- Factory Mutual
HEPA	- High Efficiency Particulate Air - Clean Room Specification Federal Standard 209
NEMA	- National Electrical Manufacturers Association
NFPA	- National Fire Protection Association
SMACNA	- Sheet Metal & Air Conditioning Contractors National Association
SSPC	- Steel Structures Painting Council

UL - Underwriters' Laboratories

4. MATERIALS:

4.1 The Contractor shall furnish (except Owner furnished equipment) and install all items of equipment an materials as shown on the drawings, and/or specified, and/or as required to complete the work in a complete acceptable manner. NOTE: BASE BID shall be based on PVC pressure piping which shall be Schedule-80 only as specified to be used for replacement Domestic Water Piping Mains for overhead piping shown on the Flat Rock project documents, unless written approval is obtained from the Owner and the Engineers for any other pressure rated piping that the Contractor may want to be submitted as an alternate piping material for replacement scope of work. BASE BID shall be based on Schedule-80 PVC Pressure Pipe & fittings.

4.2 For equipment specified to the Contractor, the major equipment and materials have been shown on the drawings and/or specified by manufacturer and model number in order to establish quality, performance, and physical limitations. This does not limit the Contractor to the specific manufacturers notes; however, any equipment or materials proposed shall be equal in quality, performance, arrangement, and space requirements to that specified. All equipment and materials shall be submitted for approval to the Architects- Engineers, before purchase or use.

4.3 All equipment and materials shall be new and of the quality noted or specified. All equipment and materials of inferior quality shall be rejected. Rejected equipment and materials shall be removed from the job site and immediately replaced.

4.4 The Architects-Engineers will decide upon the quality of equipment and materials furnished and also upon all questions arising from the specifications and plans.

4.5 The Contractor shall pay all royalties and license fees, and shall defend all suits or claims for infringement of any patent rights on account of the use of any patented invention, process, article, or appliance, and save the Owner harmless from loss on account thereof, except that the Owner shall be responsible for all such loss when a particular process or product of a particular manufacturer or manufacturers is specified herein; but if the Contractor has information that the process or article specified is an infringement of a patent he shall be responsible for such loss unless he promptly gives such information to the Architects-Engineers.

4.6 No deviations shall be allowed except for very special reasons, which reasons shall be submitted in writing to the Architects-Engineers, and written approval must be obtained before such deviations are made. Such deviations shall in no way be a cause for delay in completion of the project.

5. INSTALLATION RESPONSIBILITY, WORKMANSHIP, AND EMPLOYEES

5.1 The Contractor is responsible for the proper and acceptable installation of all equipment and materials he furnishes and all equipment and materials furnished to him by the Owner.

5.2 The Contractor shall coordinate the installation of all the above equipment and materials with other Contractors and workers employed by the Owner, i.e., the General Contractor, Electrical Contractor, Piping Contractor, Owner's personnel, etc. All work shall be completed within the contractual allocated time. The Contractor shall keep up with the work by other Contractors and workers employed by the Owner. The Contractor shall report any foreseeable delays in the completion of his work to the Owner as soon as the delay is recognized by the Contractor.

5.3 Any questions arising over work, equipment, and materials furnished by other contractors or the Owner that is necessary for proper installation and operation of the Plumbing equipment, shall be referred to the Owner for determination of responsibility and correction.

5.4 The Contractor's workmen shall be skilled in the work to which they are assigned and all work shall be performed under the direct supervision of an experienced and competent foreman.

5.5 Before commencing work on this project, the Contractor shall verify in writing over his signature to the Owner that his project manager, superintendents, foremen, and others of his personnel responsible for this project have read these specifications, reviewed the drawings and understand what is required for proper completion of the systems.

5.6 The Contractor shall keep sufficient workmen on the work at all times, and shall enforce strict discipline and good order among his employees.

5.7 The Contractor shall not employ on the work any person, in any capacity, who may be unskilled in or incompetent for his position, intemperate, disorderly, or otherwise objectionable. The Contractor, if requested in writing by the Architects-Engineers or Owner, shall dismiss any such objectionable persons from the work.

5.8 All work, including piping, shall be constructed true to lines and surfaces indicated in a neat, substantial, and workmanlike manner and in such a way as to properly serve the purpose intended. Equipment shall be plumb and level. All members and parts, upon installation, shall be properly framed, secured together and anchored in place.

5.9 The Contractor shall visit the job site, obtain measurements required and make shop drawings of all items he intends to fabricate and/or install as part of the Plumbing systems inclusive of all piping systems. These drawings shall be submitted to the Architects-Engineers for approval and/or corrections and comments before actual fabrication and erection of piping, and related accessories.

5.10 The Contractor shall provide the Architects-Engineers with prints of Record Drawings if there are deviations from the Contract Drawings.

6. OTHER CONTRACTS AFFECTING THIS WORK:

6.1 Some electrical work allied with this part of the specifications shall be performed under a separate contract such as power wiring and devices, and power controls, except as indicated on the drawings for controls.

6.2 All service piping work associated with this part of the specifications shall be performed under this contract.

6.3 The instrumentation and control work allied with this part of the specifications shall be performed under this contract.

6.4 Insulation work pertaining to service piping shall be performed under this contract.

6.5 The building work such as equipment room, pads, curbs, wall opening, and roof openings, will be performed under general contract, unless noted otherwise on drawings, but requirements shall be set by

the Contractors for all work.

7. CERTIFIED DRAWINGS:

7.1 The Contractor shall submit six (6) copies of certified equipment drawings and data that clearly indicate but not necessarily be limited to the following minimum information:

A. Owner Data:
1) Owner's (project) (plant) (name) and address.
2) Owner's (purchase) (and) (requisition) number or code, as may be applicable.
3) Owner's (equipment) (system) (and) (are) number or code.

B. Architects-Engineers Data:
1) Name and Address.
2) Project name and job number.

C. Contractor's name, address, project number or code, purchase order number, and certification that the Contractor has reviewed the drawings and data before submitting them for approval.

D. Manufacturer's Data.

1) Manufacturer's name, address, and project number or code.
2) Manufacturer's model, shop, and serial number.
3) Performance specification, limitations (including) (curves), (charts) (and) computer printout of projected performance).
4) Physical arrangement, dimensions, weights, foundation, and support requirements.
5) Utility requirements.
6) Statement of compliance with all federal, state, and local statutory requirements in force at time of submittal of drawings and data.
7) Certification of UL, FIA, FM, NEMA, ARI, AGA, AMCA, etc., as designated on the drawings, in the equipment schedules or elsewhere in this specification.
8) Clearly stated description of what the manufacturer is including with the equipment he is furnishing for this project.
9) Installation, operation and maintenance, drawings, manuals, and schedules.
10) Recommended spare parts list with replacement prices currently in effect.
11) Clearly defined warranty statement.

8.0 WORK UNDER CONTRACT FOR ALL SYSTEMS:

8.1 It is not the intent of this section of the specification to give explicitly every detail as to the requirements of all work intended relative to each above mentioned system description. Rather, the combined interpretation of the entire set of specifications and contract drawings should explain the necessary new work requirements for the systems described.

END OF SECTION 15P002

2019-2020 MECHANICAL HVAC UPGRADES to
Flat Rock & Rugby Middle Schools
Henderson County Schools
Hendersonville, North Carolina
DEI Job No. 19005

SECTION 15P099 - SEISMIC PROTECTION FOR PLUMBING SYSTEMS

1. RELATED DOCUMENTS:

The provisions of Division 1 and Sections 15P001, 15P050, and 15P099 shall govern and/or relate to this section.

1.1 GENERAL:

1.1.1 All material and equipment shall be new, unless otherwise shown or called for, and shall be furnished in accordance with the standard mentioned throughout this section. Seismic design shall be provided by the Vendor supplier and certified by a registered South Carolina Professional Engineer with all design submittals stamped with the Engineer's seal. All seismic design criteria shall be done in accordance with the IBC Code for category "C".

1.1.2 Equipment, Pipe and Pipe Fittings. The arrangement of equipment and general location and size of all and piping is clearly shown. Install all equipment, to clear level condition and piping accurately to grade and alignment. Should structural or other conditions require installation of or pipe mains or any of the piping differently from the manner shown, the Contractor shall consult with the Architect/Engineer and obtain written approval for all changes before proceeding with the work. All piping shall be installed to allow for expansion using offsets, expansion bends or expansion joints as may be required, to prevent undue strain on the piping.

1.1.3 Seismic Requirements: The requirements for seismic protection measures to be applied to plumbing piping systems specified herein are in addition to any other items called for in other sections of these specifications.

1.1.3.1 Plumbing Piping/Equipment: Plumbing Piping and/or equipment as applicable for the Scope of the plumbing work performed for the project shall include the following items to the extent required in other sections of these specifications:

a) Domestic Cold & Hot Water Piping

1.1.3.2 Plumbing Systems: Plumbing systems shall include the following items to the extent required in other sections of these specifications:

b) Domestic Water Distribution Systems, Sanitary Drainage Waste & Vent Piping, and Roof Drainage Piping Inside the Building

1.1.3.3 Seismic Zone: This facility project is located in old Seismic Zone 2, Greenville County, in accordance with the IBC Code for category "C".

2. BRACINGS & CONNECTIONS:

2.1 Sway Brace: Material used for members listed in Tables I and II, of this specification, except for pipes, shall be structural steel conforming with ASTM A 36. Steel pipes shall conform to ASTM A 501.

2.2 Flexible Couplings: Flexible couplings shall have same pressure ratings as adjoining pipe.

2.3 Flexible ball joints conforming to the following requirements may be employed on aboveground piping. Joints shall have cast or wrought steel casing and ball parts capable of 360-degree rotation plus not less than 15 degree angular movement. Joints shall be certified to be suitable for the service intended by the

manufacturer, based on not less than 2 years' satisfactory operation in a similar application.

2.3.1 Flexible couplings and joints of the mechanical joint type may be used for aboveground or underground piping.

2.3.1.1 Mechanical couplings for steel or cast-iron pipe shall be of the sleeve type and shall provide a tight flexible joint under all reasonable conditions, such as pipe movement caused by expansion, contraction, slight settling or shifting of the ground, minor variations in trench gradients, and traffic vibrations. Where permitted in other sections of these specifications, joints utilizing split-half couplings with grooved or shouldered pipe ends may be used.

2.3.1.2 Sleeve-type couplings shall be used for joining plain-end pipe sections. The coupling shall consist of one stee1 middle ring, two steel followers, two gaskets, and necessary steel bolts and nuts to compress the gaskets. Underground bolts shall be high-strength type as specified hereinbefore.

3.0 BRACING SUPPORTS:

3.1 SWAY BRACES shall be installed on piping not otherwise rigidly anchored to preclude damage during seismic activity. Bracing shall conform to approved arrangements. Provisions of this paragraph apply to all piping within a 5-foot line around outside of building unless buried in the ground.

Piping grouped for support on trapeze-type hangers shall be braced at the same intervals as determined by the smallest diameter pipe of the group.

Hanger rods shall be increased in cross-sectional area proportionate to the increased weight per linear foot of pipe and contents supported at each trapeze hanger. No trapeze-type hanger shall be secured with less than two 1/2 inch bolts. Bracing rigidly attached to pipe flanges, or similar, shall not be used where it would interfere with thermal expansion of piping.

3.2 Sway Braces for Piping:

3.2.1 Transverse Sway Bracing: Transverse sway bracing shall be provided at intervals not to exceed those given in Table I except for cast-iron soil pipe, which shall be braced at not more than 10-foot intervals.

3.2.2 Longitudinal Sway Bracing: Longitudinal sway bracing shall be provided at 40-foot intervals.

3.2.3 Vertical Runs: Vertica1 runs of piping shall be braced at not more than 10-foot vertical intervals. For smaller tubing, bracing shall be provided at no more than 4-foot spacing.

3.2.4 Anchor Rods, Angles, and Bars: Anchor rods, angles, and bars shall be bolted to either pipe clamps or pipe flanges at one end and cast-in-place concrete or masonry insert or clip angles bolted to the steel structure on the other end. Rods shall be solid metal or pipe as specified hereinafter. Anchor rods, angles, and bars shall not exceed lengths given in Table III.

3.2.5 Clamps: Clamps on uninsulated pipes shall be applied directly to pipe. Insulated piping shall have clamps applied over insulation vapor barrier with high-density inserts and metal protection shields under each clamp.

3.2.6 Bolts: Bolts used for attachment of anchors to pipe and structure shall be not less than 1/2 inch diameter.

4.0 SPREADERS shall be provided between racked or adjacent piping runs to prevent contact during seismic activity whenever pipe or insulated pipe surfaces are less than 4 inches apart or four times the maximum displacement due to seismic force. Spreaders to be applied at same interval as sway braces. Spreaders shall be applied to surface of bare or insulated hot pipe and over insulation utilizing high-density inserts and pipe protection shields where vapor-barrier type insulation is employed.

TABLE I

MAXIMUM SPAN FOR TRANSVERSE SWAY BRACES

Pipe Diameter (in.)	Std. Wgt. Steel Pipe - 40S		Ex. Strong Steel Pipe - 80S		Copper Tube Type L	
	*L(ft)	**F(lbs)	*L(ft)	**F(lbs)	*L(ft)	**F(lbs)
1	22	70	22	80	11	17
1-1/2	25	140	26	180	12	35
2	29	220	30	290	14	70
2-1/2	32	380	33	460	15	110
3	34	550	35	710	17	150
3-1/2	36	730	38	930	18	220
4	39	960	40	1,200	19	300
5	41	1,440	44	1,900	20	470
6	45	2,120	46	2,750	22	730
8	49	3,740	54	5,150	26	1,550
10	54	6,080	59	7,670	28	2,630
12	58	8,560	61	10,350	31	3,950

*L = Maximum span between lateral supports multiplied by 1.25 for Zone 2.

**F = Horizontal force on the brace multiplied by 0.5 for Zone 2.

NOTE: Bracing shall consist of at least one vertical angle 2 x 2 x 16 gage and one diagonal angle of the same size.

TABLE II

MAXIMUM LENGTH FOR ANCHOR BRACES

Type	Size	Maximum Length*	Allowable Loads* (kips)
Angles	1-1/2" x 1-1/2" x 1/4"	4'-10"	5.7
	2" x 2" x 1/4"	6'-6"	7.8
	2-1/2" x 1-1/2" x 1/4"	8'-0"	9.8
	3" x 2-1/2" x 1/4"	8'-10"	10.8
	3" x 3" x 1/4"	9'-10"	11.9
Rods	3/4"	3'-1"	3.7
	7/8"	3'-8"	5.0
Flat Bars	1-1/2" x 1/4"	1'-2"	3.1
	2" x 1/4"	1'-2"	4.1
	2" x 3/8"	1'-9"	6.2
Pipes 1"		7'-0"	4.1
(40S) 1-1/4"		9'-0"	5.5
	1-1/2"	10'-4"	6.6
	2"	13'-1"	8.9

*Based on the slenderness ratio of 1/r = 200 and ASTM A 36 steel.

5.0 FLEXIBLE COUPLINGS OR JOINTS:

5.1 Building Piping: Flexible couplings or joints in building piping shall be provided at bottom of all pipe risers 3-inch size and larger. Cast-iron waste and vent piping need only comply with these provisions when calked joints are used. Flexible bell and spigot pipe joints using rubber gaskets or no-hub fittings may be used at each branch adjacent to tees and elbows for underground waste piping inside of building to comply with these requirements.

5.2 Underground Piping: All underground piping shall have flexible couplings installed adjacent to building as shown. Additional flexible couplings shall be provided as follows:

a. On each side of the joints of demarkation between soils having widely differing degrees of consolidation.

b. At all points that can be considered to act as anchors.

c. On every branch of a tee and each side of an elbow.

6.0 ANCHOR BOLTS: All rigidly mounted equipment will have a minimum of four anchor bolts securely fastened through bases. Anchor bolts must conform to ASTM A 307. Anchor bolts shall have an embedded straight length equal to at least 12 times the nominal diameter of the bolt and shall conform to the following

table of sizes for various equipment weights.

Maximum Equipment Weight (Pounds)	Minimum Bolt Sizes (Inches)* Zones 4	3	2	1
500	1/2	1/2	1/2	1/2
1,000	1/2	1/2	1/2	1/2
5,000	1/2	1/2	1/2	1/2
10,000	1/2	1/2	1/2	1/2
20,000	1/2	1/2	1/2	1/2
30,000	5/8	5/8	1/2	1/2
50,000	7/8	3/4	1/2	1/2
100,000	1-1/8	1	3/4	1/2

* Based on four bolts per item, a minimum embedment of 12 bolts diameters, a minimum bolt spacing of 16 bolt diameters and a minimum edge distance of 12 bolt diameters. Use equivalent total cross-sectional areas when more than four bolts per item are provided. Anchor bolts that exceed normal depth of equipment foundation piers or pads shall either extend into concrete floor or the foundation shall be increased in depth to accommodate bolt lengths.

When height-to-width ratio of the equipment exceeds 8.9 overturning must be investigated. Expansion anchors shall not be used to resist seismic or vibratory loads unless test data are provided to verify the adequacy of the specific anchor and application. In no case shall the expansion anchor size be less than that required for bolts in the preceding table.

7.0 RESILIENT VIBRATION ISOLATION DEVICES: Selection of anchor bolts for vibration isolation devices and/or snubbers to equipment base and foundations shall follow the same procedure as in paragraph ANCHOR BOLTS except that an equipment weight equal to five times the actual equipment weight shall be used.

7.1 Resilient and Spring-Type Vibration Devices: Vibration isolation devices shall be selected so that the maximum movement of equipment from the static deflection point shall be 0.5 inch.

7.2 Multidirectional Seismic Snubbers: Multidirectional seismic snubbers employing elastomeric pads shall be installed on all floor- or slab-mounted equipment. These snubbers shall provide 0.25 inch free vertical and horizontal movement from the static deflection point. Snubber medium shall consist of multiple pads of cotton duct and neoprene or other suitable materials arranged around a flanged steel trunnion so both horizontal and vertical forces are resisted by the snubber medium.

8.0 EQUIPMENT SWAY BRACING shall be provided for all items supported from overhead floor or roof structures. Braces shall consist of angles, rods, bars, or pipes run at a 45-degree angle from the equipment frame to the building structure secured at both ends with not less than 1/2 inch bolts. Braces shall conform to Table II. Bracing shall be provided in two planes of directions, 90 degrees apart, for each item of equipment. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45 degrees, provided that supporting members are properly sized to support operating weight of equipment when inclined at a 45-degree angle.

9.0 BRACINGS, SUPPORTS AND DETAILS:

9.1 Details: Refer to the attached herein details of sketches for seismic bracings of piping, duct, and equipment, referenced by this specification.

END OF SECTION 15P099

2019-2020 MECHANICAL HVAC UPGRADES to
Flat Rock & Rugby Middle Schools
Henderson County Schools
Hendersonville, North Carolina
DEI Job No. 19005

SECTION 15P002 - SCOPE OF WORK - PLUMBING SYSTEMS

1. RELATED DOCUMENTS:

The provisions of Division 1 and Section 15P001 shall govern this section.

2. GENERAL:

2.0 The facilities and systems of the plumbing work for the project can be described, but not by way of limitation, to be as follows:
1) Provide for the plumbing demolition and disposal of all existing remaining interior building aboveground plumbing and piping systems inclusive of:
General Outline: The facilities and systems of the plumbing work for the project can be described, but not by way of limitation, to be as follows:

a) Provide for the selective plumbing demolition and disposal of all existing interior building aboveground plumbing domestic water piping systems and exterior and interior natural gas piping inclusive of:

- Pressurized overhead domestic water piping, and,
- all designated domestic cold water piping branch with new line sized all-bronze ball valves , and,
- all new extensions of natural gas piping, and,

b) Provide all designated new plumbing natural gas piping extensions and new replacement water piping systems installations with all replacement aboveground, portions of:

- new replacement domestic cold water piping and new extended interior and exterior natural gas piping, and
- natural gas piping to new rooftop mechanical HVAC equipment systems with new natural gas pressure regulators for each natural gas connected pieces of equipment, and all roof piping supports, and,
- new one-piece 3/4' piping insulation of closed cell type flexible pipe insulation or 3/4" one-piece fiberous glass piping insulation with ASJ type reinforced self-sealing type exterior jacket for all new replaced overhead domestic cold water piping & valves.

3) Provide all new replacements connections of domestic water to existing overhead piping and new all-bronze ball shut-off valves connected to all remaining and re-used existing above floor domestic water piping.

4) Providing all materials and labor complete for all items (1) thru (3) above.

5) Providing all piping insulation materials and labor for items (2) and (3) interior domestic cold water piping systems listed above.

2.1 This specification serves to supplement Divisions and Sections listed in "Related Documents" above and to describe the materials and installation procedures to be followed for furnishing and installing the Plumbing as outlined and described by the descriptive contract drawings provided to the Contractor and as noted in this part of the specification, for the Contract. Where any discrepancy or conflict occurs in this section with the referenced "Related Document," the "Related Documents" shall govern.

2.2 Where the word Contractor appears in these specifications, it applies to the Div-15P Plumbing Contractor performing the Div-15P Plumbing portion of the work.

2.3 The Contractor shall install multiple systems as may be specified herein and/or stipulated on the

drawings and furnish all labor, material, tools, scaffolds, erection equipment, services, and other items of expense as specified as a part of this Contract. It further includes placing the systems into operation and proper balance and adjustment on all items of equipment as approved by the Architects-Engineers.

2.4 The installation shall conform to all codes, laws, and requirements in force at the jobsite, and the Contractor at his expense shall obtain all licenses and inspection certificates required.

2.5 IN THE EVENT ADDITIONAL DRAWINGS OR SPECIFICATIONS ARE FURNISHED, SUCH DRAWINGS SHALL BE OF EQUAL FORCE WITH THOSE FIRST FURNISHED WITH THESE SPECIFICATIONS.

2.6 The Contractor shall give his personal superintendence and direction to the work and maintain and supply complete supervision over all subcontractors that may be employed by him. He shall be held responsible for all legal violations, and shall give the proper authorities all notices required by law, paying at his expense all proper legal fees and charges. He shall hold the Owner harmless for any damage or expense arising from the fulfillment of the Contract and at the completion of the work he shall repair at his expense all damages done. He shall be removed from the premises all rubbish and waste materials resulting from his work.

2.7 This specification shall apply to any Contract or subcontract that the Contractor may enter into for the supplying of equipment, materials, or construction for various parts of the work as shown on the drawings or specified herein, and it shall hereby be understood that the Contractor shall inform all sub-contractors of same requirements.

2.8 The Contractor shall receive and unload all equipment and material furnished by and to him. He shall further be responsible for the equipment and material from the standpoint of moving in and out of storage to the point of usage.

3. CODES AND STANDARDS

3.1 Various nationally recognized codes and standards shall be referred to by their abbreviated names as listed below. Reference to these standards shall be understood to mean the latest published edition:

AGA	- American Gas Association
AGMA	- The American Gear Manufacturer's Association
AIA	- American Institute of Architects
AMCA	- Air Moving and Conditioning Association
ANSI	- American National Standards Institute
ASHRAE	- American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	- American Society of Mechanical Engineers
ASTM	- American Society of Testing and Materials
FIA	- Factory Insurance Association
FM	- Factory Mutual
HEPA	- High Efficiency Particulate Air - Clean Room Specification Federal Standard 209
NEMA	- National Electrical Manufacturers Association
NFPA	- National Fire Protection Association
SMACNA	- Sheet Metal & Air Conditioning Contractors National Association
SSPC	- Steel Structures Painting Council

UL - Underwriters' Laboratories

4. MATERIALS:

4.1 The Contractor shall furnish (except Owner furnished equipment) and install all items of equipment an materials as shown on the drawings, and/or specified, and/or as required to complete the work in a complete acceptable manner. NOTE: BASE BID shall be based on PVC pressure piping which shall be Schedule-80 only as specified to be used for replacement Domestic Water Piping Mains for overhead piping shown on the Flat Rock project documents, unless written approval is obtained from the Owner and the Engineers for any other pressure rated piping that the Contractor may want to be submitted as an alternate piping material for replacement scope of work. BASE BID shall be based on Schedule-80 PVC Pressure Pipe & fittings.

4.2 For equipment specified to the Contractor, the major equipment and materials have been shown on the drawings and/or specified by manufacturer and model number in order to establish quality, performance, and physical limitations. This does not limit the Contractor to the specific manufacturers notes; however, any equipment or materials proposed shall be equal in quality, performance, arrangement, and space requirements to that specified. All equipment and materials shall be submitted for approval to the Architects- Engineers, before purchase or use.

4.3 All equipment and materials shall be new and of the quality noted or specified. All equipment and materials of inferior quality shall be rejected. Rejected equipment and materials shall be removed from the job site and immediately replaced.

4.4 The Architects-Engineers will decide upon the quality of equipment and materials furnished and also upon all questions arising from the specifications and plans.

4.5 The Contractor shall pay all royalties and license fees, and shall defend all suits or claims for infringement of any patent rights on account of the use of any patented invention, process, article, or appliance, and save the Owner harmless from loss on account thereof, except that the Owner shall be responsible for all such loss when a particular process or product of a particular manufacturer or manufacturers is specified herein; but if the Contractor has information that the process or article specified is an infringement of a patent he shall be responsible for such loss unless he promptly gives such information to the Architects-Engineers.

4.6 No deviations shall be allowed except for very special reasons, which reasons shall be submitted in writing to the Architects-Engineers, and written approval must be obtained before such deviations are made. Such deviations shall in no way be a cause for delay in completion of the project.

5. INSTALLATION RESPONSIBILITY, WORKMANSHIP, AND EMPLOYEES

5.1 The Contractor is responsible for the proper and acceptable installation of all equipment and materials he furnishes and all equipment and materials furnished to him by the Owner.

5.2 The Contractor shall coordinate the installation of all the above equipment and materials with other Contractors and workers employed by the Owner, i.e., the General Contractor, Electrical Contractor, Piping Contractor, Owner's personnel, etc. All work shall be completed within the contractual allocated time. The Contractor shall keep up with the work by other Contractors and workers employed by the Owner. The Contractor shall report any foreseeable delays in the completion of his work to the Owner as soon as the delay is recognized by the Contractor.

5.3 Any questions arising over work, equipment, and materials furnished by other contractors or the Owner that is necessary for proper installation and operation of the Plumbing equipment, shall be referred to the Owner for determination of responsibility and correction.

5.4 The Contractor's workmen shall be skilled in the work to which they are assigned and all work shall be performed under the direct supervision of an experienced and competent foreman.

5.5 Before commencing work on this project, the Contractor shall verify in writing over his signature to the Owner that his project manager, superintendents, foremen, and others of his personnel responsible for this project have read these specifications, reviewed the drawings and understand what is required for proper completion of the systems.

5.6 The Contractor shall keep sufficient workmen on the work at all times, and shall enforce strict discipline and good order among his employees.

5.7 The Contractor shall not employ on the work any person, in any capacity, who may be unskilled in or incompetent for his position, intemperate, disorderly, or otherwise objectionable. The Contractor, if requested in writing by the Architects-Engineers or Owner, shall dismiss any such objectionable persons from the work.

5.8 All work, including piping, shall be constructed true to lines and surfaces indicated in a neat, substantial, and workmanlike manner and in such a way as to properly serve the purpose intended. Equipment shall be plumb and level. All members and parts, upon installation, shall be properly framed, secured together and anchored in place.

5.9 The Contractor shall visit the job site, obtain measurements required and make shop drawings of all items he intends to fabricate and/or install as part of the Plumbing systems inclusive of all piping systems. These drawings shall be submitted to the Architects-Engineers for approval and/or corrections and comments before actual fabrication and erection of piping, and related accessories.

5.10 The Contractor shall provide the Architects-Engineers with prints of Record Drawings if there are deviations from the Contract Drawings.

6. OTHER CONTRACTS AFFECTING THIS WORK:

6.1 Some electrical work allied with this part of the specifications shall be performed under a separate contract such as power wiring and devices, and power controls, except as indicated on the drawings for controls.

6.2 All service piping work associated with this part of the specifications shall be performed under this contract.

6.3 The instrumentation and control work allied with this part of the specifications shall be performed under this contract.

6.4 Insulation work pertaining to service piping shall be performed under this contract.

6.5 The building work such as equipment room, pads, curbs, wall opening, and roof openings, will be performed under general contract, unless noted otherwise on drawings, but requirements shall be set by

the Contractors for all work.

7. CERTIFIED DRAWINGS:

7.1 The Contractor shall submit six (6) copies of certified equipment drawings and data that clearly indicate but not necessarily be limited to the following minimum information:

A. Owner Data:
1) Owner's (project) (plant) (name) and address.
2) Owner's (purchase) (and) (requisition) number or code, as may be applicable.
3) Owner's (equipment) (system) (and) (are) number or code.

B. Architects-Engineers Data:
1) Name and Address.
2) Project name and job number.

C. Contractor's name, address, project number or code, purchase order number, and certification that the Contractor has reviewed the drawings and data before submitting them for approval.

D. Manufacturer's Data.

1) Manufacturer's name, address, and project number or code.
2) Manufacturer's model, shop, and serial number.
3) Performance specification, limitations (including) (curves), (charts) (and) computer printout of projected performance).
4) Physical arrangement, dimensions, weights, foundation, and support requirements.
5) Utility requirements.
6) Statement of compliance with all federal, state, and local statutory requirements in force at time of submittal of drawings and data.
7) Certification of UL, FIA, FM, NEMA, ARI, AGA, AMCA, etc., as designated on the drawings, in the equipment schedules or elsewhere in this specification.
8) Clearly stated description of what the manufacturer is including with the equipment he is furnishing for this project.
9) Installation, operation and maintenance, drawings, manuals, and schedules.
10) Recommended spare parts list with replacement prices currently in effect.
11) Clearly defined warranty statement.

8.0 WORK UNDER CONTRACT FOR ALL SYSTEMS:

8.1 It is not the intent of this section of the specification to give explicitly every detail as to the requirements of all work intended relative to each above mentioned system description. Rather, the combined interpretation of the entire set of specifications and contract drawings should explain the necessary new work requirements for the systems described.

END OF SECTION 15P002

2019-2020 MECHANICAL HVAC UPGRADES to
Flat Rock & Rugby Middle Schools
Henderson County Schools
Hendersonville, North Carolina
DEI Job No. 19005

SECTION 15P001- PLUMBING GENERAL PROVISIONS

1. PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

The provisions of Division 1 shall govern this section.

1.1.1 MECHANICAL, PLUMBING AND PROJECT MANAGER AFFIDAVIT: *

PLUMBING AND MECHANICAL SUPERINTENDENT(S) AND THE PROJECT MANAGER ARE REQUIRED TO SUBMIT A SIGNED AFFIDAVIT INDICATING THAT EACH PERSON HAS READ THESE MECHANICAL AND PLUMBING SPECIFICATIONS IN THEIR ENTIRETY WITH THE DRAWINGS PRIOR TO CONSTRUCTION.

1.2 DESCRIPTION OF WORK/FIELD CHECKING:

1.2.1 General: This section specifies several categories of provisions for plumbing work, including: 1) Certain adaptive expansions of requirements specified in Division 1, as uniquely applicable to plumbing work, 2) general performance requirements within the plumbing work as a whole, 3) general work to be performed as plumbing work, because of its close association with plumbing work and 4) complete installation of plumbing work inclusive of providing all materials and labor for complete workable plumbing systems. NOTE: BASE BID shall be based on PVC pressure piping which shall be Schedule-80 only as specified to be used for replacement Domestic Water Piping Mains for overhead piping shown on the Flat Rock project documents, unless written approval is obtained from the Owner and the Engineers for any other pressure rated piping that the Contractor may want to be submitted as an alternate piping material for replacement scope of work. BASE BID shall be based on Schedule-80 PVC Pressure Pipe & fittings.

1.3 SUMMARY OF PLUMBING WORK:

1.3.1 Drawings/Field Checking/RFI Process: Refer to all drawings for graphic representations, equipment schedules and notations showing plumbing work and associated work relative to plumbing work. All piping systems shown are a graphic representation of the intended sizes and general routing, but all should be field verified by the Contractor for final physical routing before any fabrications. Under all circumstances the Contractor shall exercise extra precautionary means & methods to check for all available space(s), to accommodate all materials, all equipment, and all pipe. At all times the Contractor shall read all the Contract Documents first, and then field-verify all actual final sizes, and actual physical spaces for all equipment (with Code required clearances); this shall include but not be limited, to all overhead routing(s), before he acquires or purchases any equipment, any fabrication of piping or material.

RFI Process: If any conflicts or needed changes of sizes in specified or unspecified equipment or materials, or the need for any clarifications occur, the Contractor shall contact the General Superintendent of Construction (by original copy) through the numbered "RFI Process" ("Request for Instructions") for answers & clarifications. The Contractor shall request that the General Superintendent forward such numbered RFI Request(s) to both the Architect and Engineer (A/E) for their information, knowledge, and record, and as that such issue(s) being not resolved between the General Superintendent, does pose the need for A/E resolution. All such requests shall be numbered sequentially by a written "RFI" ("Request for Instructions") to request clarifications and/or resolution(s) within this trade & between other trades. Under all circumstances, this RFI Process shall always be used for any and all conditions of clarification & resolution, and/or, to discuss by written record the requests for such conditions and alternatives in order to render a satisfactory resolution acceptable to the A/E. In the case for A/E resolution, both the A/E and

Contractor shall be mutually made aware of such agreement of the resolution and/or answers to the RFI.. Upon such RFI Process of resolution, the RFI initiated changes as a result of the RFI process shall govern and shall be recorded and processed in written form of confirmation by the Contractor with complete copy given to the A/E.

UNDER NO CIRCUMSTANCES SHALL A "CONTRACTOR INITIATED CHANGE" (which shall mean the Contractor took it upon himself to change with or without the coordination of the General Superintendent) TO THE INTENTIONS OF THE CONTRACT DOCUMENTS BECOME BINDING AS FOR A FORMAL "CHANGE ORDER REQUEST" OR PURPOSE OF SUCH A REQUEST. THIS SHALL MEAN THROUGH THE LIFE OF THE CONSTRUCTION CONTRACT TO THE END OF ACCEPTABLE WORK BY BOTH THE A/E AND THE OWNER OF THE FACILITY.

1.3.2 Specifications and drawings: Refer to all sections of Division 15P for the primary technical specifications and the drawings of all plumbing work.

1.3.3 General Outline: The facilities and systems of the plumbing work for the project can be described, but not by way of limitation, to be as follows:

1) Provide for the selective plumbing demolition and disposal of all existing interior building aboveground plumbing domestic water piping systems and exterior and interior natural gas piping inclusive of:
   - Pressurized overhead domestic water piping, and,
   - all designated domestic cold water piping branch with new line sized all-bronze ball valves , and,
   - all new extensions of natural gas piping, and,

2) Provide all designated new plumbing natural gas piping extensions and new replacement water piping systems installations with all replacement aboveground, portions of:
   - new replacement domestic cold water piping and new extended interior and exterior natural gas piping, and
   - natural gas piping to new rooftop mechanical HVAC equipment systems with new natural gas pressure regulators for each natural gas connected pieces of equipment, and all roof piping supports, and,
   - new one-piece 3/4' piping insulation of closed cell type flexible pipe insulation or 3/4" one-piece fiberous glass piping insulation with ASJ type reinforced self-sealing type exterior jacket for all new replaced overhead domestic cold water piping & valves.

3) Provide all new replacements connections of domestic water to existing overhead piping and new all-bronze ball shut-off valves connected to all remaining and re-used existing above floor domestic water piping.

4) Providing all materials and labor complete for all items (1) thru (3) above.

5) Providing all piping insulation materials and labor for items (2) and (3) interior domestic cold water piping systems listed above.

1.4 COORDINATION AND INSTALLATION OF PLUMBING WORK:

1.4.1 General: Refer to the Division 1 sections for general coordination requirements applicable to the entire work. It is recognized that the Contract Documents are diagrammatic in showing certain physical relationships which must be established within the plumbing work, and in its interface with other work including utilities and electrical work, and that such establishment is the exclusive responsibility of the Div-15P plumbing Contractor. The Contractor shall verify all clearances, dimensions and sizes of piping and

equipment with the Contract Documents before fabrication of any materials or work to be performed.

Arrange all plumbing work in a neat, well organized manner with layout and installation of piping and similar services running parallel with primary lines of the building construction.

Give right-of-way to piping which must slope for drainage.

ADVISE OTHER TRADES OF OPENINGS REQUIRED IN THEIR WORK FOR THE SUBSEQUENT MOVE- IN OF ALL PLUMBING WORK (EQUIPMENT, PANELS, VALVES, ETC.).

1.4.2 COORDINATION OF WORK AND COORDINATION DRAWINGS BEFORE ORDERING * MATERIAL, OR FABRICATION: FOR LOCATIONS WHERE ANY ELEMENT OR ELEMENTS OF PLUMBING (OR COMBINED PLUMBING AND MECHANICAL OR ELECTRICAL) EQUIPMENT OR WORK MUST BE COORDINATED, VERIFIED, SEQUENCED AND POSITIONED WITH PRECISION IN ORDER TO FIT INTO THE AVAILABLE SPACE, PREPARE DIMENSIONS (AT ACCURATE SCALE) AS MAY BE REQUIRED FOR THE INSTALLATION. PREPARE AND SUBMIT COORDINATION DRAWINGS PRIOR TO PURCHASE-FABRICATION- INSTALLATION OF ANY OF THE ELEMENTS INVOLVED IN THE COORDINATION. ANY DEVIATIONS FROM THE LAYOUT CONTRACT DRAWINGS SHALL BE THE RESPONSIBILITY OF THE INSTALLING CONTRACTOR.

1.4.3 Contractor's Work, Performance and Responsibility Indemnification:

The Contractor shall install systems as designed and setforth by the Contract Documents and Specifications and the design concept intended by the Documents. The Contractor shall be responsible for all dimensions which shall be confirmed and correlated at the jobsite, fabrication processes and techniques of construction, coordination of his work with that of all other trades, and the satisfactory performance of his work.

The Engineer shall not be responsible for any acts or omissions of any contractor, or sub-contractor or any of the contractor(s) or sub- contractors' agents, employees or any other persons.

The Contractor and/or all sub-contractors shall indemnify and hold harmless the Owner, Architect and Engineers, and any of their agents, servants, and employees, from any and all losses, expenses, damages demands, and claims asserted against or sustained by the Owner and/or Architect and/or Engineers, their agents, servants, and employees as the result of or alleged to be the result of any acts or the negligent acts or omissions of the Contractor and/or sub-contractor, their agents and/or employees (including any costs incurred by the Owner, and/or Architect and/or Engineers' for correction of contractors work); and to pay all damages, costs, and expenses, including attorneys' fees, in connection therewith or resulting there from.

1.4.4 Div-15P Plumbing/Mechanical Coordinator: The Div-15P Plumbing Contractor shall provide a full-time Project Manager Coordinator with not less than 10 years of supervisory experience in the installation of plumbing/mechanical work similar to that of this project.

1.5 QUALITY, ASSURANCE, STANDARDS, CODES AND SYMBOLS:

1.5.1 General: Refer to Division 1 sections for general administrative/procedural requirements related to compliance with codes and standards. Specifically, for the plumbing work (in addition to standards specified in individual work sections), the following standards are imposed, as applicable to the work in each instance, (with all latest revisions and amendments up to and including all time of work during construction of project):

IBC 2006 Plumbing Code (Plumbing Code)
IBC 2006 Building Code & Energy Code
IBC 2006 Fuel Gas Code and the 2003 IPC Code
NFPA 54 National Fuel & Gas Code
NFPA Fire Protection and Life Safety Code
All Local Governing Codes and Requirements by Local Code Officials

Where any discrepancies or differences occur between codes, the code which is most stringent shall govern. All interpretations of the codes shall be by the governing code official; if no code official is governing, the final interpretation of the code will be by the Architect/Engineer.

1.5.2 PERMITS AND FEES:

Division 15P Contractor shall provide all costs for his work to secure and pay permits & fees for all costs related to and necessary for the proper execution and completion of all work, as is applicable at the time the bids are received. Division 15P Contractor shall provide all costs for his work to secure and pay for all costs related to sewer taps, water taps, gas taps, and other related costs necessary for the proper execution and completion of the work, which are applicable at the time the bids are received.

1.5.3 Symbols: Except as otherwise indicated, refer to the "National Plumbing Code" for definitions of symbols used on the drawings to show plumbing work.

1.6 SUBMITTALS:

1.6.1 General: Refer to Division 1 sections for general requirements concerning work-related submittals (refer to other Division 1 sections for administrative submittals).

1.6.2 Architects/Engineers Stamping of Shop Drawings: Each submittal shall bear the following Shop * Drawing Stamp to constitute review by the Engineer. NO ITEM REQUIRING SUBMITTAL SHALL BE FABRICATED, PROVIDED, OR INSTALLED UNLESS SUBMITTAL BEARS THIS STAMPING AND IS COMPLETED AS SET FORTH BY MARKING AND DATE.

☐ NO EXCEPTION TAKEN	☐ MAKE CORRECTIONS NOTED
☐ REJECTED	☐ REVISE AND RESUBMIT

☐ SUBMIT SPECIFIED ITEM

☐ _____

Checking is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any action shown is subject to the requirements of the plans and specifications. Contractor is responsible for: dimensions, which shall be confirmed and correlated at the job site; fabrication processes and techniques of construction; coordination of his work with that of all other trades; and the satisfactory performance of his work.

Date _____ By _____

(THE ABOVE IS A-E SHOP DRAWING STAMP PROVIDED BY A-E; NOT CONTRACTOR)

1.6.3 Shop Drawings: Refer to General Provisions Division 1 for number of Drawings and Submittal Procedures.

1.6.4 Product Data: Refer to General Provisions Division 1 for Submittal Procedures. Data shall include the following:

Valves, Piping, Piping Insulation, Hangars & accessories
Domestic Water All-Bronze Ball Valves
Pressure Reducing Valves (ALL-water and Gas)
Pipe for all Water & Gas Services

1.6.5 Samples: Refer to General Provisions Division 1

1.6.6 Warranties (Guarantees): Warranty shall be standard one year parts and labor for plumbing equipment and systems. Refer to General Provisions Division 1

1.6.7 Maintenance Manuals: 3 complete sets with individual sets of this data bound in a * 10-1/2 x 11-1/2 inch loose-leaf 3-ring binders, 1-1/2", 2" or 3" ring size, with rigid permanent vinyl covered back and front. Separators with index tabs and loose-leaf sheet protectors shall be provided. One set shall have all sheets individually encased in clear plastic document protectors.

Each set shall include the following data:

Valve Directory indicating valve number, size, manufacturer, location, function, and normal position.

Plumbing Fixture and Equipment: Show the following information for all plumbing service & equipment:

Nameplate designation
Manufacturer's nameplate date
Location of equipment
Area served
Complete parts drawing and list
Manufacturer's operating instructions
Manufacturer's maintenance instructions
Manufacturer's installation instructions
Nearest supplier for parts and replacements with telephone number
Nearest service organization for equipment with telephone number
Control diagrams and wiring diagrams where applicable

Maintenance Instructions: A typewritten form of instructions for maintenance of the systems, in itemized form and with time schedule for maintenance work, shall be furnished. The instructions shall list each item of plumbing equipment requiring inspection, lubrication or service and describe the performance of such maintenance. The list shall include the type of seals, bearings, etc. for each piece of equipment or fixture, the type of and frequency of service and/or lubrication required. The operating personnel shall be instructed in the care of the system in accordance with the typewritten instructions.

1.7 PRODUCTS, PLUMBING WORK: *

1.7.1 General: Refer to Division 1 sections for general requirements on products materials, and equipment. The following provisions expand or modify the requirements as applicable to plumbing work. *

1.7.1.1 PRE-BID PRIOR APPROVAL REQUIREMENTS: THE REQUIREMENTS OF DIVISION 1 SHALL* GOVERN THIS PARAGRAPH AND SHALL REQUIRE THE MINIMUM AS FOLLOWS:

- ANY PRODUCT OR MATERIAL IN THE DIV. 15P DRAWINGS AND/OR SPECIFICATIONS THAT ARE LISTED OR NOT LISTED, AS "*EQUAL*", OR "*APPROVED EQUAL*", SHALL REQUIRE THE CONTRACTOR TO OBTAIN "*PRE-BID PRIOR APPROVAL*" FROM THE ENGINEERS FOR ANY CONTRACTOR SUBSTITUTED PRODUCT OR MATERIAL DEEMED BY THE CONTRACTOR AS "*AN EQUAL*" TO THAT SHOWN. NO CONTRACTOR ONLY PRE-APPROVED PRODUCT OR MATERIAL WILL BE ACCEPTED.
- REQUEST FOR "*PRE-BID PRIOR APPROVAL*" IS THE RESPONSIBILITY OF THE BIDDING CONTRACTOR(S) AND VENDORS, AND/OR SUPPLIERS. THIS REQUEST SHALL BE SENT IN WRITING ON DATED LETTERHEAD TO THE ENGINEER NO LATER THAN FOURTEEN (14) CALENDAR DAYS PRIOR TO BID DATE.
- EACH WRITTEN "*REQUEST FOR PRIOR APPROVAL*" SHALL HAVE ATTACHED WITH IT THE SUBMITTAL DRAWING DATA, CUT SHEETS, DIMENSIONAL DATA, PERFORMANCE AND CONSTRUCTION SPECIFICATIONS INDICATING THE ITEM REQUESTED FOR "*PRE-BID PRIOR APPROVAL*." INFORMATION SHALL BE CLEARLY MARKED WITH EITHER "RED" ARROW OR HIGHLIGHTED WITH "YELLOW" TRANSPARENT MARKING TO INDICATE THE SPECIFIC SIZE, TYPE, ETC. IF THE SUBMITTAL DATA IS NOT PROPERLY MARKED AS INDICATED ABOVE, THE ENGINEER SHALL RESERVE THE RIGHT TO REJECT THE REQUEST FOR PRIOR APPROVAL. REJECTED REQUESTS WILL BE FINAL AND BINDING.

1.7.1.2 PRODUCT LISTINGS AND SUBSTITUTE PRODUCT APPROVALS: *

1.7.1.2.1 Product Listings (By Prime-Contractor): The successful Prime-Contractor with his subcontractor(s) shall prepare and submit to the Architect-Engineer a product listing for plumbing work, separately from the listing(s) of products for other work. Include all specified and pre-bid prior approved

products listing each significant item of equipment, fixtures, and material used in the work; and indicate the generic name, product name, manufacturer, model number, related specification section number(s), and estimated date for start of installation. Bulk materials, including pipe and fixtures, taken from Installer's stock, need not be listed.

1.7.1.2.2 Substitute Products: Where one, or more than one, manufacturer is listed within the specifications, or listed by the clause "Approved Equal", or items which have been Pre-Bid Prior Approved by the Architect-Engineer, and the Contractor desires to list such item as a substitute for approval as an equal to that specified, then the Contractor shall furnish adequate product listing data along with shop drawing sketches, as necessary, that will demonstrate that the substitute item is equal in all respects to the specified item and that the substitute item will dimensionally fit into the space or system as designed and is compatible with other components specified. Substitute item approval shall be the responsibility of the Architect-Engineer.

1.7.1.2.3 THE ABOVE "INTENDED PRODUCT LISTING" SHALL BE SUBMITTED TO THE ARCHITECT-ENGINEER WITHIN, BUT NOT MORE THAN 30 CALENDAR DAYS AFTER CONTRACT AWARD FOR NOTICE TO PROCEED HAS BEEN GIVEN TO THE SUCCESSFUL PRIME CONTRACTOR. ARCHITECT-ENGINEER APPROVED PRE-BID ITEMS WILL NOT BE APPROVED ON CONTRACTOR SUBSTITUTE SUBMITTALS IF NOT LISTED ON THIS "INTENDED PRODUCT LISTING" SUBMISSION. IF PRODUCTS ARE NOT LISTED ON THIS LISTING IT WILL BE INTERPRETED BY THE ARCHITECT-ENGINEER THAT THE CONTRACTOR WILL PROVIDE THE ITEMS SPECIFIED BY THE ARCHITECT- ENGINEER ON THE CONTRACT DOCUMENTS.

SHOULD THE ABOVE "INTENDED PRODUCT LISTING" SUBMISSION NOT BE RECEIVED, POSTMARKED WITHIN THE ABOVE 30 CALENDAR DAYS IT SHALL BE UNDERSTOOD THAT THE CONTRACTOR INTENDS TO PROVIDE THE MATERIAL AND/OR EQUIPMENT AS SPECIFIED BY THE CONTRACT DOCUMENTS.

1.7.1.2.4 THE ABOVE "SUBSTITUTE PRODUCTS" SUBMITTED BY THE CONTRACTOR FOR APPROVAL SHALL BE SUBMITTED UNDER REQUIREMENTS OF SHOP DRAWING SUBMITTALS PROVIDING THAT SUCH SUBSTITUTE PRODUCTS HAVE BEEN PREVIOUSLY LISTED AND SUBMITTED ON THE "INTENDED PRODUCT LISTING" SUBMITTAL ABOVE.

1.7.2 Compatibility: Provide products that are compatible with other products of the plumbing work, and with other work requiring interface with the plumbing work. Coordinate the selections from among options (if any) for compatibility of products.

2. PARTS 2 AND 3 - PRODUCTS AND EXECUTION

2.1 ELECTRICAL PROVISIONS OF PLUMBING WORK:

2.1.1 WIRING:
ALL WIRING SHALL BE IN CONDUIT, SHALL CONFORM WITH DIVISION 16 OF THESE SPECIFICATIONS, ALL LOCAL CODES, THE NATIONAL ELECTRICAL CODE AND SHALL BE INSTALLED BY AN APPROVED LICENSED ELECTRICAL CONTRACTOR. WIRING DIAGRAMS INDICATING WIRE SIZES AND CONDUIT RUNS FOR ALL ELECTRICAL WORK THAT IS REQUIRED TO BE INSTALLED UNDER THIS CONTRACT SHALL BE SUBMITTED TO THE ENGINEER FOR PRIOR APPROVAL BEFORE WORK IS BEGUN. UPON COMPLETION OF THE WORK, THE WIRING DIAGRAMS SHALL BE REVISED TO INCORPORATE ANY ADDITIONS OR CORRECTIONS AND TWO COPIES OF THE "AS INSTALLED" DIAGRAMS SHALL BE FURNISHED TO THE OWNER AND ONE TO THE ENGINEER.

2.1.2 STARTERS AND DISCONNECTS:

Any starters and disconnects for plumbing equipment that is not furnished integral with the plumbing equipment shall be furnished and installed by the Electrical under Division 16. Devices furnished under Electrical Division shall be as specified under Division 16. Plumbing equipment provided under this Division 15P with these devices integral to the equipment shall also meet all the requirements of Division 16, and shall minimally be heavy-duty, non-fused type "S" with NEMA Class 1 or NEMA Class 4 enclosures. Switches shall be as manufactured by "G.E.", "General Electric", "Allen-Bradley," "Square D," "Cutler-Hamer," "ITT" or approved equal.

2.1.3 EACH ELECTRICAL AND/OR CONTROLS ENCLOSURE:

Each enclosure for electrical and/or control devices not mounted in control cabinets, such as magnetic starters, contactors, junction boxes, manual switches, etc., shall have a phenolic strip to indicate the device or circuit which it protects. The lettering on the strips shall be white-filled engraved; the strip shall be of black finish, the letters in white and 3/16" in height; the use of manufactured nameplates that meet this specification are acceptable.

All contactors, disconnects, and panels, etc., shall be supported on suitable angle iron racks or stands securely anchored to the floor or wall construction but shall not be attached to any equipment without Engineer's approval. No steel shall be in direct contact with the floor, but shall be supported on concrete pads at least 4" high.

2.2 FOUNDATIONS AND MISCELLANEOUS STEEL SUPPORTS:

2.2.1 Foundations: All concrete foundations anchor forms, or pads indicated on the drawings that may be necessary and required for the installation of equipment specified under this contract, shall be furnished and installed. Provide anchor bolts for the equipment foundations/pads.

2.2.2 Miscellaneous Steel Supports: All supporting steel grillage, steel angles, channels, pipe or structural steel stands, and anchoring devices that may be required to adequately and rigidly support either piping, insulation, or equipment installed under this contract, shall be provided and installed by this Division 15P.

2.3 VALVES, CHASES, OPENINGS, SLEEVES, FIRESTOPPING:

2.3.1 General:

Provide individual wall access panels with water shut-off service valves in each branch of cold water and hot water piping serving each toilet room, break room at each floor to permit shut-off and isolation of each toilet group, or room served by the separate branch lines. Lay out all chases and openings required for the execution of this work well in advance of the structural work. Provide pipe sleeves, thimbles in walls and partitions for horizontal pipe, as well as in floors for vertical runs of pipe. Sleeves and thimbles shall be standard weight galvanized steel pipe. All pipe sleeves shall be fire-stopped with a fire-retardant sealant which is Underwriter Laboratory ("U.L.".) No. 1479 tested and approved for use as fire-stopping material, equal to "Dow Corning" - "Firestop" system.

2.4 PLUMBING SYSTEM IDENTIFICATION:

2.4.1 Piping System: All piping installed under this Division of the specifications shall be identified as

follows:

Method of Marking: Colored coded plastic pipe markers by "Seten Name Plate Co." of Style No. "RPM" for pressure sensitive markers or Style No. "PMR" for roll-cut type markers or equal. These shall be provided and installed with letters that designate the material being handled, shall be applied at not more than 40 foot intervals on straight pipe runs, and adjacent to valves and where pipe passes through walls and floors. Piping shall be marked at all the equipment connections, except plumbing fixtures.

Identification: Plastic pipe markers lettering shall be in block letter, size as scheduled below. Letters on covered (insulated) pipe shall be sufficient to wrap over 2/3 of insulated covering. On uncovered pipe, colored bands shall be wide enough (see Table 1) to accommodate required letters. Each pipe marker shall be positioned so that it can be easily read by a man standing on the floor. Pipe Markers on parallel groups of lines shall be neatly lined up. Surfaces of piping or insulation finished in dark colors shall be lettered in white; and that finished in light colors shall be lettered in black. Colors used for pipe service identified shall be standard - ANSI/OSHA specified colors, as listed by "Seton" catalog; (tel. No. 1-800-243-6624). All lines also shall be marked with plastic pipe flow arrows indicating the direction of flow. Letter sizes shall be according to Table 1 as follows:

TABLE 1

Letter Size

Outside Diameter of Pipe or Covering	Minimum Size of Letter
1/2 to 1-1/4	1/2
1-1/2 to 2	3/4
2-1/2 to 6	1-1/4

(All dimensions are given in inches.)

Valve Identification:

Tags: Polished brass tags by "Seton Nameplate Co." Style No. 250-BL, with black-filled letters or equal, shall be provided and installed, with 1/4" high stamped-engraved lettering, different shapes for each generic piping service.

Application: Tag every major valve, cock and control device in each plumbing work piping system; exclude check valves, valves within equipment units, hose bibbs, faucets and shutoff valves of plumbing fixtures.

Valve Schedule: Prepare and submit valve tag schedule (in duplicate), listing each tagged * valve by location, service, and tag description. Install one copy of each page of the valve schedule in glazed frames, and mount where directed.

Equipment:

Signs: Provide engraved plastic-laminate signs at locations of major equipment units, primary control devices, emergency equipment dangerous elements of the plumbing work and similar places. Provide text of sufficient clarity and lettering, of sufficient size to convey adequate information at each location, and mount permanently in an appropriate and effective location. Comply with recognized industry standards for color and design. Signage shall be by "Seton Nameplate Co." Style "EBS," with Gothic letter style, or equal.

Operational Tags: Where needed for proper and adequate information on operation and maintenance of plumbing systems, provide tags of plasticized card stock, either pre-printed or hand printed to convey the message; example: "DO NOT CLOSE THIS VALVE EXCEPT WHEN UNIT IS OFF."

Selection: Refer to instances where either a plastic-laminate sign or plasticized tag might be appropriate, to the Architect/Engineer for resolution.

2.5 ACCESSIBILITY OF EQUIPMENT, DEVICES, VALVES & CONTROLS:

2.5.1 General:

No valves, controls, unions, etc., shall be placed in any pipe line or electrical devices located at a location that will be inaccessible after the system is completed.

2.5.2 Access Doors:

Any controls, valves and piping controls, expansion joints, electrical devices or other apparatus which must be located in an inaccessible location shall be provided with suitable access doors (fitted in a framed hole) which will permit proper operation and servicing of the apparatus, all in accordance with governing codes. Access doors shall be labeled per the requirements of Para. 607.4 in the 2003 IMC.

2.5.3 (Deleted)

2.5.4 GAS PRESSURE REGULATORS/FLOW CONTROLS FOR NATURAL GAS SERVICES:

2.5.4.1 Gas pressure regulators/flow controls for all natural gas service to the building and to terminal service equipment, HVAC equipment, plumbing equipment and appliances shall be provided by Div. 15P Contractor, unless the above equipment and appliances are provided with gas pressure regulators. Div. 15P Contractor shall provide all auxiliary gas vent piping to exterior of building from all gas pressure regulators serving all the above equipment systems except for gas pressure regulators provided with vent limiting devices where permitted by the NFPA 54 and International Fuel Gas Code, Section 410 (FGC). All gas pressure regulators provided and installed by Div. 15P Contractor shall be labeled for utilization with approved integral vent limiting devices in accordance with regulator manufacturer supplied valve. The gas pressure regulator shall be of the vent limiting type unless otherwise noted or unless otherwise prohibited by the code for gas supply pressures exceeding the gas pressure limits for the use of such valve.

2.6 EXCAVATING FOR PLUMBING WORK:

2.6.1 General: The work of this article is defined to include whatever excavating and backfilling (but excluding insulating backfill) is necessary to install the plumbing work. Coordinate the work with other excavating and backfilling in the same area, including dewatering, flood protection provisions, and other temporary facilities. Coordinate the work with other work in the same area, including other underground services (existing and new), landscape development, paving, and floor slabs on grade. Coordinate with weather conditions and provide temporary facilities needed for protection and proper performance of excavating and backfilling.

2.6.2 General Standards: Except as otherwise indicated, comply with the applicable provisions of the sections for plumbing work excavating and backfilling. Refer instances of uncertain applicability to the

Architect/Engineer for resolution before proceeding.

2.6.3 Piping Support: Support pipe 4" and smaller directly on undisturbed soil. Compact previously disturbed and unsatisfactory subsoil to provide adequate, uniform support for work; or excavate and replace with stable subbase material or lean concrete.

2.6.4 Sequencing: Delay backfill of piping until testing of piping system has been completed, and inspection of system by the Architect/Engineer.

2.7 PAINTING PLUMBING WORK:

2.7.1 General: No painting shall be done under this division other than the sizing of the insulation jackets. Piping Color stenciling of piping for identification, and touching up paint that is chipped or scratched from mechanical equipment supplied. Finishes for electric water coolers and any other items exposed to view shall be selected by the Architect.

2.8 CLEANING, TESTING, ADJUSTMENTS AND INSPECTIONS:

2.8.1 General: Cleaning, testing, adjustments and inspections shall be accomplished in accordance with the following instructions and requirements. Provide temporary fill and drainage lines, wherever required, and connect them to the piping systems for these procedures and, finally, upon completion disconnect and remove these temporary lines.

2.8.2 Cleaning and Oiling: All piping systems shall be thoroughly cleaned of grease, iron cuttings, welding slag, loose scale and other refuse. Should any pipe, valves, traps, strainers, and other specialties, and equipment be stopped up by refuse, disconnect, clean and reconnect such pipe, equipment and material. All strainer baskets shall be removed, cleaned and replaced.

Plumbing piping systems shall be filled and flushed with clean water for a period of not less than one hour. Pumps, pressure reducing and/or automatic valves and specialties shall be disconnected, isolated or removed from piping systems during this cleaning period; otherwise, piping systems shall be cleaned in sections before such equipment is installed.

Exterior surfaces of piping, materials, or equipment that is to be painted or insulated shall be cleaned to remove lint, grease and oil.

All components of the plumbing systems shall be cleaned on outside of dust, trash, paint and masonry droppings and left in first-class condition.

2.9 TESTS: *

2.9.1 General and Affidavit Letter of Tests: All tests are to be made in the presence of the Architect/Engineer's field representative. All services tested by the Contractor shall require the Contractor to submit a letter of affidavit that all systems have been tested and proven operable satisfactory to the herein requirements and codes governing such tests. This letter of submission shall be made to the Architect-Engineer not later than ten (10) calendar days prior to

Architect-Engineer's final review of all systems. Final review or approval shall not be given until such letter is received by the Architect-Engineer.

2.9.2 (Deleted)

2.9.3 Domestic Water Lines. After lines are in place and before concealing, all water lines shall be subjected to a hydrostatic pressure of 150 lbs. for a period of at least 6 hours.

Test instruments shall be tested for accuracy by an approved laboratory or by the manufacturer, and certificates showing degree of accuracy shall be furnished to the Engineers.

Accurate records shall be kept of test readings and, at the close of each three-day interval, during test period, test results and field notes shall be carefully, orderly and legibly transcribed and two copies of the results submitted to the Engineers.

Tabulate the final readings and analysis, and deliver four typewritten copies of the completed report to the Engineer. The Contractor shall advise the Engineer in writing not less than 10 days in advance of when final testing will begin.

All labor and technical personnel, instruments and appliances for tests shall be furnished. If gauges, thermometers, etc., which are to be left permanently installed are used for tests, they shall not be installed until just prior to the tests to avoid possible changes in calibration.

Water and electricity will be furnished by the Owner for final operating tests.

2.9.4 Pressure Vessels: All unfired pressure vessels furnished under this division shall be constructed, inspected and stamped in accordance with applicable sections of the ASME Codes. Data shall include inspector's National Board registration number.

2.9.5 Gas Piping/Systems: Tests shall be in accordance with NFC Code No. 54, Part 4 (National Fuel Gas Code) and the 2003 International Fuel Gas Code.

2.10 PLUMBING WORK CLOSEOUT:

2.10.1 General: Refer to the division 1 sections for general closeout requirements. Maintain a daily log of operational data on plumbing equipment and systems through the closeout period; record hours of operation, assigned personnel, consumption and similar information; submit copy to Owner.

2.10.2 RED LINED RECORD DRAWINGS: FOR PLUMBING WORK, GIVE SPECIAL ATTENTION TO THE COMPLETE AND ACCURATE RECORDING OF UNDERGROUND PIPING, OTHER CONCEALED AND NON-ACCESSIBLE WORK, BRANCHING ARRANGEMENT AND VALVE LOCATION FOR PIPING SYSTEMS, SENSORS AND OTHER CONTROL DEVICES, AND WORK OF CHANGE ORDERS WHERE NOT SHOWN ACCURATELY BY CONTRACT DOCUMENTS. RECORD ALL VALVES, ETC., WITH ANY PIPING OR EQUIPMENT DEVIATION WITH RED-LINED PENCIL ONTO ONE (1) BLUEPRINT SET OF THE CONTRACT DOCUMENTS AND PROVIDE ONE (1) SET, NEATLY LETTERED, RECORD SETS OF RED-LINED PRINTS TO THE ARCHITECT-ENGINEER AT THE COMPLETION OF THE PROJECT. THIS WILL SERVE AS "AS-BUILT" RECORD SET FOR THE OWNER AND A-E'S USE.

2.10.3 Closeout Equipment/Systems Operations: Sequence operations properly so that work of project will not be damaged or endangered. Coordinate with seasonal requirements. Operate each item of equipment and each system in a test run of appropriate duration (with the Architect/Engineer present, and with the Owner's operating personnel present), to demonstrate sustained, satisfactory performance. Adjust and correct operations as required for proper performance. Clean and lubricate each system, excessively worn parts and similar expendable items of the work.

2.10.4 Operating Instructions: Conduct a one (1) day walk-through instruction seminar for the Owner's personnel to be involved in the continued operation and maintenance of plumbing equipment and systems. Explain the identification system, operational diagrams, emergency and alarm provisions, sequencing requirements, seasonal provision, security, safety, efficiency and similar features of the systems.

2.10.5 Turn-Over of Operation: At the time of substantial completion, turn over the prime responsibility for operation of the plumbing equipment and systems to the Owner's operating personnel.

2.10.6 Owner or Others Furnished Equipment. The Contractor shall become totally familiar with all equipment items furnished by the Owner or others affecting his work requirements for installing and connecting to same said equipment. For additional data and information pertaining to Owner or others furnished equipment and requirements necessary for installing and connecting said equipment, see the Contract Drawings and shop drawings of Owner's or others equipment.

2.11 SUBMITTAL DATA SUMMARY:

THE CONTRACTOR SHALL SUBMIT TO THE A/E ALL DATA, TESTS, BOOKLETS, INSTRUCTIONS, ETC., AS PREVIOUSLY OUTLINED HEREIN BEFORE ARCHITECT/ENGINEER'S FINAL ACCEPTANCE OF THE PROJECT IS COMPLETE. ALL DATA SHALL BE IN ACCORDANCE WITH THE SPECIFIC REQUIREMENTS OUTLINED HEREIN. THE FOLLOWING IS A SUMMARY OF EACH FOR CONTRACTOR REFERENCE, AND SHALL SERVE AS A CHECKLIST FOR THE A/E:

*SUBMITTAL DATA

(An asterisk (*) indicates submittal paragraphs in text.)

Referenced Paragraph No./ Section No., Etc.	Description	Date Submitted By Contractor To AE (AE use only)
1.1.1	Plumbing Project Manager Affidavit	
1.4.2	Coordination Drawings (If Applicable)	
1.6.2	Submittals-Shop Drawings	
1.6.7	Maintenance Manuals	
1.7.1	General	
1.7.1.1	Pre-Bid Prior Approval Requirement	
1.7.1.2	Product Listing/Substitute Product Approvals	
2.1.1	Wiring (If Applicable)	
2.4.1	Valve Schedule	
2.9	Tests with Affidavit Letters of Each	
2.10.2	Red-Lined Record Drawings	
Section 15P180	(Para. 1.2.5) Prior Written Approvals of Insulating Contractor	

END OF SECTION 15P001

SECTION 16E020 — DEMOLITION

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division 16 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

A. The extent of demolition work shall be in general, but not limited to, removal of existing power cable and conduit to all removed equipment at each fan coil unit designated for demolition and minor electrical panel modification. Alternate bid items may include:

    1. The removal of electrical lighting fixtures located in the dropped ceiling as designated in the drawings.
    2. The modification of electrical panels and disconnects associated with the Icehouse chiller.

B. Demolition includes removal and disposal of demolished materials.

1.3 JOB CONDITIONS

A. Occupancy: Building will not be occupied and in operation during work. If the building must be occupied, a phased demolition and installation schedule will be developed between the Mechanical Contractor, Owner/Client, and the Designer of Record.

B. Condition of existing systems: The Owner assumes no responsibility for actual condition of items to be demolished. Conditions existing at time of inspection for bidding purposes will be maintained by Owner insofar as practicable.

C. Protection: Ensure safe passage of persons in and around areas of demolition. Conduct operations to prevent injury to building, structure, other facilities and persons.

D. Damages: Promptly repair damages caused to facilities by demolition operations at no cost to Owner.

E. Utility Services: Maintain existing utilities, keep in service and protect against damage during demolition operations.

PART 2 - PRODUCTS
NOT USED

PART 3 - EXECUTION

3.1 DEMOLITION

A. Demolition: Demolition of all parts to be removed shall be done in a safe, orderly fashion, taking care to avoid damage to parts which are to be left in place. All debris shall be removed from the

premises as it is generated and shall not be allowed to accumulate. In the event the Contractor has any questions regarding items to be removed, the Contractor is to ask the Engineer.

B. Disposal of Demolished Materials:

1. Contractor shall investigate all existing circuits on equipment and/or walls to be removed and shall remove any electrical equipment associated with items to be removed. In general, equipment conduit and cable shall be removed back to panels, holes plugged and schedules re-written (typed). Conduit in walls being demolished shall be removed and/or relocated to avoid new construction, and remain concealed above ceilings, etc.

2. General: Remove from site, debris, rubbish and other materials resulting from demolition operations.

3. Removal: Transport demolished materials removed from premise and legally dispose of off site.

END OF SECTION 16E020

SECTION 16E995 - COMMISSIONING OF ELECTRICAL SYSTEMS
PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. Drawings and general provisions of the Contract, including General Conditions and Division-1 Specifications Sections, apply to Work of this section.

B. Provisions of Section 160E10, General Provisions shall be made an integral part of this Section.

C. Provisions of Section 16E100, Basic Materials shall be made an integral part of this section.

D. Provisions of Section 01400, Quality Requirements, and 01810, Total Building Commissioning, shall be made an integral part of this Section with all requirements, responsibilities, and recourse described in those sections.

E. All electrical testing shall be in compliance with the latest edition of the International Electric Testing Association - Acceptance Testing Specifications (NETA-ATS).

F. All lighting and illumination testing shall be in compliance with the recommendations in the latest edition of Illuminating Engineering Society - Reference Volume (I.E.S.).

1.02 WORK INCLUDED

A. Participate in the Commissioning program as outlined in this section.

1.03 COMMISSIONING PROGRAM CRITERIA

A. Intent:

1. The intent of Electrical System Commissioning is to assure delivery to the Owner of electrical systems, which are fully functioning in accordance with all specifications, and which the Owner's personnel are fully trained and equipped to operate, maintain and troubleshoot.

2. The General Contractor shall execute a Commissioning Program, which delivers the intended results of Electrical System Commissioning, using whatever personnel, time and resources are required.

3. This Section provides minimum program requirements, however, the Contractor shall exceed those requirements whenever necessary to achieve the intent of Building Commissioning.

B. Commissioning Authority:

1. The Commissioning Authority is responsible for the overall enforcement and implementation of the Commissioning Program. The Commissioning Authority will schedule and chair all commissioning meetings, and be responsible for all documentation and final acceptance of the commissioning phase of the project.

C. Electrical Trade Representative:

1. The Electrical Contractor shall assign a qualified individual to function as the Trade Representative to coordinate the Commissioning Program. The Trade Representative reports to the Commissioning Authority.

D. Definitions and Abbreviations:

1. Maintenance Orientation and Inspection: At prescribed times during the Work the Contractor will walk the Owner's Maintenance personnel through the Work, orient them to equipment types and locations, assist access for any requested inspections, answer all questions concerning performance of the Work, workmanship standards and quality control.

2. Equipment Placement Completion: Stage of the Work at which the major items of Division 16 equipment have been placed at final locations, but have not received electrical connections. Major equipment includes, but is not limited to, Switchboards, Generators, Transformers, Automatic Transfer Switches, Motor Control Centers and Panelboards.

3. Distribution Completion: Stage of the Work at which distribution conduit and cable trays have been installed and tested, but not concealed by further work.

4. O&M Manuals: Operation and Maintenance Manuals as specified in Contract Documents.

5. Testing: Stage of work at which major feeders and grounding conductors have been installed and tested, but not terminated.

6. Trade Representative: Person who competently represents the work force engaged by the Contractor for the individual trade named. This person shall be completely familiar with the work performed for this Contract at all levels of detail of his trade and with coordination to other trades. This person shall be capable of and have authority to execute all commissioning responsibilities of the trade as described in these Contract Documents.

6. Participate: Attend commissioning events, provide technical expertise or knowledge, equipment, measurements and observation needed or requested by the Commissioning Authority or Owner. Provide follow-up analysis, equipment data, design data, or other trade or professional service needed in response to commissioning events.

7. Verify: To positively determine that the measured or observed quantity satisfies all required criteria. Simply performing the test, measurement or observation does not constitute "verification". The test result must also pass all Contract criteria. Tests that fail must be repeated at no additional cost to the Owner after repairs or adjustments are made, until full verification is achieved.

8. Pre-functional Testing: Ensure that individual pieces of equipment are capable of performing in accordance with the Specifications, Drawings, and manufacturers' requirements. This is documented with a Field Installation Verification checklist provided and completed by the contractor. The Commissioning Authority shall overview this testing.

E. Scope: For coordination purposes, the entire commissioning scope involving all parties is described here. The responsibilities of Division 16 Trades with respect to commissioning are separated out under Section 3.03 - RESPONSIBILITIES.

1. Document Electrical design intent.

2. Verify that equipment and systems have been properly installed in accordance with the contract documents and manufacturer's written installation instructions.

3. Verify that equipment has been placed into operation with manufacturer's oversight and approval.

4. Assemble contract documents and record drawings.

5. Assemble operation and maintenance instructions and submittal data.

6. Verify the performance of each piece of equipment and each system.

7. Train Owner's personnel in the proper operation of each piece of equipment and each system.

8. Document warranty start and end dates.

9. Assemble all records of Code authority inspections and approvals.

10. Monitor and enforce accessibility of all work versus maintenance requirements of each piece of equipment.

11. Identify, document and report all deficiencies of the work versus Contract specifications and performance requirements

F. Commissioning Cost:

1. Each Trade and supplier of equipment shall include in his quoted price the cost of furnishing the material requested and manpower necessary for the operation and maintenance manuals, training and system verification as specified under this section.

PART 2 - PRODUCTS

2.01 NOT APPLICABLE.

PART 3 - EXECUTION

3.01 PREPARATION OF COMMISSIONING PLAN

A. The Commissioning Plan shall be prepared by the Systems Commissioning Administrator (SCA). The plan shall take full cognizance of all intent and specific requirements for the Program described in the Contract Documents.

B. The Commissioning Plan shall be submitted to the Owner and shall be subject to approval in all aspects by the Owner. The Owner reserves the right to require changes

in the Commissioning Plan or personnel assigned at any time to satisfy the Owner's quality assurance within the Commissioning Program.

3.02 COMMISSIONING TEAM

A. A Commissioning Team shall be designated consisting of all members needed to execute the approved Commissioning Program. Membership shall include:

1. Commissioning Authority designated by SCA
2. Electrical Trade Representative
3. Facility Management and Control System (FMCS) Trade Representative
4. Owner's Mechanical Engineer
5. Owner's Electrical Maintenance Representative
6. Engineer of Record

B. The Contractor's personnel shall be made available to execute all aspects of the Commissioning Program until the Owner accepts final results. Commissioning Program tasks and meetings may be repeated until the Owner is satisfied and will not be fixed as one-time, one-chance events for the Contractor.

3.03 RESPONSIBILITIES

A. Owner:

1. Assign maintenance and engineering personnel and schedule them to participate in the various meetings, training sessions and inspections as follows:

    a. Pre-commissioning coordination meeting.
    b. Initial Owner training session at initial placement of major equipment.
    c. Maintenance orientation and inspection at initial placement of major equipment.
    d. Maintenance orientation and inspection at connection of distribution systems.
    e. Owners training session.
    h. Verification demonstrations.
    i. Final review and acceptance meeting.

B. Commissioning Authority:

1. Prepare Commissioning requirements sections of the Contract.

2. Prepare the Commissioning Plan. Include list of all Trade Representatives for commissioning events by name, firm and trade specialty.

3. Execute the Commissioning Plan, through organization of all meetings, tests, demonstrations, training events and performance verifications described in the Contract Documents and approved Commissioning Plan. Organizational responsibilities include preparation of agendas, attendance lists, arrangements for facilities and timely notification to participants for each commissioning events. The Commissioning Authority shall act as chairman at all commissioning events and assure execution of all agenda items. The Commissioning Authority shall prepare minutes of every commissioning event and send copies to all attendees within 5 workdays of the event.

4. Review the plans and specifications with respect to their completeness in all areas relating to the commissioning program. This includes ensuring that the commissioning guidelines have been followed.

5. The plan and specification review by the Commissioning Authority does not include any responsibility for the system evaluation, adequacy of the system to meet design intent, capacity of the system, quality control check or any of the other elements of the system design which are the strict responsibility of the Engineer of record.

6. Schedule a pre-commissioning coordination meeting within 90 days of the award of the contract, at some convenient location and at a time suitable to the Electrical Contractor and Engineer of Record. This pre-commissioning meeting will be for the purpose of reviewing the complete commissioning program and establishing tentative schedules for Maintenance orientation and inspections, O&M submittals, training sessions, job completion, system start-up and test work.

7. Schedule first Owner Electrical training just prior to the Maintenance orientation and inspection. This session will be attended by the Owner's Representatives, the Electrical Trade Representative, the Engineer of Record and the Commissioning Authority. The Engineer of Record will conduct this session giving an overview of the system, the system design goals and the reasoning behind the selection of the equipment. This session will be video taped by the General Contractor.

8. Schedule the first Electrical Maintenance orientation and inspection following the initial training session. The Maintenance orientation and inspection will be conducted by the Electrical Trade Representative. The emphasis on this Maintenance orientation and inspection will be an observation of the equipment location with respect to accessibility. Prepare minutes of this meeting, with separate summary of deficiency findings by the Owner and Commissioning Authority. Distribute to attendees.

9. Receive and review operation and maintenance (O&M) manuals as submitted by the contractor through the Engineer of Record.

10. Schedule the second Electrical Maintenance orientation and inspection at the Distribution Completion stage. The emphasis on this Maintenance orientation and inspection will be an observation of the equipment location with respect to accessibility. The Maintenance orientation and inspection will be conducted by the Electrical Trade Representative and will be attended by the Commissioning Authority, the Engineer of Record, the Electrical Trade Representative and the Owner's Representative. Prepare minutes of this meeting, with separate summary of deficiency findings by the Owner and Commissioning Authority. Distribute to attendees.

11. Adequate accessibility for maintenance and component replacement or repair is the Electrical Contractor's responsibility and will be checked by the Commissioning Authority at shop drawings, and during initial and final phases for each item of equipment.

12. Schedule the Owner training sessions. These training sessions are to be

attended by the Owner, Commissioning Authority, Engineer of Record, Electrical Contractor, Trade Representatives and equipment suppliers as necessary. The format will follow the outline in the O&M Manuals. Schedule the third Maintenance orientation and inspection with hands on training as a part of the training program. All training sessions will be video taped by the General Contractor.

13. Schedule regular commissioning coordination meetings during construction.

14. Upon receipt of notification from the Electrical Contractor that all systems have been started, tested, that the systems and equipment are functioning as designed and specified, and that all Field Installation Verification forms and checklists have been completed schedule the verification demonstrations. These demonstrations will be conducted by the Contractor and witnessed by the Commissioning Authority. Prepare minutes of each verification event, with separate summary of deficiency findings by the Commissioning Authority. Distribute to attendees.

15. Prepare final commissioning report per paragraph 3.09 and submit to Owner. Schedule final review with Owner. Present all documentation and turn over signed acceptance of the system by the Owner and Commissioning Authority to the Contractor.

C. Engineer of Record:

1. Provide Electrical system Design Intent and Basis of Design Narrative. Incorporate in the appropriate sections of the O&M Manual.

2. Attend initial pre-commissioning coordination meeting to be scheduled by the Commissioning Authority within 90 days of the award of the contract.

3. Verify adequate maintenance accessibility for each piece of equipment in shop drawings and actual installation. Visit site periodically and inspect construction.

4. Conduct the first electrical training session on the overview of the system design, the system design goals and the reasoning behind the selection of equipment.

5. Participate in first electrical Maintenance orientation and inspection following the first training session.

6. Review O&M Manuals submitted by the Electrical Contractor. Insert Design Narrative.

7. Participate in second electrical Maintenance orientation and inspection at the Distribution Completion stage.

8. Attend the classroom portion of the Owner training sessions.

9. Prepare record drawings as required by contract documents and turn over to Owner.

D. Electrical Contractor:

1. Include cost for commissioning requirements in the contract price.

2. Include commissioning requirements in the Electrical and electrical sub-contracts and ensure full cooperation of all parties in the commissioning program.

3. Provide an approved Plan to the Commissioning Authority to prepare and coordinate execution of the Commissioning Program. Provide the Commissioning Authority with means and authority to execute Commissioning Program.

4. Coordinate the interface of the Commissioning Program.

5. Prepare record drawings as required by contract documents and submit to the Owner.

E. Electrical Trade Representative:

1. Include requirements for submittal data, O & M data and training in each purchase order or sub-contract written.

2. Ensure cooperation and participation of specialty sub-Trade Representatives.

3. Ensure participation of major equipment manufacturers and their representatives.

4. Coordinate this commissioning program with the Mechanical Trade Representative.

5. Attend initial pre-commissioning coordination meeting scheduled by the Commissioning Authority. Prepare necessary preliminary schedule for Maintenance orientation and inspections, O & M manual submission, training sessions, test, and job completion for use by the Commissioning authority. Update schedule as appropriate throughout the construction period.

6. Attend initial training session and conduct Maintenance orientation and inspection at the equipment placement completion stage. Update drawings to the record condition, to date, and review with the Commissioning Authority prior to the Maintenance orientation and inspection meeting.

7. Obtain O & M data on all equipment and assemble in binders using tabs as required. Submit to Engineer of Record for approval prior to the Distribution completion stage.

8. Notify the Commissioning Authority of the time for all equipment start up activities.

9. Conduct the second Maintenance orientation and inspection at the Distribution completion stage. Update drawings to the record condition, to date, and review with the Commissioning Authority prior to the inspection.

10. Participate in and schedule vendors and other Trade Representatives to participate in the training sessions set up by the Commissioning Authority.

11. Conduct a Maintenance orientation and inspection with hands on training. Update drawings to the record condition to date and review with the Commissioning Authority prior to the orientation.

12. Attend all regularly scheduled commissioning coordination meetings.

13. Provide written certification and completed Field Installation Verification forms and checklists documenting that the following work has been completed in accordance with the plans and specifications and that they are functioning as designed. Where the Work has been sub-contracted, the sub-Trade Representative shall be responsible for the initial certification with the Electrical Trade Representative recertifying that he has inspected the Work and that it has been completed and functioning as designed. This certification must be submitted to the Commissioning Authority prior to the final verification.

a. Correct labeling of all circuits with connected equipment.
b. Automatic operation of emergency generator, bus transfer and UPS equipment.
c. Lighting system controls operations, including occupancy sensors, automatic time controls or Energy Management control, override timers, manual dimming controls, exterior lighting controls, multi-level switching, as applicable to the Work.

15. Demonstrate the performance of each piece of equipment to the Commissioning Authority. Schedule sub-Trade Representatives as may apply to demonstrate the performance of the equipment and systems.

16. Provide set of record mark-ups to the Engineer of Record for inclusion into record documents.

3.04 OPERATION AND MAINTENANCE MANUALS

A. Operating and Maintenance Manuals:

1. Initial preparation shall be made by the Electrical Trade Representative.

2. Quantity: provide four (4) hard copies of the manual and One (1) electronic copy in PDF format on a CD.

3. Format: 3" thick, 8-1/2" x 11 loose leaf binders. Provide as many as required. Binders shall not be overloaded.

4. Content:
a. Cover sheet.
b. Table of contents (as follows):
c. Description of systems.
The description of systems will be provided by the Engineer of Record for insertion at the time of review and before turn-over to the Commissioning Authority. This description of systems shall be a comprehensive overview of the entire system. Simplified professionally drawn system diagrams shall be provided on 8-1/2" x 11" or 11" x 17" sheets. These shall include power distribution systems, UPS power systems, interior and exterior lighting systems and emergency power

systems. These shall show major pieces of equipment such as switchboards, transformers, circuit panels and control panels, as well as important devices such as timers, relays, actuation or initiation devices, monitoring devices, etc. It will be the basis for the starting of the owner's instruction program

d. Design parameters.
The design parameters will be provided by the Engineer of Record. It will be a detailed listing of the design criteria on a room-by-room and system-by-system basis used as a basis for the design. This will be inserted by the Engineer of Record at the time of review and before turnover to the Commissioning Authority.

e. Contract Electrical Specifications.

f. Wiring and control diagrams, with data to explain detailed operation and control of each component.

g. Control sequences describing start-up, all modes of operation, and shutdown.

h. Installation instructions.

i. Operating Instructions.

j. Preventative Maintenance Instructions.

k. Maintenance and overhaul instructions.

l. Lubricating schedule including type, grade, temperature, and frequency range.

m. Corrected shop drawings and submittal data.

n. Product information identifying all rating data, features, and options on all installed equipment

o. Copies of approved certifications and laboratory test reports.

p. Copies of warranties.

q. Test procedures.

r. Parts list, including source of supply and recommended spare parts.

s. Name, address, and 24-hour telephone number of each subcontractor who installed equipment and systems and local representative for each type of equipment for each system.

t. Other pertinent data applicable to the operation and maintenance of particular systems or equipment and/or other data specified in technical sections of the specification.

u. Uninterruptible power supplies, including a list of equipment and design kW load on each.

v. Emergency power generation, including a list of equipment and design kW load on each.

w. The documentation during the construction phase shall be updated to match the equipment supplied on the project.

x. Procedures for starting, operation, and shutdown for every system, including all required emergency instructions and safety precautions.

5. Detailed Preparation Requirements:

a. The cover sheet shall list: project name, location, names of the project manager, architect, and electrical engineer, name of the firms, address and telephone number.

b. Each major heading in the table of contents shall have a large distinctive, clearly marked, non-erasable, plastic encased tab.

c. Each section shall have the following sub-tabs. Sub-tabs shall be similar to the main tabs but of a different color.

1) Specifications:
The specification shall be copied and inserted complete with all addenda.
2) Submittal and Product Data:
This section shall include all approved submittal data. If submittal was not required for approval, descriptive product data shall be included.
3) Installation Instructions:
If the product, such as conduit, etc., does not have any written installation instructions, include a statement "Manufacturer's Written Installation Instructions not Available - Product Installed in Accordance with Specifications and Good Practice".
4) Operation and Maintenance Instructions:
These shall be the written manufacturer's data edited to omit reference to products or data not applicable to this installation.
5) Parts List:
These shall be edited to omit reference to items, which do not apply to this installation.
6) Equipment Supplier:
This section shall include the name, address and telephone number of the manufacturer's agent and/or service agency supplying or installing and starting up of the equipment.
7) Field Installation Verification forms, checklists, and Commissioning Checklist:
This will be filled out by the Contractor with the specified data and submitted data and inserted into the manual for submission to the Engineer of Record. The form shall be forwarded with the certification of system completion and commissioning request.
8) System Description:
This section shall include that portion of the overall description included in the beginning of the manual as it applies to each subsection. In sections such as pumps, the pump designations and their use shall be listed as shown in the equipment schedule.
9) Preventative Maintenance Instructions:
This section shall include condensed typewritten excerpts from the manufacturers written instructions on weekly, monthly, quarterly, annually, etc. This summary shall be prepared by the Electrical Trade Representative with help from the equipment supplier. It will be reviewed by the Engineer of Record prior to turning over to the Commissioning Authority. It shall be prepared for all items listed under "Condensed Operating Instructions" above.

d. Commissioning of Electrical Systems shall be prepared by the Commissioning Authority and shall contain the following sections:

1) Specifications.
2) Commissioning Plan.
3) Final Report of the Commissioning Authority.

B. Submittal Requirement:

1. The O&M manuals shall be submitted at the equipment placement completion stage, which shall be defined as that time in the project when the major pieces of

equipment have been set in place ready for connection to piping and duct systems.

3.05 TRAINING OF OWNERS OPERATORS:

A. The owners shall be given comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of equipment.

B. The Commissioning Authority, in cooperation with the Engineer of Record and Contractor, will be responsible for scheduling the training which shall start with classroom sessions followed by hands on training on each piece of equipment. Hands on training shall include start-up, operation in all modes possible, shut-down and any emergency procedures.

C. Training shall be conducted in a minimum of three sectors. The first, or systems orientation portion, shall be scheduled prior to the equipment placement Maintenance orientation and inspection. This training session will include a review of all systems using the simplified system schematics.

D. The second, or equipment portion, shall be scheduled as soon as possible after distribution completing and start-up of the equipment.

E. The third portion, or the TAB and commissioning portion, shall be conducted after completion of this work.

F. Classroom sessions shall include the use of overhead projections, slides, video and audio taped material as might be appropriate.

G. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual.

H. The Engineer of Record will attend all training sessions and conduct the first session on the overall system design concept and the design concept portion of each equipment section.

I. The manufacturer's representative shall provide the instructions on each major piece of equipment. These sessions shall use the printed installation, operation and maintenance instruction material included in the O&M manuals and shall include a review of the written O&M installations emphasize safe and proper operating requirements and preventative maintenance. Training will be included for all major pieces of equipment. Qualified service engineers employed by the manufacturers or their qualified sales representatives shall do equipment training. The operation and function of the equipment in the system shall be discussed.

J. Each classroom training session shall be followed by an inspection, explanation and demonstration of the equipment. The start-up and shut-down modes of operation shall be demonstrated.

K. The Contractor shall attend all sessions and shall add to each session any special information relating to the details of installation of the equipment as it might impact the operation and maintenance.

L. The Commissioning Authority shall conduct a final session summarizing the

commissioning program.

3.06 NOTIFICATION OF SYSTEM COMPLETION AND REQUEST FOR FINAL ELECTRICAL SYSTEM COMMISSIONING VERIFICATION

A. When systems are ready for final commissioning verification, the Electrical Trade Representative shall notify the Commissioning Authority in writing and provide completed Field Installation Verification forms and checklists. Commissioning data sheets must be complete through the column labeled "Tested" and included with the request.

B. Should the verification test reveal that the equipment is not performing as specified or control operation is not acceptable, the Contractor will be entitled to one re-inspection of any failed item at no additional cost.

C. Should the verification test determine that the equipment is still not performing as specified or control operation is not acceptable on the second inspection, the time and expenses to make further verification shall be considered as additional cost to the Owner. The total sum of such costs shall be deducted from the final payment to the Contractor.

3.07 VERIFICATION OF PERFORMANCE

A. Verification of performance will take place after certification of the completion of the construction, and completion of all functional test form checklists. Performance demonstration shall be done by the Electrical Trade Representative or the FMCS Trade Representative as appropriate, and shall be witnessed by the Commissioning Authority and/or the Owner's Representative.

B. The "specified", "submitted" and as "tested" shall be entered on the Commissioning Data Sheets prior to the verification. The witnessed performance data shall be added to the data sheet at the time of verification.

C. The following demonstrations will be required:

1. Correct Labeling of all Circuits with Connected Equipment:
    a. Break circuit and observe equipment or check voltage at equipment to verify.
    b. Equipment found to exhibit incorrect labeling shall be compiled in a list form titled "Incorrect Equipment Circuit Identification" and attached to the Commissioning Data Sheet package.

2. Main Switchboard Overcurrent Protection Performance:
    a. Main Switchboard Overcurrent Protection.
    b. The main power disconnect switch and feeder disconnect switches overcurrent and ground fault sensor trip settings shall be tested by primary injection method and in accordance with NETA-ATS Section 7.6.
    c. The switchboard assemblies shall be meggered in accordance with NETAATC Section 7.
    d. The switchboard metering instrumentation shall be tested in accordance with NETA-ATC Section 7.10 and 7.11.
    e. Switchboard single-phase monitors shall be tested for operation upon actual loss of a phase voltage.

3. Panelboard Installation and Branch Circuit Labeling Verification:

a. Panelboards.
b. Voltage and ampere measurements shall be made in accordance with NETA recommendations.
c. Panelboard circuit labeling and grounding continuity shall be verified (up to 10% of circuits in each panel).
d. Circuits/outlets found to be incorrectly labeled or grounded shall be compiled in a list form titled "Incorrect Branch Circuit Wiring".

4. Distribution Transformer Performance:
   a. Distribution Transformer.
   b. Voltage and ampere measurements shall be made in accordance with NETA recommendations.
   c. Grounding conductor impedance to the building structure shall be measured between two points other than the location of the grounding conductor connections.
   d. Ventilation clearance from transformer enclosure to partitions shall be measured and verified with contract documents.

5. Motor Controllers Compliance:
   a. Motor Controllers.

6. Grounding System Performance:
   a. Grounding System.
   b. Performance tests shall be performed in accordance with NETA-ATS Section 7.13.

7. Interior Lighting System Performance:
   a. Interior Lighting System.
   b. All luminaire/lamp combinations shall be verified by inspection. All incorrectly lamped lights shall be compiled in a list form titled "Incorrect Light Lamping." List shall include room name locations of incorrect lights.
   c. Operational tests shall be performed for all interior lighting control/dimming systems.
   d. Interior Lighting Control performance Including Operation of Occupancy Sensors, Automatic Time Controls, Energy Management Control Override Timers, Manual Dimming Control, Multi-level Switching, etc.
   e. Illumination Foot Candle Level Measurement in up to 20% of Building Area.
8. Emergency Generator Performance including Simulation of Actual Power Outage:
   a. Stand-by engine generator.
   b. Operating performance tests shall be performed and recorded in accordance with NETA-ATS Section 7.22.1.
9. Bus transfer Equipment Operation:
   a. Bus transfer Equipment.
   b. Operating performance tests shall be performed and recorded in accordance with NETA-ATS Section 7.22.4.

3.08 PHASING OF CONSTRUCTION AND COMMISSIONING:

A. The commissioning plan shall take into account the staged start-up of each phase. Commissioning documentation and verification to begin with each phase completion.

3.09 COMMISSIONING DATA SHEETS

A. The Commissioning Data Sheets for various equipment shall be as provided in the Commissioning Plan. They shall be completed as described in Para. 3.07 - Verification of Performance.

3.10 REPORT REQUIREMENTS

A. The Commissioning Authority shall document each commissioning event with meeting minutes or a report. The documents shall separately list deficiencies observed or discovered during the event. The document shall be distributed to Commissioning Team.

B. The Commissioning Authority shall prepare a final formal report to the Owner which will include a narrative in the form of an Executive Summary of the results of program, impressions of the training sessions and the level of operating competence and a certification that the verification of each item is complete and all systems are operating as intended.

C. Transmitted with the report shall be edited Operation and Maintenance Manuals including:

1. Commissioning Data Sheets.
2. Warranties.
3. Permits and Inspection Reports.

END OF SECTION 16E995

SECTION 16010 — GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. The provisions of The Supplement to Advertisement, The Instructions to Bidders, Supplement to Instruction to Bidders, General Conditions, Supplementary Conditions and all other sections of Division 1 of these Specifications shall govern the work under this Division or Section the same as if incorporated herein.

1.2 SCOPE

A. Provide and install complete electrical systems including all conductors, raceways, fittings, protective devices, wiring devices, fixtures, supports, and all miscellaneous hardware necessary. All of the above equipment shall be completely installed and left in proper operating condition. All electrically powered equipment whether furnished by others or by the Contractor shall be wired by the Contractor.

B. Complete Power distribution and utilization system shall be installed, including service entrance, panelboard, utilization devices and equipment as indicated on drawings. Coordinate and comply with Owner requirements for service and metering and pay all cost for difference in the standard service and service specified.

C. Furnish and install power, wiring and/or disconnects as shown on drawings for wiring systems for mechanical systems specified in Division 15. Temperature control wiring, equipment control and interlock wiring are not included in this division unless specifically noted in these specifications or shown on the plans. All motor disconnects, starters, combination motor controllers and motor control centers shall be furnished under this division of specifications unless noted otherwise.

1.3 REQUIREMENTS

A. Field verification of scale on electrical plans is directed since actual locations, distances and levels will be governed by actual field conditions.

B. In case of conflicts or discrepancies between plans, plans and specifications and/or actual field conditions, Contractor shall notify the Engineer before work is continued. Coordinate with other trades to avoid conflicts.

C. Permits, Inspections and Tests - The Contractor shall procure and pay for all permits, fees, inspections, and licenses required. Perform all tests to ensure all systems are in good operating condition.

D. Review of Material; Specific reference in the specification to any article, device, product, material, fixture, form or type of construction by name, make or catalog number, with or without

the words "or equal", shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition.

E. Bidders shall base bids on the material specified or on equals receiving approval 10 working days prior to Bid Opening. Any increase in the cost of work resulting from substitution of any product specified is part of this contract and shall be accomplished in an approved manner at no extra cost to the Owner.

F. Substitutions. No substitution will be considered unless written request for approval has been received by the Engineer at least 10 working days prior to the date of receipt of bids. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitution including drawings, cuts, performance and test data and any other information necessary for an evaluation. A statement setting forth any changes in other materials, equipment or other Work that incorporation of the substitute would require shall be included; failure to do so does not alleviate the Contractor of his responsibility to make any and all necessary changes required for installation of the approved substitution. The burden of proof of the merit of the proposed substitute is upon the proposer. The Engineer's decision of approval or disapproval of a proposed substitution shall be final.

G. All materials shall be new and of current manufacturer. Where more than one of a type of device is used, all shall be by the same manufacturer. All materials shall conform to the grade, quality and standards of those specified.

H. Shop drawings shall be submitted in accordance with the General Conditions. Forward all shop drawings at one time. Each item shall bear project name and identifying symbol from plans. Shop Drawings required are as follows:
1. Lighting Fixtures
2. Wiring Devices
3. Panelboards
4. Disconnect Switches

I. Interferences - The drawings are generally diagrammatic in nature, and accordingly the Contractor shall coordinate his work with that of all other trades to avoid interferences. The Contractor shall examine the complete set of drawings and specifications for the job before installation of electrical work, coordinating locations and routings with other trades to avoid interferences. Work installed by the Contractor which does interfere with another trade shall be removed and reinstalled at the Contractor's expense when directed by the Architect.

J. Workmanship shall be of the highest quality and all work shall be done by workmen skilled in the trades involved.

K. The Contractor shall guarantee all work under this contract for one year and shall be responsible for the maintenance of all electrical equipment furnished and installed under this contract, excluding lamp replacement, for a period of one year from the date of substantial completion.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 APPLICABLE CODES AND STANDARDS

Note: The materials and installation shall conform to the minimum requirements and latest outstanding issues and revisions of the following codes, standards, and regulations wherein they apply:

NFPA No. 70, National Electrical Code, (latest edition).

NFPA No. 101, Life Safety Code, (latest edition).

American National Standard, National Electrical Safety Code, (latest edition).

Applicable Publications of NEMA, ANSI, IEEE and IPCEA.

Underwriter's Laboratories, Inc. Standards

City, State and Local Codes and Regulations having jurisdiction.

OSHA requirements.

ADA requirements.

END OF SECTION 16010

SECTION 16450 — GROUNDING

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Materials specified in this Section shall comply with all applicable requirements of SECTION 16010, GENERAL PROVISIONS.

1.2 WORK INCLUDES

A. As Required By the NEC. In general, fixtures, outlets, the enclosing cases, mounting frames, etc., of all switches, circuit breakers, control panels, motors and any other electrically operated or electrical equipment, conduit, and other raceways shall be effectively and permanently grounded with a separate copper grounding conductor of cross-section as required by the National Electrical Code and drawings. It shall be of capacity sufficient to insure continuity and continued effectiveness of the ground connections to carry fault currents. Ground conductors must be as short and straight as possible, protected from mechanical injury and if practicable without splice or joint. The grounding conductor shall be run from a ground established at the source of supply to the equipment to be grounded. Ground wires from below grade shall be protected by galvanized conduit and the conductor shall be brazed to conduit sleeve on each end. All grounding conductors shall be copper.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 INSTALLATION

A. Power Conductors Supplying Equipment. A copper grounding conductor must be run inside the conduit or raceway, enclosing the power conductors supplying the equipment, or in case of a multi-conductor power cable, must be located within the sheath.

B. Connect at Source. Ground conductors in power cable or ground wire in conduits shall always be connected directly to station ground at the source end, and to motor frame or equipment enclosure and/or equipment ground bar.

C. System Neutral. The equipment grounding conductor in all circuits shall be connected to the frame and ground lug in the panelboard and not the neutral bus. Equipment ground connections to a system neutral are not permitted.

D. Fuses. In all cases of grounded circuits, fuses must be omitted from the grounded neutral conductor throughout the entire installation.

E. Equipment Frames. Frames of all electrical apparatus will be connected to the grounding system. Neutrals of service transformers shall be connected to the grounding system.

F. Metallic Raceways. All metallic conduits and wiring channels must be connected at each end to the grounding conductor with a good electrical contact.

G. Identification. The grounding conductor shall be stranded and covered with a green jacket.

H. In all cases the white wire should be used for the current-carrying neutral only and never as a grounding conductor, or other purpose.

I. Ground Rods. Where specified on drawings, grounding connections to earth shall be made with 5/8" diameter (minimum) copper-clad steel exten-type ground rods a minimum of 8 feet long, or depth as indicated.

END OF SECTION 16450

SECTION 16110 — ELECTRICAL RACEWAYS

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Materials specified in this Section shall comply with all applicable requirements of SECTION 16010, GENERAL PROVISIONS.

1.2 SCOPE

A. Contractor Furnished. The contractor shall provide all conduit, fittings, and supports required and not otherwise shown on plans as furnished by others.

B. The types of electrical raceways required for the project include the following:

1. Electrical Metallic Tubing
2. Intermediate Metal Conduit
3. Flexible Metal Conduit
4. Liquid-Tight Flexible Metal Conduit
5. Rigid Galvanized Conduit
6. PVC Rigid Conduit

C. The minimum raceway size shall be 3/4".

D. Product Delivery, Storage, and Handling. Contractor is to provide color-coded end-cap thread protectors and handle conduit and tubing carefully to prevent damage. Store pipe and tubing inside whenever possible. When necessary to store outdoors, elevate well above grade and enclose with durable, watertight wrapping.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. Electrical Metallic Tubing. Galvanized, thin wall tubing, fittings shall be hex-nut, expansion gland type, zinc plated, and U.L. listed as "raintight." No crimp, spring, or set-screw type fittings will be accepted.

B. Intermediate Metal Conduit. Galvanized steel tubing, with zinc coated interior.

C. Flexible Metal Conduit. Galvanized single steel strip, flexible, interlocked.

D. Liquid-Tight Flexible Metal Conduit. Galvanized single steel strip, flexible, interlocked, double wrapped, with liquid-tight PVC jacket.

E. Rigid Galvanized Conduit. Rigid steel, hot-dipped galvanized conduit.

F. PVC Rigid Conduit: U.L. listed Schedule 40 heavy wall rigid conduit.

G. Conduit, tubing and duct accessories including straps, hangers, expansion and deflection fittings as recommended by conduit, tubing, and duct manufacturers.

PART 3 - EXECUTION

3.1 APPLICATION

A. Electrical Metallic Tubing. Branch circuits run in hollow dry walls and above ceilings. Not to be exposed.

B. Flexible Metal Conduit. Connection of motors and for other electrical equipment where subject to movement and vibration and located in a dry, interior location. Flexible conduit is not to exceed 60" in length for any one application.

C. Liquid-tight Flexible Metal Conduit. Connection of motors and for other electrical equipment where subject to movement and vibration, and also subjected to one or more of the following conditions: Exterior location; moist or humid atmosphere where condensate can be expected to accumulate; corrosive atmosphere; subjected to water spray; subjected to dripping oil, grease or water. Flexible conduit is not to exceed 60" in length for any one application.

D. Intermediate Metal Conduit. All conduits of 2" nominal trade size or more and/or where exposed. Not to be stubbed up at floor level.

E. Rigid Galvanized. Where specified on plans for certain underground or exposed runs, or where stubbed up at floor level.

F. Rigid PVC. Where specified on plans for certain underground runs, UL approved Schedule 40 heavy wall rigid PVC conduit shall be used. Not to be stubbed up at floor level. All PVC underground runs shall transition to rigid galvanized before stubbing up through floor slab or grade.

3.2 INSTALLATION

A. Install conduit and tubing in accordance with NEC and National Electrical Contractors Association's "Standard of Installation", and with recognized industry practices. Where NECA and NEC standards differ, use the more stringent requirement.

B. Complete the installation of raceways before starting installation of wires.

C. Wherever possible, install horizontal raceway runs above water and steam piping.

D. Care shall be taken to keep the interior of conduits clean, and each conduit run shall be thoroughly cleaned and dried before any cable is pulled through.

E. Unless indicated otherwise on drawings, all exposed conduits shall be run parallel with or perpendicular to building structural members.

F. Conduits entering sheet metal enclosures shall be made up with double locknut and insulating bushing. Locknut shall be of the type which will bite into the metal of the box.

G. Conduits entering threaded openings in equipment enclosures, boxes, etc., shall have at least five full threads engaged. In outdoor and underground locations, threaded joints shall be made up with a thin application of conducting joint compound. The inside of the fitting shall be thoroughly cleaned of any excess compound.

H. Power operated bending machines shall be used on conduits 1-1/4" and larger. Heating with torches will not be permitted.

I. All conduit runs shall be continuous from outlet to outlet with all joints and connections pulled tight to insure an electrically continuous and mechanically secure raceway system.

J. All raceways in "finished areas" such as offices, corridors, etc., shall be concealed.

Note: In no case shall any raceway be used as an equipment grounding conductor. Instead, a separate green colored wire, sized per NEC table 250-95, shall be used throughout for the equipment grounding conductor.

3.3 CONDUIT OPENINGS

A. Contractor's Responsibility. The Contractor shall be responsible for all sleeves and openings through walls and floors necessary for passage of electrical conduits and raceways. Where contractor must provide openings and/or drill concrete floors and/or walls, he shall be responsible for the repair of these openings. Structural members and reinforcing shall not be cut, burned or damaged in any way. All openings in walls and floors, and under panelboard where electrical cables and conduits are installed, shall be closed by the Contractor to prevent dust, dirt and water from entering.

B. Sealing. The Contractor shall be responsible for sealing all wall and floor openings and all floor and wall sleeve openings utilized by the contractor whether furnished by Others or by the Contractor.

C. Sleeves and openings shall be sealed with materials that will withstand fire and heat to the same rating as the wall, floor, or ceiling through which the conduit or tray passes and shall not be less than a 30-minute barrier.

END OF SECTION 16110

SECTION 16130 — CONDUCTORS

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Materials specified in this Section shall comply with all applicable requirements of SECTION 16010, GENERAL PROVISIONS.

1.2 SCOPE

A. This specification covers the requirements for all wire and cable to be used in the installation of the electrical systems for the project, including all power, lighting, control and instrumentation systems.

B. Wire and cable will normally be furnished by the Contractor for installation. Drawings will indicate where cable is not to be furnished.

C. All cable is to be "Contractor-furnished", the Contractor shall submit for approval by the Owner any deviations anticipated or proposed with respect to the cable manufacturer, cable type, or specification contained herein.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All wire and cable shall be Underwriters' Laboratories (UL) listed. In addition to other standard labeling, all wire and cable shall be marked UL on the outer surface indicating Underwriters' Laboratories, Inc. certification.

B. Grounding conductors, where insulated, shall be colored solid green. Conductors intended as a neutral shall be colored solid white.

C. For all circuits 600 volt and less, wires and cables shall have code grade, 600 volt type THWN-THHN, 75 degrees C., wet or dry locations, moisture and heat resistant thermoplastic insulation. Insulation thickness shall be per National Electrical Code, Table 310-13.

D. Conductor sizes are expressed in American Wire Gage (AWG) or in circular mils. Conductors shall be annealed copper wire, minimum size #12 AWG, except that #14 AWG may be used for control. All conductors shall be stranded except that solid conductors may be used for #12 AWG lighting and receptacle branch circuits.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Separation of Usage. Lighting and power wiring shall be routed in conduits, or other raceways as shown on the drawings. Lighting and power wiring shall not be routed in a common raceway except where shown on drawings. Push-button wiring shall be routed in separate raceways even though related to a particular motor circuit.

B. Pulling. Where mechanical assistance is used for pulling conductors, patented wire pulling compounds having inert qualities that do not harm the wire insulation or covering shall be applied to the conductors as they are pulled into raceways. Interior of all raceways shall be free from grease, filings or foreign matter before conductors are pulled in.

3.2 IDENTIFICATION

A. Wire, Cable, Raceways, and Conduits.

B. Circuit identification numbers shall be placed on each end of the conductor involved by using self-laminating marker tags, T&B Company E-Z Code Type WSL or equal. Circuit numbers shall be as shown on the plan and panel schedule drawings.

C. Phase Identification. Phase sequence throughout the installation shall be standardized wherever practical in all electrical power equipment as follows:

	Phase A	Phase B	Phase C
Position Occupied	Front	Center	Rear
	Top	Center	Bottom
	Left	Center	Right
Color Code: 208/120V, 3-phase	Black	Red	Blue

3.3 SPLICES AND TERMINATIONS

A. Lighting Conductors. Splices in lighting conductors shall be made with splicing caps with metal inserts only, such as 3M Company's "Scotchlock" spring connectors. The splices shall be firmly and neatly taped to prevent entry of moisture.

B. Power Conductors shall be continuous from outlet to outlet. No power cable shall be spliced except on explicit instructions of the Owner's Representative.

3.4 LUGS

A. All lugs shall be furnished and installed by the Contractor where required.

B. Lugs for copper power wiring, Sizes No. 12 and No. 10 AWG, shall be T&B "Sta-Kon" uninsulated ring type lugs. Lugs for copper power wiring from No. 10 AWG to size 1/0 AWG shall be T&B 1-hole Type 54100 Series. Size 2/0 AWG and larger lugs shall be 2-hole type 54200 series (except where 1-hole is required to match motor lead lugs). Sizes above 1/0 are to be applied using hydraulic pump tool.

C. Where motor leads are furnished without lugs, T&B 54500 Series 2-way connectors (splicing sleeves) shall be used. Splice sleeves may be desirable where limited space for termination exists.

D. The proper lugs will normally be furnished with equipment in all Owner-furnished equipment. All other lugs shall be furnished and installed by the Contractor. No mechanical type lugs shall be used except in panelboards. If any mechanical type lugs are furnished with Owner-furnished equipment, the Contractor shall replace them with proper compression type lugs where practical.

3.5 TAPING

A. All voids, sharp corners and bolt projections shall be made smooth by filling with Okonite or Scotch Fill before applying the laps of tape required for insulation. All loose strands of wire shall be removed before taping. Duxseal will not be permitted.

B. Joints and other sections of wiring requiring tape shall be half lap and at least two layers. Taping shall be neatly done and shall form a permanent insulation equal in mechanical and electrical strength to the insulation of the conductor. Taping shall be as follows:

1. 600 Volt insulation - A minimum of 1-1/2 lap layer varnished cambric and 2-1/2 lap layers of 3M No. 33 vinyl plastic electrical tape.

C. All taping, splicing and termination materials shall be furnished by the Contractor.

END OF SECTION 16130

SECTION 16100 — BASIC MATERIALS

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Materials specified in this section shall comply with all applicable requirements of SECTION 16010, GENERAL PROVISIONS.

1.2 SCOPE

A. Contractor Furnished. Unless otherwise noted on the drawings, equipment list, or specifications, the Contractor shall furnish and install all materials, devices, and apparatus necessary for the complete electrical system. All materials and equipment shall be of types and manufacturer specified wherever practical. Should materials or equipment so specified be unobtainable, the Contractor shall submit the description and manufacturer's literature, reason for the substitution request and shall secure the approval of the Engineers before substitution of other material or equipment. This specification establishes performance requirements and the quality of equipment acceptable for use and shall in no way be construed to limit procurement from other manufacturers.

B. Equal or Equivalent. The term "or equal" and similar terms as used on the drawings or specifications shall be interpreted to mean "equal or equivalent" in the opinion of the Engineers.

C. Manufacturer's Prints. Where the Contractor furnishes equipment other than standard construction items, he shall furnish manufacturer's prints and reproducibles of all such equipment to the Engineers.

D. U.L. Listing. All equipment and materials shall be new and conform to the requirements of this specification. All equipment and materials shall be listed by the Underwriter's Laboratories, Inc., and shall bear their label whenever standards have been established and label service is regularly furnished. All equipment and materials shall be of the best grade of their respective kind for the purpose.

PART 2 - PRODUCTS AND EXECUTION

2.1 PANELBOARDS

A. Contractor Furnished. The contractor shall furnish all lighting, service, and power distribution panelboards required. All panelboards shall be of deadfront construction and shall incorporate all switching and protective devices of the type, quantity, number of poles, rating and type specified or shown on the drawings. The drawings and schedules indicate the ampere rating of mains, main breaker or disconnect, main lugs, voltage rating, phases, neutral and type of devices and enclosures. Enclosures for panelboards may be flush or surface type as designated on the drawings.

B. Boxes. Boxes shall be constructed of code gauge galvanized sheet steel and provided with not less than 7" wiring gutters at the sides and 5" at top and bottom. Where feeder cables supplying the mains of a panel are carried through its box to supply other electrical equipment (loop feeds), the box shall be sized to include this wiring space. This wiring space shall be in addition to the minimum gutter space specified above and the limiting width may be increased accordingly. Knockout type boxes may be used on flush mounted installations where conduits are routed concealed. Surface mounted boxes shall be furnished without factory stamped knockouts and the contractor shall punch the box for the conduit group desired. Conduit hubs shall be T&B Series 370 "Bullet" hubs or approved equal.

C. Doors. Hinged doors covering all switching device handles shall be included in all panel trims, except that panelboards having individual metal clad externally operable deadfront units may be supplied without such doors. Doors shall have flush or semi-flush type, corrosive resistant, cylinder lock and catch, except that doors over 48" in height shall have a vault handle and 3-point latch, complete with lock, arranged to fasten door at top, bottom and center. Door hinges shall be concealed. Two keys shall be supplied for each lock. All locks shall be keyed alike for all panelboards supplied. Trims shall be fabricated of code gauge sheet steel. Trims for flush panels shall overlap the box by at least 3/4" all around. Surface trims shall have the same width and height as the box. Trims shall be mountable by a screw-driver without the need for special tools. Trims shall be properly cleaned and finished with a gray paint over a rust inhibiting primer coating. The finish coat shall be the type that will permit adherence of field applied paint.

D. Directory. A directory holder with glass or heavy plastic plate and metal frame shall be mounted inside of each door with a neatly typed directory properly identifying each circuit as shown on panel schedule drawings.

E. Nameplate. The contractor shall furnish and install an engraved, laminated plastic nameplate on the trim. The nameplate shall identify the panel by power source designation, panel designation, voltage rating and phase. Nameplate shall be black engraved letters on white background.

F. Bus Bars. Bus bars and other conductive parts shall be copper and sized in accordance with Underwriter's Laboratories standards, full size insulated neutral bars shall be included. Bussing shall be braced equal to or greater than the highest rated practice governing short circuit stresses in panelboards. Phase bussing shall be full height without reduction. Cross connectors shall be copper.

G. Neutral Bus. Neutral bussing on 3-phase panels shall have a suitable lug for each outgoing feeder requiring a neutral connection.

H. Ground Bus. All panels shall be furnished with a bare equipment ground bus. The ground bus shall be of copper and 1/4" x 2" minimum size, properly bonded to the housing. Suitable lugs shall be provided for termination of each equipment ground conductor.

I. Phase Sequence. Bus bar connections to the branch circuit shall be the "distributed phase" or "phase sequence" type. Single-phase, three-wire panelboard bussing shall be such that any two adjacent single-pole units are connected to the opposite polarities in such a manner that two-pole units can be installed at any location. Three-phase, four wire bussing shall be such

that any three adjacent single-pole units are individually connected to each of the three different phases in such a manner that two or three-pole units can be installed in any location.

J. Circuit Numbering. Panelboard circuit numbering shall be such that starting at the top, odd numbers shall be used in sequence down the left-hand side and even numbers shall be used in sequence down the right-hand side.

K. Terminals. Terminals for feeder conductors to the panelboard mains and neutral shall be U.L. listed as suitable for type of conductor specified and shall be T&B 54000 Series where possible. Terminals for branch circuit wiring, both breaker and neutral, shall be U.L. listed as suitable for the type of conductor specified.

L. 120/208V Panels. All lighting/service panels rated 120/208 volt, shall be equal to Square D Company, Type NQOD equipped with bolt-on branch breakers of the type and rating specified on the drawings.

M. Circuit Breaker Type Distribution Panels. Circuit breaker type distribution panels for the various voltages shall be similar to Square D I-Line type, equipped with I-Line breakers of the type and rating specified in paragraph titled Circuit Breakers, and on the drawings. Panels shall be approved for use as service entrance equipment.

N. Panels and Panelboards are designed around Square D equipment. Acceptable alternate manufacturers are Cutler-Hammer, Siemens, and General Electric Company. All alternate or substitution requests shall meet all performance requirements of specified equipment, as well as space and dimension requirements noted on drawings.

2.2 CIRCUIT BREAKERS

A. Contractor Furnished. The contractor will provide breakers unless specifically designated to be "Owner Furnished" on the drawings, equipment list, or within the specifications.

B. As Specified. Breakers shall be of the type, rating, number of poles, size, and interrupting capacity, specified or required for the environment, location, application, and load served.

C. Molded Case Circuit Breakers. Molded case circuit breakers shall be circuit interrupting devices which will operate both manually for normal switching functions and automatically under overload and short circuit conditions. Circuit breakers shall provide circuit protection when applied within rating.

D. Operating and Switching Mechanism. The operating mechanism shall be entirely trip-free so that the contacts cannot be held closed against an abnormal over-current or short circuit condition. The switching mechanism shall be quick-make, quick-break type.

E. Overload and Short Circuit Protection. The operating handle of the circuit breaker shall open and close all poles of a multi-pole breaker simultaneously. The breakers shall meet applicable NEMA and U.L. specifications. Each circuit breaker shall have a trip unit to provide overload and short circuit protection. The trip unit for each pole shall have elements providing inverse time delay under overload conditions and instantaneous magnetic tripping for short circuit protection. The trip element shall operate a common trip bar which shall operate all poles in case of an overload or short circuit through any one pole. Automatic tripping shall be clearly indicated by handle position.

F. Rating. The molded case circuit breakers shall be rated for fault duty as specified on the plans. Series ratings are not allowed. The Contractor shall verify available fault current with the Utility Company for the actual installation and forward to the Engineer.

2.3 SAFETY SWITCHES

A. Contractor Furnished. The contractor shall provide all safety disconnect switches required. The switches shall be of the type, voltage, ampere, and horsepower rating, number of poles, fusible or nonfusible, as specified or required for the environment, location, application, and load served.

B. Description. All safety switches shall be NEMA premium heavy duty, horsepower rated, industrial type, and shall be Underwriters' Laboratories listed. Fusible switches shall be complete with fuses of the type and rating specified (refer to paragraph "Fuses") and as indicated on the drawings or within these specifications. All switches shall have switch blades that are fully visible in the OFF position when the door is open and shall be of dead front construction with arc suppressors. The mechanism shall be quick-make, quick-break type. The door shall be interlocked (defeatable type) with the handle or mechanism to prevent unauthorized opening of the door in ON position. Pad-locking provisions shall be provided for padlocking in the OFF position with one or more locks or lockable hasps. Grounded switches in a common enclosure shall be mounted in enclosure types specified elsewhere. Individually mounted switches shall be mounted in enclosures suitable for the location and environment as specified on the drawings.

C. Nameplate. All switches shall be provided with an engraved laminated phenolic nameplate showing the power source (Unit No. or other), and title of equipment served. Nameplates to be black letters on white background.

D. Manufacturer and Enclosures. All switches furnished shall have enclosures as specified on the drawings. Acceptable manufacturers shall be Square D, General Electric, Siemens, and Cutler-Hammer.

2.4 FUSES

A. Contractor Furnished. The contractor shall furnish and install fuses in all fusible devices and equipment that are furnished by the contractor.

B. Manufacturer and Listing. The following fuse types shall be used for the applications listed. The following are trade names of the Bussman Manufacturing Division, however, equivalent products by Chase Shawmut Division shall be acceptable.

Application	Trade Names	Class	Voltage (Type)
Motors & Miscellaneous Equipment 0-600 Amps	Fusetron	K-5 K-5	240 (FRN) 600 (FRS)

2.5 MISCELLANEOUS CONTROL DEVICES

A. Furnished by Others. Miscellaneous control devices such as duct switches, air flow switches, thermostats and temperature control devices, and similar equipment shall normally be furnished under another division. Any such device that is to be furnished under this division shall be specifically designated on the drawings.

B. Enclosures. All devices furnished shall be suitable for the control requirements and shall have voltage rating and adequate capacity for the application. They shall be housed in enclosures suitable for the location and environment as indicated on the drawings.

2.6 RECEPTACLES – OUTLETS

A. Contractor Furnished. The contractor shall furnish and install all convenience (and power type) receptacles and outlets shown on the drawings. Suitable boxes, covers and matching plugs as specified shall be provided and the installation shall conform to typical details, drawings, and as described elsewhere in this specification. See electrical symbol drawings for additional descriptive data. Contractor shall install ivory devices where called for on plans except in paneled rooms or areas with cabinetry or millwork where brown devices and plates shall be installed.

B. Single Manufacturer. Receptacles of similar usage and rating shall be those of a single manufacturer.

C. Usage and Manufacturer. General use and convenience outlets shall be as specified by symbol on the drawings and as listed on the symbols drawing.

D. Ground Fault Protection. Note that all convenience receptacles to be installed as ground fault interrupting type are so noted on drawings.

2.7 BOXES

A. Contractor Furnished. The contractor shall furnish and install all electrical boxes required for the proper installation of the electrical systems. Boxes shall be of the NEMA type suitable for the location. Boxes shall be installed as specified on the drawings and as described under "Wiring Methods", and other applicable sections of this specification for wiring devices such as switches, receptacles, and similar devices. In order to maintain fire ratings, boxes installed "back-to-back" in fire walls shall not be located in the same space between studs, but shall have a stud located between them.

B. Concealed. Fixture, outlet, and switch boxes installed concealed in walls or ceiling areas shall be galvanized or cadmium plated sheet steel of not less than the minimum size as recommended in the National Electrical Code and shall be furnished with appropriate covers as specified in other applicable sections of these specifications or on the drawings. All boxes shall be accessible for maintenance purposes.

C. Exact locations of all floor boxes shall be coordinated in the field with the architect unless specific dimensions are shown on the drawings

D. Surface Mounted. Fixture, outlet, and switch boxes installed surface mounted in unfinished areas shall be threaded, cast alloy iron or malleable iron. Iron type shall have a cadmium/zinc electroplate, or galvanized finish with appropriate lacquer. Boxes shall be of the approved type for the outlets, switches, and fixtures served and shall be made of the material and finish compatible with the conduit system and location. Surface mounted boxes shall be only as noted on the plans.

E. Splice and Tap Boxes. Splice and tap boxes for power circuits shall be used only where designated on the drawings and shall be of the type and size indicated. Otherwise all power wiring shall be continuous, splice and tap free, between equipment. On lighting and convenience receptacle circuitry, wiring may be spliced and boxes shall be provided for concealed or surface mounting as previously specified or may be JIC oil-tight of size and type indicated on the drawings or minimum size as specified in the National Electrical Code.

F. Pull Boxes. Pull boxes for interior, or outdoor exposed power wiring shall be provided where shown or required to facilitate the installation of the wiring. Pull boxes shall not be located in finished rooms and shall be accessible for maintenance use. For conduit sizes 3/4 and 1 inch, conduit fittings of the "C", "LB", "TB" and similar types may be used for "Pulling In." Unless designated otherwise, all pull boxes shall be the straight-through type and changes in direction shall not be made in the box. The boxes shall be of the minimum size and type as required by the National Electric Code or as sized on the drawings.

G. Exterior and Underground. For exterior exposed work, pull boxes shall be of NEMA 3R construction and shall be threaded hub type with gasketed cover.

2.8 COVERS AND DEVICE PLATES

A. Contractor Furnished. The contractor shall furnish and install the appropriate cover on all boxes, conduit fittings, panels, cabinets, switches, receptacles, and similar wiring devices and other equipment that is Contractor furnished. Conduit outlet fitting covers shall be the type specified under "Conduit Fittings."

2.9 ENCLOSURES

A. Enclosures and housings for all Contractor furnished electrical equipment and devices shall be suitable for the location and environmental conditions and shall be of NEMA type as shown on symbol sheet drawing.

END OF SECTION 16100

SECTION 16401 — SERVICE AND DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Materials specified in this section shall comply with all applicable requirements of SECTION 16010, GENERAL PROVISIONS.

1.2 WORK INCLUDES

A. Contractor shall coordinate as required with the utility company, and sub-contractors as required for site electrical services to provide electrical service to the building by way of underground 120/208V, 3 phase service from pole-mounted transformer(s) by the Utility.

B. Include in bid all costs, fees, or charges associated with installation of service to the building by the utility company.

C. Confirm exact location of all service and distribution equipment with owner's representative prior to installation.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. "K" rated meter base, per Utility company requirements.

B. Conduit from meter base into ground shall be per section 16110, and shall be schedule 40 PVC underground and galvanized rigid steel above ground.

PART 3 - EXECUTION

3.1 The required coordination and service installation work shall include, but not be limited to the following:

A. Contractor shall be responsible for furnishing and installing meter base per the utility company's installation requirements, and shall install all service entrance conduit and cable from meter base to service entrance panelboard as shown on drawings.

B. Provide coordination with the utility company for service cable entry into meter base. Stub one 4" schedule 40 PVC conduit from meter base underground and extend 48" past the edge of any sidewalks etc. beside the building in the direction requested by the utility company.

C. Install required conduit for signal wires to meter. Meter base shall be provided and mounted on building by contractor as shown on plans and as coordinated with the Utility.

D. Install all secondary cables, pulling sufficient lengths for terminations at meter base and at service entrance panelboard. Service entry conduit shall be PVC, size as noted on plans, and buried a minimum of 30" below finished grade with yellow warning tape placed 6" above conduits in earth. Coordinate all routings with that of other disciplines.

END OF SECTION 16401