

Table of Contents

DIVISION 22 - PLUMBING

220400 - Plumbing Pg. 19

DIVISION 23 - HEATING VENTILATION AND AIR CONDITIONING

230600 – Heating ventilation and Air Conditioning Pg. 16

DIVISION 26 - ELECTRICAL

260400 - Electrical Systems Pg. 34

260450 – Electrical Demolition Pg. 7

SECTION 220400 PLUMBING

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. Work Included: Provide plumbing where shown on the Drawings, as specified herein, and as needed for a complete and proper installation including, but not necessarily limited to:
 - 1. Domestic hot and cold water piping system.
 - 2. Drain, waste, and vent systems.
 - 3. Plumbing fixtures and trim as shown on the Drawings.
- B. Related Work: Documents affecting Work of this Section include, but are not necessarily limited to: General Conditions, Supplementary, and Sections in Division 1 of these Specifications.
- C. Drawings: The mechanical drawings show the general arrangement of piping, equipment, and appurtenances and shall be followed as closely as actual building construction, site conditions, and the work of other trades will permit. The mechanical work shall conform to the requirements shown on all of the drawings. General and structural drawings shall take precedence over mechanical drawings. Because of the small scale of the mechanical drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The contractor shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly.

1.2 QUALITY ASSURANCE:

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this Section.
- B. Codes and Regulations:
 - 1. In addition to complying with the specified requirements, comply with pertinent regulations of governmental agencies having jurisdiction, all applicable laws, codes, and ordinances including those of the state, county and city.
 - 2. The Work shall also comply with all applicable requirements of the National Fire Protection Association, International Building, Plumbing and Mechanical Codes, and all locally accepted amendments to these codes.
 - 3. In the event of conflict between or among specified requirements and pertinent regulations, the more stringent requirement will govern.
 - 4. Non-compliance: Should the contractor perform any work that does not comply with the requirements of the applicable building codes, state laws, local

ordinances, industry standards, and utility company regulations, he shall bear all costs arising in correcting the deficiencies.

- C. Install all utility connections to water, sewer, and gas per requirements of Governing Agencies. Pay all fees and permits for inspection and certification for the execution of this Work.
 - 1. Temporary Utility Service: All required utility services such as gas, water, storm and sanitary shall be obtained and paid for by the contractor under the section of the specifications for which they are required. The general contractor shall be responsible for utilities used during construction.
- D. Certificate of Final Inspection: Under each applicable section of the specifications, the contractor shall, upon completion of the work under that section, furnish a certificate of final inspection from the department having jurisdiction.

1.3 EXAMINATION OF SITE:

- A. Visit the site, inspect the existing Conditions and check the Drawings and Specifications so as to be fully informed of the requirements for completion of the Work.
- B. Lack of such information shall not justify a request for extra compensation to the contract price.

1.4 MATERIAL AND EQUIPMENT:

- A. All materials and equipment shall be new, those of the same type shall be by the same Manufacturer, and shall be of the best quality and design and free from defects.
- B. A Manufacturer's nameplate affixed in a conspicuous place will be required on each major component of equipment stating Manufacturer's name, address and catalog number.
- C. Manufacturer's name and model numbers used herein and on the Drawings establish type and quality required. Equal products may be considered if submitted in writing to the Engineer/Architect for approval 10 days prior to bid date. The Contractor shall be responsible for assuring the items and equipment substituted for those shown on the Drawings will physically fit in the space allocated.
- D. Delivery and Storage: Equipment and materials shall be delivered to the site and stored in original containers, suitably sheltered from the elements, but readily accessible for inspection until installed. All items subject to moisture damage (such as controls) shall be stored in dry, conditioned spaces.

- E. Protection: Equipment shall be tightly covered and protected against dirt, water and chemical or mechanical injury. Damage or defects developing before acceptance of the work shall be made good at the contractor's expense.
- F. Dimensions: It shall be the responsibility of the contractor to insure that items to be furnished fit the space available. He shall make necessary field measurements to ascertain space requirements, including those for connections, and shall furnish and install sizes and shapes of equipment so that the final installation shall suit the true intent and meanings of the drawings and specifications.
- G. Manufacturer's Directions: Shall be followed completely in delivery, storage, protection and installation of all equipment and materials. The contractor shall promptly give notice in writing of any conflict between any requirement of the Contract Documents and the manufacturer's directions and shall obtain written instructions before proceeding with the work. Should the contractor perform any work that does not comply with the manufacturer's directions or such written instructions, he shall bear all costs arising in correcting the deficiencies.

1.5 SUBMITTALS:

- A. Comply with pertinent provisions of Division 1.
- B. Product Data: After the Contractor has received the Owner's Notice to Proceed, submit:
 - 1. Materials list of items proposed to be provided under this Section.
 - 2. Manufacturer's Specifications, catalog cuts, and other data needed to prove compliance with the specified requirements.
 - 3. Shop Drawings and other data as required to indicate method of installing and attaching equipment, except where such details are fully shown on the Drawings.
 - 4. All sheets of the submittal shall have the job name stamped or permanently written neatly on them and shall be assembled in an indexed brochure. The descriptive material shall be arranged in the brochure in the same order as found in the specifications. Each brochure shall be submitted in a hardback, 3-ring binder. The leading sheet of the descriptive material for each item shall be full size, of heavy paper, with a numbered outside tab, and an index sheet showing the location in the brochure.
 - 5. Manufacturer's regular catalog sheets will not be acceptable under these requirements unless they indicate completely all of the specification requirements. Where drawings cover several sizes or types of construction, they shall clearly indicate the size or type of construction to be used on the project. In cases where several sizes of the same type of equipment are required to be furnished, the submittal shall include a schedule identifying each piece of equipment, complete with all capacity information needed to compare every submittal item with its respective specified item. Special features shall be listed on a separate typewritten sheet.
 - 6. Brochures shall contain a certification by the Contractor that the equipment or materials are suitable for conditions shown and specified; that the equipment or

materials are believed to be in conformity with the plans and specifications, except as may be specifically described; be signed by the Contractor. Brochures received not in conformity with these requirements will be returned for required action.

7. Finding "APPROVED" or "APPROVED AS NOTED" shall not eliminate responsibility for compliance with the plans and specifications, unless specific attention has been called, in writing, to the proposed deviations at the time of transmittal of the brochures and such deviations have been found acceptable, nor shall it eliminate the responsibility for freedom from errors of any sort in the data submitted. Discovery of such deviations at or after installation shall be cause for immediate replacement at no additional cost to the Owner.
 8. No material or equipment so governed shall be ordered until found acceptable by the Architect/Engineer/Owner.
- C. Sterilization Certificate: Upon completion of water line sterilization, deliver to the Architect two copies of an acceptable "Certificate of Performance" for that activity.
- D. Record Drawings:
1. Comply with pertinent provisions of Division 1.
 - a. Record Drawings- The contractor shall furnish to the owner CAD record drawings consisting of three (3) sets of 11" x 17" prints (To be bound in O&M Manuals), one (1) full size set of prints and one (1) disk, showing the piping and ductwork for the HVAC and plumbing systems. Piping sizes, rerouting, etc., for both under floor and above ceiling piping shall be shown. Also, provide a blue-line of the site plan, clearly marked, to indicate any and all changes in sanitary sewer, storm sewer, domestic cold water and natural gas piping to the building. In addition to these drawings, a complete set of approved ductwork shop drawings and temperature control shop drawings shall be included in this set of drawings.
 - 1) CAD Record drawings shall incorporate all change and field orders. (No separate or supplemental drawings).
 - 2) All equipment schedules to be revised to reflect installed manufacturer model numbers and capabilities.
 2. Include a copy of the Record Drawings in each copy of the operation and maintenance manual as described below. (Original document shall be reproducible paper.)
- E. Manuals: Upon completion of the Work of this Section, deliver to the Architect two copies of an operation and maintenance manual compiled in accordance with the provisions of Division 1 of these Specifications. Include within each manual:
1. Copy of the approved record documents for this portion of the Work.
 2. Copies of all warranties and guarantees.
 3. Description of equipment control and seasonal operation, including schedule of required maintenance.

1.6 INSPECTION:

- A. Make written notice to the Architect adequately in advance of each of the following stages of construction:
 - 1. In the underground Condition prior to placing concrete floor slab, when all associated Work is in place.
 - 2. When all rough-in is complete, but not covered.
 - 3. At completion of the Work of this Section.
- B. When material and/or workmanship is found to not comply with the specified requirements, within three days after receipt of notice of such non-compliance, remove the non-complying items from the job site and replace them with items complying with the specified requirements, all at no additional cost to the Owner.

1.7 PRODUCT HANDLING:

- A. Comply with pertinent provisions of Division 1.

1.8 CLEANING, TESTING AND PLACING IN SERVICE:

- A. Immediately prior to final inspection, the Contractor shall make a final cleanup of dirt and refuse resulting from his Work and shall assist in keeping the premises clean at all times.
- B. Immediately prior to final inspection, the Contractor shall clean all material and equipment installed under this Contract. Dirt, dust, plaster, stains and foreign matter shall be removed from all surfaces. Damaged finishes shall be touched up and restored to their original Condition.
- C. Mechanism of all equipment shall be checked, adjusted and tested for proper operation. Protective devices and parts shall be checked and tested for specified and required application and adjusted as required to produce the intended performance.

1.9 ADJUSTMENT AND INSTRUCTION:

- A. Energize all systems, equipment and fixtures and check for proper operation.
- B. The Contractor's service personnel shall instruct the Owner's Representative in the proper operation of all systems.

1.10 GUARANTEE:

- A. The Contractor guarantees all Work against any defects due to faulty workmanship or material and that all raceways, ducts, and piping are free from foreign material, obstructions, holes, or breaks of any nature.

- B. Upon written notice from the Architect or Owner, the Contractor shall promptly remedy without cost to the Owner any defects occurring within a period of one (1) year from the date of final acceptance.

1.11 WARRANTY:

- A. The Contractor shall properly execute in the Owner's name all Manufacturer's standard warranty certificates applying to equipment installed on the project and shall deliver said certificates to the Architect at completion of the job. All warranty cards shall also be properly executed and delivered to the supplier or Manufacturer's records. Standard warranties for equipment shall not be less than one (1) year.

PART 2 - PRODUCTS

2.1 PIPE SCHEDULE:

- A. Drain, Waste, and Vent System:
 - 1. For sanitary Work below the floor and outside underground:
 - a. Provide service weight cast iron pipe and fittings or Schedule 40 PVC or ABS DWV pipe if allowed by local codes.
 - b. Soil lines 5'-0" or more away from the structures may be Schedule 40 PVC.
 - 2. Above ground:
 - a. Provide service weight cast iron pipe and fittings with No-Hub joints. Schedule 40 PVC or ABS DWV pipe may be used in lieu of cast iron if allowed by local codes. All above ground rain water piping shall be cast iron and insulated.
- B. Water System (domestic piping):
 - 1. Above ground, provide Type "L" copper with sweated connections.
 - 2. Below grade, provide Type "K" copper with sil-fossed connections. Schedule 40 PVC may be used for water service, if allowed by local codes.
- C. Gas Piping:
 - 1. Underground piping equal to Republic X-Tru-Coat plastic coated black steel pipe with protective wrap over joints.
 - a. Piping 2" and smaller: Threaded fittings.
 - b. Piping 2-1/2" and larger: Welding fittings.
 - 2. Above ground piping shall be black steel.
 - 3. Gas service piping up to the building shall be continuous plastic pipe meeting ASTM D2513 and D2517.

2.2 MATERIALS:

- A. Cast Iron Soil Pipe and Fittings:
 - 1. Provide service weight cast iron conforming to ASTM A74 and CISPI 301, or provide hubless type per above standards. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and be listed by NSF International.
- B. Galvanized:
 - 1. Provide standard weight complying with ASTM A53 and A120 for above ground piping. (Galvanized not allowed underground or under slab floors.)
- C. Copper Pipe:
 - 1. Provide copper pipe conforming to ASTM B42 and B302. (Type "M" copper not allowed underground or under slab floors.)
- D. Copper Tube:
 - 1. Provide copper tube conforming to ASTM B75, B88, and B251. (Type "M" copper not allowed underground or under slab.)
- E. Polyvinyl Chloride Pipe:
 - 1. Provide PVC pipe conforming to ASTM D2665 for waste, vent, and drainage pipe above and underground within 5'-0" of the building.
 - 2. Provide PVC pipe conforming to ASTM D2265 for building sewer pipe.
 - 3. Provide PVC pipe conforming to ASTM D1785 for water service pipe.
- F. Unions:
 - 1. For copper lines, provide copper unions.
 - 2. For connections in iron pipe lines:
 - a. 2" and smaller provide ground joint brass-to-iron fittings.
 - b. 2-1/2" and larger provide standard cast iron with flanged ends and gaskets.
- G. Lead:
 - 1. Provide new pig lead complying with ASTM B29.

2.3 VALVES:

- A. All valves of the same type shall be by the same Manufacturer.
- B. Gate Valves: Provide solid wedge disc, rising stem, 200# WOG; non-rising stem valves may be used only where there is insufficient clearance. Sweat joint valves shall be used on all copper pipes.
 - 1. 2" and smaller, rising stem: Provide Hammond #IB-640, bronze, screwed, B-62 bronze body and stem, malleable iron handwheel.
 - 2. 2" and smaller, non-rising stem: Provide Hammond IB-645, bronze, screwed, B-62 bronze body and stem, malleable iron handwheel.

3. 2-1/2" and larger: Provide Hammond #IR-1140, IBBM, flanged, non-rising stem.
- C. Globe Valves: Provide replaceable composition disc suitable for 200°F water.
 1. 2" and smaller: Provide Hammond #IB-413T, bronze, screwed, malleable iron hand wheel.
 2. 2-1/2" and larger: Provide Hammond #IR-116, iron body, flanged, 200# WOG.
- D. Ball Valves: Provide large port ball of chrome plated, bronze or stainless steel construction, screwed ends, quarter turn operation, lever or C-handle operator. Valve shall be rated for 150 psi steam, 600 psi WOG. Valve shall have blow out proof stem and adjustable packing nut.
 1. 2" and smaller: Hammond #8501 Series or approved equal.
- E. Check Valves:
 1. 2" and smaller: Provide Hammond #IB-940, bronze, screwed, Y-pattern, 200# WOG, swing check type.
 2. 2-1/2" and larger: Provide Hammond #IR-1124, IBBM, flanged, 200# WOG.
- F. Plumbing Fixture Service Valves:
 1. 1/2" angle valve with wheel handle stop, 1/2" I.P.S. female inlet, 3/8" tube compression fitting outlet, 3/8" chrome plated flexible riser and chrome plated escutcheon plate. Chicago Faucet #1015 or equal.

2.4 FLASHING:

- A. Where pipes of this Section pass through the roof, flash with Semco, #1100-4 seamless 4 lb. flashing, with steel reinforced "Vari-Pitch" boot and cast iron counterflashing sleeve or equal method approved by the Architect.

2.5 PIPE HANGERS:

- A. Water Piping:
 1. Provide Fee and Mason #212 split ring hangers with supporting rods.
 2. Copper plated hangers or hangers with dielectric isolators to be installed for copper pipe.
- B. Soil and Waste Piping:
 1. Provide Fee and Mason #212 adjustable ring hangers with supporting rods.
 2. Use Fee and Mason #241 riser clamps at each floor and as required.

2.6 CLEANOUTS:

- A. Exterior:

1. Provide Wade W-6030-Z, or Smith #4253 with XH cast iron top in concrete areas.
- B. Floors:
 1. Provide Wade W-6030-1 or Smith #4023 with round nickle bronze top in finished room floors.
 2. Provide Wade W-6030-Z or Smith #4223 with round cast iron top in unfinished room floors.
 3. Provide "flush-with-floor" type cleanouts, with adjustable watertight covers and integral anchoring flange with clamping collar where waterproofing membrane is used.
- C. Finished Walls:
 1. Provide Wade W-8460-R6 or Smith #4532 with round chrome plate or stainless steel access plate and screw.
- D. Provide cleanout plugs of extra heavy bronze.

2.7 ACCESS BOXES:

- A. Walls:
 1. Provide Wade W-8480-ST or Smith #4730 with polished chrome plate face in tile walls.
 2. Provide Wade W-8490-AKL, Smith #4760-AKL or #4765-AKL with bonderized prime-coated steel face and with Allen locks in walls of other finished rooms.
- B. Ceilings:
 1. Provide Acorn DW Series bonderized prime-coated steel face with Allen lock.

2.8 TRAPS:

- A. For lavatories and sinks, except service sinks, provide chrome plated cast brass traps with brass nuts. Provide deep seal traps where required and/or shown on the Drawings.
- B. For handicap lavatories, provide off-set tailpiece ahead of P-trap.

2.9 WATER HAMMER ARRESTORS:

- A. Provide Smith #5000 series or Precision Plumbing Products, Inc. stainless steel.

2.10 INSULATION:

- A. Insulate hot water, cold water, and condensate piping with ½" thick glass fiber preformed pipe insulation with factory applied all purpose glass fiber reinforced flame retardant kraft paper and aluminum foil self sealing lap.

- B. Elbows and fittings to be insulated with factory preformed PVC jacketed insulation material to match thickness of pipe insulation.
- C. Valve bodies shall be insulated with Armstrong Armaflex type "FR" or equal insulation with vapor barrier. Factory preformed insulation enclosures may be substituted for field applied insulation.
- D. Insulated waste traps receiving cooling coil condensate and piping for a minimum of 10 feet after trap with ½ inch Armstrong Armaflex type "FR" or equal insulation with vapor barrier.
- E. Where shown on the Drawings or required by governmental agencies having jurisdiction, at lavatories for handicapped persons provide TRUEBRO Inc. Handi Lav-Guard model #102W and #105W white finish insulation on hot water supply, cold water supply, tailpiece, and trap.

2.11 FIXTURES AND EQUIPMENT:

- A. Provide plumbing fixture, trim, (exposed trim to be chrome plated) and equipment as shown on the "Plumbing Fixture Schedule" in the Drawings. China fixture shall be of the best grade vitreous ware without pit holes and blemishes. The Architect reserves the right to reject any pieces which, in his opinion, are faulty.
 - 1. For the purpose of identification only one Manufacturer's model numbers are used throughout the schedule shown on the Drawings.
 - 2. Approved Manufacturers: American Standard, Crane, Kohler, or Eljer.
- B. Non-Freeze Hose Bibbs (FPHB):
 - 1. Provide 3/4" non-freeze type of cast bronze construction with lock shield cap and loose key operator to suit wall size.
 - 2. Hose bibb to have integral backflow preventer, pressure relief valve and vacuum breaker.
 - 3. Approved equal by Wade (W-8620), Zurn or Woodford.
- C. Cover Plates (Escutcheons):
 - 1. Provide chrome plated brass equal to Beaton Corbin Company style 2-BC for copper tube and 13-BC for standard pipe.
- D. Floor Drains:
 - 1. Provide floor drains where indicated on the Drawings complete with deep seal P-trap as listed below for various floor conditions:
 - a. Linoleum or asphalt tile floor - Wade W-1100-STD-1 with nickle bronze raised lip strainer.
 - b. Quarry tile or Terrazzo floor - Wade W-1100-G-1 with nickle bronze square strainer.
 - c. General - Wade W-1100 with type B nickle bronze strainer:
 - 1) 2" drain to have 5" strainer;
 - 2) 3" drain to have 6" strainer;

- 3) 4" drain to have 8" strainer.
- d. Heavy duty - Wade W-1200-13-5 with 12" diameter secured coated iron grate.
- e. Manufacturers - Zurn, Wade, or J.R. Smith.

2.12 INSULATION:

- A. Insulate hot water, cold water, rain leader, condensate, and refrigerant suction lines with 1/2" thick IMCOA Polyolefin Insulation or Armstrong Armaflex type "FR" with vapor barrier.
- B. Also see requirements specified for "Handicap Fixture Insulation."

2.13 SLEEVES:

- A. Where pipes pass through concrete, masonry, or stud walls, or pass through ceilings, provide 20-gauge galvanized sheet metal sleeve large enough to allow for free movement of the pipes with expansion.

2.14 OTHER MATERIALS:

- A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS:

- A. Examine the areas and Conditions under which Work of this Section will be performed. Correct Conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory Conditions are corrected.

3.2 PLUMBING SYSTEM LAYOUT:

- A. Lay out the plumbing system in careful coordination with the Drawings, determining proper elevations for all components of the system and using only the minimum number of bends to produce a satisfactorily functioning system.
- B. Follow the general layout shown on the Drawings in all cases except where other Work may interfere.

- C. Lay out pipes to fall within partition, wall, or roof cavities, and do not require furring other than as shown on the Drawings. Do not install domestic water lines in exterior walls without proper considerations of required insulation and routing.
- D. Slots, Chases, Openings, and Recesses: Through floors, walls, ceilings, and roofs as specified in new structure will be provided by the various trades in their respective materials, but the trade requiring them shall see that they are properly located and shall do any cutting and patching caused by the neglect to do so. No cuts shall be made into any structural element, beam or column, without written approval. Opening in existing structures will be provided by the trade requiring same.
- E. Locations: Of pipes, ducts, switches, panels, equipment, fixtures, etc., shall be adjusted to accommodate the work to interferences anticipated and encountered. The contractor shall determine the exact route and location of each pipe, duct and electrical raceway prior to fabrication.
 - 1. Right-of-Way: Lines which pitch shall have the right-of-way over those which do not pitch. For example, plumbing drains shall normally have right-of-way. Lines whose elevations cannot be changed shall have the right-of-way over lines whose elevations can be changed.
 - 2. Offsets, transitions and changes in direction in pipes and ducts shall be made as required to maintain proper head room and pitch of sloping lines whether or not indicated on the drawings. The contractor shall furnish and install all traps and sanitary vents, etc., as required to effect these offsets, transitions and changes in direction.

3.3 TRENCHING AND BACKFILLING:

- A. Perform trenching and backfilling associated with the Work of this Section in strict accordance with the provisions of Division 2 of these Specifications.
- B. Cut bottom of trenches to grade. Make trenches 12" wider than the greatest dimension of the pipe.
- C. Bedding and Backfilling:
 - 1. Install piping promptly after trenching. Keep trenches open as short a time as practicable.
 - 2. Under the building, install pipes on a 6" bed of damp sand. Backfill to bottom of slab with damp sand.
 - 3. Outside the building, install underground piping on a 6" bed of damp sand. Backfill to within 12" of finish grade with damp sand. Backfill remainder with native soil.
 - 4. Do not backfill until installation has been approved and Project Record Documents have been properly annotated.
 - 5. Provide bare copper trace wire 6 inches above all buried plastic pipe.
 - 6. Provide continuous plastic banner labeled CAUTION-GAS PIPING 12 inches above all buried gas piping.

3.4 INSTALLATION OF PIPING AND EQUIPMENT, GENERAL:

A. General:

1. Proceed as rapidly as the building construction will permit. Install piping parallel and perpendicular to building walls and partitions.
2. Thoroughly clean items before installation. Cap pipe openings to exclude dirt until fixtures are installed and final connections have been made.
3. Cut pipe accurately, and work into place without springing or forcing, properly clearing windows, doors, and other openings. Excessive cutting or other weakening of the building will not be permitted.
4. Show no tool marks or threads on the exposed plated, polished, or enameled connections from fixtures. Tape all finished surfaces to prevent damage during construction.
5. Make changes in directions with fittings; make changes in main size with eccentric reducing fittings. Unless otherwise noted, install water supply and return piping with straight side of eccentric fittings at top of the pipe.
6. Run horizontal sanitary piping at a uniform grade of 1/4" per ft., unless otherwise noted. Branch connections and changes in direction to be made with 45 degree "Y" fittings or long sweep ells.
7. Run horizontal water piping with an adequate pitch upward in direction of flow to allow complete drainage.
8. Install vent connections on all fixtures, traps, and equipment connected to the soil and waste system and extend not less than 3'-6" above floor before turning horizontal. Extend vent through roof minimum 1'-0" above roof or adjacent wall within 18" of roof penetration.
9. Provide sufficient swing joint, ball joints, expansion loops, and devices necessary for a flexible piping system, whether or not shown on the Drawings. Make branch connections with offsets to provide for pipe movement.
10. Support piping independently at pumps, and similar locations, so that weight of pipe will not be supported by the equipment.
11. Pipe drain lines from drip pans, air vents, relief valves and similar locations, to spill over an open sight drain, floor drain, or other acceptable discharge point, and terminate with a plain end, unthreaded pipe 2" above the drain.
12. Securely bolt all equipment, isolators, hangers, and similar items in place.
13. Support each item independently from other pipes. Do not use wire for hanging or strapping pipes.
14. Provide complete dielectric isolators between ferrous and non-ferrous metals.
15. Provide union and shut-off valves suitably located to facilitate maintenance and removal of equipment and apparatus.
16. Provide shut-off gas valve and union at each piece of gas fired equipment and service penetration through exterior wall and roof.
17. Valves, strainers, check valves, and fittings shall be full size of the line they serve unless noted otherwise.
18. Make change in pipe size noted on the plans after last fitting of larger pipe. When supply pipes are larger than equipment tappings, reduce size immediately prior to entry.

B. Equipment Access:

1. Install piping, equipment, and accessories to permit access for maintenance. Reroute pipe and/or relocate items as necessary to provide such access, and without additional cost to the Owner.
2. Provide access doors where valves, motors, or equipment requiring access for maintenance are located in walls or chases or above ceilings. Coordinate location of access doors with other trades as required.

3.5 PIPE JOINTS:

A. Copper Tubing:

1. Cut square, remove burrs, and clean inside of female fitting to a bright finish.
 - a. Apply solder flux with brush to tubing.
 - b. Remove internal parts of solder-end valves prior to soldering.
2. Provide dielectric unions at points of connection of copper tubing to ferrous piping and equipment.
3. For joining copper tubing, use:
 - a. Water piping 3" and smaller : 95-5 solder.
 - b. Water piping larger than 3" : "Sil-fos" brazing.
 - c. Underground : "Sil-fos" brazing.

B. Screwed Piping:

1. Deburr cuts.
 - a. Do not ream exceeded internal diameter of the pipe.
 - b. Thread to requirements of ANSI B2.1.
2. Use teflon tape on male thread prior to joining other services.
3. Use litharge and glycerin on joint prior to cleaning for air and oil piping.

C. Plastic Piping:

1. Mechanical joints shall be made with an Elastomeric thread seal on male thread. Joint shall be clean and free of dirt and made in accordance with Manufacturer's instructions. (DWV piping to conform to ASTM D3212.)
2. Solvent Cementing:
 - a. Clean joint surfaces free of dirt and moisture.
 - b. Prime joint with colored primer past extend of joint.
 - c. Apply cement to all joint surfaces and make joint while cement is still wet.
 - d. Use Solvent Cement for particular pipe material and make joint in accordance with Manufacturer's instructions.
3. Threaded joints shall be made in using lubricant or tape approved for pipe material applied to male thread. Threads of joints shall conform to ANSI B2.1 and shall be clean of dirt immediately prior to making joint.

D. Welded Piping:

1. Welded pipe to be joined in accordance with American Welding Society Code using butt-welded single V beveled 45 degrees to within 1/16" of inside wall. Use welding fittings for changes of direction and intersection of lines.

- E. Leaky Joints:
 - 1. Remake with new material.
 - 2. Remove leaking section and/or fitting as directed.
 - 3. Do not use thread cement or sealant to tighten joint.

3.6 PIPE SUPPORTS:

A. Support suspended piping with clevis or trapeze hangers and rods.

B. Space hangers and support for horizontal steel pipes according to the following schedule:

<u>Pipe Size</u>	<u>Maximum Spacing on Centers</u>
1-1/4" and smaller	: 8'-0"
1-1/2" to 3"	: 10'-0"
4" to 5"	: 14'-0"

C. Space hangers and supports for horizontal copper tubing according to the following schedule:

<u>Tube Size</u>	<u>Maximum Spacing on Centers</u>
1" and smaller	: 6'-0"
1-1/2"	: 7'-0"
2"	: 8'-0"
2-1/2"	: 9'-0"
3" and larger	: 10'-0"

D. Space hangers and supports for horizontal cast iron soil pipe 5'-0" on center.

E. Space hangers and supports for horizontal PVC and ABS plastic pipe 4'-0" on center.

F. Provide sway bracing on hangers longer than 18".

G. Support vertical piping with riser clamps secured to the piping and resting on the building structure. Provide at each floor unless otherwise noted.

H. Provide insulation continuous through hangers and rollers. Protect insulation by galvanized steel shields.

I. Arrange pipe supports to prevent excessive deflection, and to avoid excessive bending stress.

J. Support piping from inserts or anchors in concrete slabs. Provide the inserts under this Section and arrange for the placing under Section 03300 of these Specifications. Use expansions inserts only where approved by the Architect.

K. Hubless Piping:

- 1. Provide hangers on the piping at each side of, and within 6" of, hubless pipe coupling so the coupling will bear no weight.

2. Do not provide hangers on couplings.
3. Provide hangers adequate to maintain alignment and to prevent sagging of the pipe.
4. Make adequate provisions to prevent shearing and twisting of the pipe and the joint.

3.7 SLEEVES AND OPENINGS:

- A. Provide sleeves for each pipe passing through walls, partitions, floors, roofs, and ceilings.
 1. Set pipe sleeves in place before concrete is poured.
 2. For uninsulated pipe, provide sleeves two pipe sizes larger than the pipe passing through, or provide a minimum of 1/2" clearance between inside and outside of the pipe.
 3. For insulated pipe, provide sleeves of adequate size to accommodate the full thickness of pipe covering, with clearance of packing and caulking.
- B. Caulk the space between sleeve and pipe or pipe covering, using a noncombustible, permanently plastic, waterproof, non-staining compound which leaves a smooth finished appearance, or pack with noncombustible cotton, rope, or fiberglass to within 1/2" of both wall faces, and provide the waterproof compound described above.
- C. Finish and Escutcheons:
 1. Smooth any rough edges around sleeves with plaster or spackling compound.
 2. Provide 1" wide chrome or nickle plated escutcheons in all pipes exposed to view where passing through walls, floors, partitions, ceilings, and similar locations.
 - a. Size the escutcheons to fit pipe and covering.
 - b. Hold escutcheons in place with set screw.

3.8 CLEANOUTS:

- A. Accessible cleanouts shall be installed in all horizontal waste lines at no greater than 100 ft. intervals and at the base of all vertical stacks.
- B. Secure the Architect's approval of locations for cleanouts in finished areas prior to installation.
- C. Provide cleanouts of same nominal size as the pipes they serve; except where cleanouts are required in pipes 4" and larger, provide 4" cleanouts.
- D. Make cleanouts accessible. After pressure tests are made and approved, thoroughly graphite the cleanout threads.

3.9 VALVES:

- A. Provide valves in water, air, and gas systems. Locate and arrange so as to give complete regulation of apparatus, equipment, and fixtures.
- B. Provide valves in at least the following locations:
 - 1. In branches and/or headers of water piping serving a group of fixtures.
 - 2. On both sides of apparatus and equipment.
 - 3. For shutoff of risers and branch mains.
 - 4. For flushing and sterilizing the system.
 - 5. Where shown on the Drawings.
- C. Locate valves for easy accessibility and maintenance.

3.10 WATER HAMMER ARRESTORS:

- A. Provide water hammer arrestors on hot water lines and cold water lines.
 - 1. Install in upright position at all quick closing valves, solenoids, isolated plumbing fixtures, and supply headers at plumbing fixture groups.
 - 2. Locate and size as specified or as shown on the Drawings and, where not shown, locate in accordance with Plumbing and Drainage Institute Standard WH-201.
 - 3. Install water hammer arrestors behind access panels.
- B. Where fixtures are not protected by water hammer arrestors, provide air compression chambers equal to twelve (12) pipe diameters, 18" minimum on all water supply connections.

3.11 BACKFLOW PREVENTION:

- A. Protect plumbing fixtures, faucets with hose connections, yard hydrants, lawn irrigation, and other equipment having plumbing connection, against possible back-siphonage.

3.12 PLUMBING FIXTURE INSTALLATION:

- A. Installation:
 - 1. Set fixtures level and in proper alignment with respect to walls and floors, and with fixtures equally spaced.
 - 2. Provide supplies in proper alignment with fixtures and with each other.
 - 3. Provide flush valves in alignment with the fixture, without vertical or horizontal offsets.
 - 4. Install all fixture supports before wall finish is applied.
- B. Grout wall and floor mounted fixtures watertight where the fixtures are in contact with walls and floors.

- C. Caulk deck-mounted trim at the time of assembly, including fixture and casework mountings. Caulk self-rimming sinks installed in casework.
- D. All fixtures shall be cleaned before setting and the installation shall be left ready for use.

3.13 DISINFECTION OF WATER SYSTEMS:

- A. Sterilize domestic hot and cold water systems to meet Health Department requirements.
 - 1. Prior to treatment, flush the system of all dirt and foreign matter.
 - 2. Fill system with water treated with 50 ppm of chlorine. Leave treated water in the systems for 24 hours.
 - 3. Open all valves and faucets several times during flushing and treatment filling to insure full circulation.
 - 4. Test the chlorine content at the end of treatment period and if chlorine content is greater than 10 ppm, flush the system. If chlorine content is found to be less than 10 ppm, repeat the sterilization process. Take samples from several points in the system.
 - 5. After sterilization, flush the system with clean water until the chlorine is less than 0.1 ppm.
- B. After final flushing, obtain Health Department Certificate of Approval on samples of water taken from the systems. (Use a testing agency approved by the Health Department.) Test shall show negative for coli-aerosene organisms.
- C. If analysis results are not satisfactory, repeat the disinfection procedures and retest until specified standards are achieved.

3.14 OTHER TESTING AND ADJUSTING:

- A. Provide personnel and equipment, and arrange for and pay the costs of, all required tests and inspections required by governmental agencies having jurisdiction.
- B. Test the following systems at the pressures listed:
 - 1. Gas piping: Test under 30 psi air pressure.
 - 2. Domestic water: Test under 130 psi hydrostatic pressure.
 - 3. Soil and waste:
 - a. Above ground test with 12 ft. water head;
 - b. Underground test with 8 ft. water head.
- C. Where tests show materials or workmanship to be deficient, replace or repair as necessary, and repeat the tests until the specified standards are achieved.
- D. Adjust the piping systems to optimum standards of operation.

END OF SECTION

SECTION 230600 HEATING, VENTILATING, AND AIR CONDITIONING

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. Work Included: Provide heating, ventilating, and air conditioning systems where shown on the Drawings, as specified herein, and as needed for a complete and proper installation including, but not necessarily limited to:
 - 1. Mini-Split system direct expansion heat pump heating and cooling system with controls, safety controls, blowers, motors, electric strip heaters, compressors, coils, filters, and related items.
 - 2. Air conditioning supply and return ductwork system with grilles, diffusers, registers, dampers, sheet metal hardware, and related items.
 - 3. Exhaust systems including, motors, ductwork, grilles, registers, controls and related items.
 - 4. Temperature control system.
 - 5. Air systems balance for air quantities shown on the plans.
 - 6. Acoustical and thermal insulation of ducts, piping, and equipment.
- B. Related Work: Documents affecting Work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of this Specification.
- C. Drawings: The mechanical drawings show the general arrangement of all piping, equipment, and appurtenances and shall be followed as closely as actual building construction, site conditions, and the work of other trades will permit. The mechanical work shall conform to the requirements shown on all of the drawings. General and structural drawings shall take precedence over mechanical drawings. Because of the small scale of the mechanical drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The contractor shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly.

1.2 QUALITY ASSURANCE:

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this Section.
- B. Codes and Regulations:
 - 1. In addition to complying with the specified requirements, comply with pertinent regulations of governmental agencies having jurisdiction, all applicable laws, codes, ordinances including those of the state, county and city.

2. The Work shall also comply with all applicable requirements of the National Fire Protection Association, International Building, Plumbing and Mechanical codes, and all locally accepted amendments to these codes.
 3. In the event of conflict between or among specified requirements and pertinent regulations, the more stringent requirement will govern.
 4. Pay all fees, taxes, licenses and permits for inspection and certification for the execution of this Work.
 5. Non-compliance: Should the contractor perform any work that does not comply with the requirements of the applicable building codes, state laws, local ordinances, industry standards, and utility company regulations, he shall bear all costs arising in correcting the deficiencies.
- C. Certificate of Final Inspection: Under each applicable section of the specifications, the contractor shall, upon completion of the work under that section, furnish a certificate of final inspection from the department having jurisdiction.

1.3 EXAMINATION OF SITE:

- A. Visit the site, inspect the existing Conditions and check the Drawings and Specifications so as to be fully informed of the requirements for completion of the Work.
- B. Lack of such information shall not justify a request for extra compensation to the contract price.

1.4 MATERIAL AND EQUIPMENT:

- A. All materials and equipment shall be new, of the same type and Manufacturer, and shall be of the best quality and design and free from defects.
- B. A Manufacturer's nameplate affixed in a conspicuous place will be required on each major component of equipment stating Manufacturer's name, address and catalog number.
- C. Manufacturer's name and model number used herein and on the Drawings establish type and quality required. Equal products may be considered if submitted in writing to the Engineer/Architect for approval 10 days prior to bid date. The Contractor shall be responsible for assuring the items and equipment substituted for those shown on the Drawings will physically fit in the space allocated.
- D. Delivery and Storage: Equipment and materials shall be delivered to the site and stored in original containers, suitably sheltered from the elements, but readily accessible for inspection until installed. All items subject to moisture damage (such as controls) shall be stored in dry, conditioned spaces.

- E. Protection: Equipment shall be tightly covered and protected against dirt, water and chemical or mechanical injury. Damage or defects developing before acceptance of the work shall be made good at the contractor's expense.
- F. Dimensions: It shall be the responsibility of the contractor to insure that items to be furnished fit the space available. He shall make necessary field measurements to ascertain space requirements, including those for connections, and shall furnish and install sizes and shapes of equipment so that the final installation shall suit the true intent and meanings of the drawings and specifications.
- G. Manufacturer's Directions: Shall be followed completely in delivery, storage, protection and installation of all equipment and materials. The contractor shall promptly give notice in writing of any conflict between any requirement of the Contract Documents and the manufacturer's directions and shall obtain written instructions before proceeding with the work. Should the contractor perform any work that does not comply with the manufacturer's directions or such written instructions, he shall bear all costs arising in correcting the deficiencies.

1.5 SUBMITTALS:

- A. Comply with pertinent provisions of Division 1.
- B. Product Data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
 - 1. Materials list of items proposed to be provided under this Section.
 - 2. Manufacturer's Specifications, catalog cuts, and other data needed to prove compliance with the specified requirements.
 - 3. Shop Drawings and other data as required to indicate method of installing and attaching equipment, except where such details are fully shown on the Drawings.
 - 4. All sheets of the submittal shall have the job name stamped or permanently written neatly on them and shall be assembled in an indexed brochure. The descriptive material shall be arranged in the brochure in the same order as found in the specifications. Each brochure shall be submitted in a hardback, 3-ring binder. The leading sheet of the descriptive material for each item shall be full size, of heavy paper, with a numbered outside tab, and an index sheet showing the location in the brochure.
 - 5. Manufacturer's regular catalog sheets will not be acceptable under these requirements unless they indicate completely all of the specification requirements. Where drawings cover several sizes or types of construction, they shall clearly indicate the size or type of construction to be used on the project. In cases where several sizes of the same type of equipment are required to be furnished, the submittal shall include a schedule identifying each piece of equipment, complete with all capacity information needed to compare every submittal item with its respective specified item. Special features shall be listed on a separate typewritten sheet.
 - 6. Brochures shall contain a certification by the Contractor that the equipment or materials are suitable for conditions shown and specified; that the equipment or

materials are believed to be in conformity with the plans and specifications, except as may be specifically described; be signed by the Contractor. Brochures received not in conformity with these requirements will be returned for required action.

7. Finding "APPROVED EQUAL" or "NO EXCEPTION TAKEN" shall not eliminate responsibility for compliance with the plans and specifications, unless specific attention has been called, in writing, to the proposed deviations at the time of transmittal of the brochures and such deviations have been found acceptable, nor shall it eliminate the responsibility for freedom from errors of any sort in the data submitted. Discovery of such deviations at or after installation shall be cause for immediate replacement at no additional cost to the Owner.
8. No material or equipment so governed shall be ordered until found acceptable by the Architect/Engineer/Owner.

C. Record Drawings:

1. Comply with pertinent provisions of Division 1.
 - a. Record Drawings- The contractor shall furnish to the owner CAD record drawings consisting of three (3) sets of 11" x 17" prints (To be bound in O&M Manuals), one (1) full size set of prints and one (1) disk, showing the piping and ductwork for the HVAC and plumbing systems. Piping sizes, rerouting, etc., for both under floor and above ceiling piping shall be shown. Also, provide a blue-line of the site plan, clearly marked, to indicate any and all changes in sanitary sewer, storm sewer, domestic cold water and natural gas piping to the building. In addition to these drawings, a complete set of approved ductwork shop drawings and temperature control shop drawings shall be included in this set of drawings.
 - 1) CAD Record drawings shall incorporate all change and field orders. (No separate or supplemental drawings).
 - 2) All equipment schedules to be revised to reflect installed manufacturer model numbers and capabilities.
2. Include a copy of the Record Drawings in each copy of the operation and maintenance manual described below. (Original document shall be reproducible paper.)

D. Manuals: Upon completion of this portion of the Work, and as a Condition of its acceptance, deliver to the Architect two copies of an operation and maintenance manual compiled in accordance with the provisions of Division 1 of these Specifications. Include within each manual:

1. Copy of the approved record documents for this portion of the Work.
2. Copies of all warranties and guarantees.
3. Description of HVAC equipment control and seasonal operation, including schedule of required maintenance.

1.6 PRODUCT HANDLING:

- A. Comply with pertinent provisions of Division 1.

1.7 INSPECTION:

- A. Make written notice to the Architect adequately in advance of each of the following stages of construction:
 - 1. In the underground condition prior to placing concrete floor slab, when all associated Work is in place.
 - 2. When all rough-in is complete, but not covered.
 - 3. At completion of the Work of this Section.
- B. When material and/or workmanship is found to not comply with the specified requirements, within three days after receipt of notice of such non-compliance, remove the non-complying items from the job site and replace them with items complying with the specified requirements, all at no additional cost to the Owner.

1.8 CLEANING, TESTING AND PLACING IN SERVICE:

- A. Immediately prior to final inspection, the Contractor shall make a final cleanup of dirt and refuse resulting from his Work and shall assist in keeping the premises clean at all times.
- B. Immediately prior to final inspection, the Contractor shall clean all material and equipment installed under this Contract. Dirt, dust, plaster, stains and foreign matter shall be removed from all surfaces. Damaged finishes shall be touched up and restored to their original Condition.
- C. Mechanism of all equipment shall be checked, adjusted and tested for proper operation. Protective devices and parts shall be checked and tested for specified and required application and adjusted as required to produce the intended performance.

1.9 ADJUSTMENT AND INSTRUCTION:

- A. Energize all systems, equipment and fixtures and check for proper operation.
- B. HVAC system shall be placed in operation and balanced to provide air and water flow as indicated on the Drawings.
- C. The Contractor's service personnel shall instruct the Owner's Representative in the proper operation of all systems.

1.10 GUARANTEE:

- A. The Contractor guarantees all work against any defects due to faulty workmanship or material and that all raceways, ducts and piping are free from foreign material, obstructions, holes or breaks of any nature.

- B. Upon written notice from the Architect or Owner, the Contractor shall promptly remedy without cost to the Owner any defects occurring within a period of one (1) year from the date of final acceptance.

1.11 WARRANTY:

- A. The Contractor shall properly execute in the Owner's name all Manufacturer's standard warranty certificates applying to equipment installed on the project and shall deliver said certificates to the Architect at completion of the job. All warranty cards shall also be properly executed and delivered to the supplier or Manufacturer's representative for Manufacturer's records. Standard warranties for equipment shall not be less than one (1) year.

PART 2 - PRODUCTS

2.1 SHEET METAL DUCTWORK:

- A. For interior heating, ventilating, and air conditioning systems, provide best grade, prime, open hearth, galvanized sheet metal ducts fabricated and installed to pertinent ASHRAE and SMACNA standards, or to the requirements of governmental agencies having jurisdiction, whichever requirement is more stringent.
- B. Round ductwork to be constructed of best grade prime, open hearth galvanized steel with spiral seams. For systems with less than .75" W.G. pressure, round duct with longitudinal snap lock seams and beaded sleeve transverse joints may be installed.

2.2 FLEXIBLE DUCT:

- A. Provide factory fabricated insulated low pressure flexible duct with the following attributes as manufactured by Thermaflex, Wire Mold, Metalflex, or Flexmaster.
 - 1. Helix wire flexible core.
 - 2. 2" fiberglass blanket insulation of 3/4 lb. density with continuous sealed vapor barrier jacket.
 - 3. Accessories shall include strap clamps, spin-in duct taps, air scoops and dampers as required.
 - 4. Composite assembly, including insulation and vapor barrier, shall meet all requirements of UL 181, including flame spread of 25 or less and smoke developed rating of 50 or less as set forth in NFPA Bulletin 90-A, and bearing UL label as a Class 1 air duct.

2.3 DUCTWORK FABRICATION:

- A. All interior ductwork and fittings shall be fabricated in accordance with recommendations as outlined in current ASHRAE and SMACNA Standards.

- B. Gauges and reinforcing in accordance with current SMACNA Standards for greatest dimensions of duct or housing.
- C. Lap metal ducts in direction of air flow. Hammer down edges and slip joints to leave smooth duct interior.
- D. Cross break all rectangular ducts 18" and larger. Omit cross breaking if two gauge heavier metal is used in duct construction.
- E. Transverse Joints: Ductwork up to 24", use s-drive, pocket, or bar slip. Ductwork 25" to 40", use joints forming outside ribs. Other joint connections of equivalent mechanical strength and air tightness may be used if approved by the Engineer.
- F. Construct elbows with radius of not less than 1-1/2 times width of duct on center line or square elbows with air foil turning vanes. Round duct elbows shall be of the smooth radius type. For round duct systems with less than .75" W.G. pressure, jointed elbows may be installed.
- G. Branch ducts shall be tied to main trunk duct through radius take-off and splitter damper, or 45 degree branch and curved blade extractor. Round branch duct tappings to be of the conical or spin-in type with air scoop and volume damper for supply air on 12" round and smaller. Flanged or bellmouth taps used for larger ducts as noted on the Drawings.
- H. Transitions shall be constructed per SMACNA Standards and shall not exceed 20 degrees for diverging air flows or 30 degrees for contracting air flows.
- I. Plenums shall be fabricated in accordance to duct gauges and shall be reinforced per SMACNA standards.

2.4 DUCT HANGERS AND SUPPORTS:

- A. Hangers shall be galvanized steel band iron or angle iron and galvanized threaded rod. Wall supports shall be galvanized steel band iron or fabricated angle bracket.

2.5 DUCT INSULATION:

- A. General:
 - 1. Provide materials complying with NFPA Bulletin 90-A, as determined by UL method NFPA 225-ASTM E84, and complying with the governing code, with flame spread rating less than 25 and smoke developed rating less than 50.
 - 2. Where vapor barriers are used, provide intact and continuous throughout with all joints sealed.
 - 3. Manufacturer of duct liners shall print density and thickness on face of duct liner.
 - 4. Acceptable Manufacturers:

- a. Owens/Corning Fiberglass
 - b. Johns-Manville
 - c. Certainteed
 - d. Armstrong
- B. Ductliner (Interior Rectangular Duct): Insulate internal supply, return and exhaust ducts with 1" glass fiber with a minimum density of 1.5 pounds per cubic foot. Liner to be coated to prevent fiber erosion at air velocities up to 4000 f.p.m.
- C. Ductwrap (Interior Round Duct and Rectangular Duct): Insulate externally all round and rectangular ducts and fresh air ducts with 2" thick, 1 pound density, fiberglass ductwrap with factory applied reinforced aluminum foil vapor barrier.
- D. Sound Attenuation Ductliner (Interior Rectangular Duct): Insulate internal supply and return ducts with 2" glass fiber with a minimum density of 3 pounds per cubic foot. Liner to be coated to prevent fiber erosion at air velocities up to 4000 f.p.m. Attenuation duct liner installed for a minimum of the first two duct sections from the unit or as noted on the drawings.
- E. Exterior Duct Liner: All ductwork exposed to weather to be internally insulated with 2" glass fiber with a minimum density of 3.0 pounds per cubic foot. Liner to be coated to prevent fiber erosion at air velocities up to 4000 f.p.m.

2.6 DUCTWORK ACCESSORIES:

- A. Acceptable Manufacturers:
1. Air Balance, Inc.
 2. Ruskin
 3. Carnes
 4. Young
 5. Krueger
 6. Prefco
 7. Nailor Industries
- B. Access Doors: Access doors shall be installed for inspection, service, and maintenance of balance dampers, fire dampers, filters, etc. Doors shall be 12" x 12" for handhole and 24" x 24" for manhole where required. Access doors shall have gasket seals, insulated core and shall be secured air tight.
- C. Flexible Connections: Duct connections to fans and where noted elsewhere on plans shall be sound isolation of fire resistant, water proof, and mildew-resistant canvas. Connections shall not be less than 4" long, shall have suitable metal collar frame on each end, and shall be made with at least 1" slack material.
- D. Opposed Blade Dampers:
1. Construct of galvanized steel blades a maximum width of 6" set in 18-gauge galvanized steel frame with blade stops. Damper blades to be equipped with

rigid linkage bar and pivoted using noncorrosive bearings of oilite or nylon. Provide with minimum of 2 inch stand-off handle.

2. Single or parallel multiple blade dampers shall be of the same quality of construction, but shall not be used unless noted on the Drawings.
3. Damper blades shall be interlocking.
4. Where low leakage dampers are noted, blades shall be airfoil, insulated type with edge seals. Damper shall also include edge and jamb seals to limit air leakage.

2.7 AIR OUTLETS:

- A. Provide and install grilles, registers, and diffusers as scheduled on the Drawings with accessories as noted.
- B. Acceptable Manufacturers:
 1. Metalaire
 2. Titus
 3. Tuttle & Bailey
 4. Barber Colman
 5. Krueger
 6. Nailor Industries
- C. Flanged frame grilles, registers, and diffusers to have gasket seals.
- D. Provide insulated plenums, adaptor boxes or square to round transitions for connection to flexible duct runouts where required.

2.8 ROOF HOODS:

- A. Provide and install all aluminum roof hoods with bird screens as sized and noted on the Drawings. Backdraft dampers and other accessories to be furnished and installed as noted on the Drawings.
- B. Acceptable Manufacturers:
 1. Penn
 2. Greenheck
 3. Cook
 4. Carnes
 5. Or as provided by fan Manufacturer when installed in conjunction with exhaust or supply fan systems.

2.9 VIBRATION ISOLATION:

- A. Vibration isolation shall be of the type and deflection for the duty indicated on the Drawings. The vibration isolator supplier shall confirm equipment weights and

revolutions (Frequency) with actual products approved and installed by Division 15 Contractor.

- B. All vibration isolators and bases shall be treated for resistance to corrosion.
- C. Size type and deflection of isolators shall conform to recommendations set forth in ASHRAE standards.
- D. Approved Manufacturers:
 - 1. Amber Booth
 - 2. Mason Industries, Inc.
 - 3. Consolidated Kinetic Corporation

2.10 FANS:

- A. Exhaust fans shall be of the type and capacity as scheduled on the Drawings. All fans bear seal of ratings certified by A.M.C.A. Fans shall be furnished and installed with accessories, special coatings, special materials and construction, and controls as noted on the Drawings.
- B. Approved Manufacturers:
 - 1. Penn
 - 2. Greenheck
 - 3. Cook
 - 4. Carnes
 - 5. Twin City

2.11 MINI-SPLIT SYSTEM HEAT PUMP:

- A. Provide heating and cooling split system fan coil airhandling unit, evaporator/condenser coil in fan unit, air cooled outdoor heat pump unit with reversing valve, of the capacities and voltage as scheduled on the Drawings.
- B. Fan coil outdoor heat pump unit shall be of the same Manufacturer and matched for the capacities scheduled on the Drawings. Performance ratings shall comply with those scheduled for the outdoor and coil entering air design data listed on the Drawings.
- C. Fan Coil Features:
 - 1. Cabinet: Constructed of cold-rolled steel finished with baked enamel and fully insulated; duct connection flanges; filter frame and access door; and removable access panels for servicing.
 - 2. Fan: Direct drive, multi-speed blower, dynamically and statically balanced; fan motor overload protection; resilient mounting.
 - 3. DX Coil: Copper tube and mechanically bonded aluminum fins; refrigerant metering device; refrigerant line fittings; condensate drain pan with primary and secondary drain line fittings.

4. 424-22; heater over 10 KW shall be wired for 2 stage operation and sequenced off and on in 5 KW increments; all heaters shall have thermal overload protection; 60 VA control circuit; 24 volt transformer and voltage terminal board.
- D. Heat Pump Features: Galvanized heavy gauge steel with enamel finish housing; hermetic spring isolated compressor with crankcase heater and noise shield; thermal and current-sensitive overload protection; compressor internal high pressure protection; outdoor coil construction of copper tube with mechanically bonded aluminum fins; coil refrigerant metering device mounted at liquid service valve; direct drive, propeller condenser fan with factory lubricated, inherently protected, and resiliently mounted motor; low pressure switch; suction line accumulator; pressure relief device; automatic defrost control; liquid line solenoid valve; charging valves; liquid line filter dryer; compressor and condenser fan starters; EER and C.O.P. ratings to meet local code requirements for unit performance.
- E. Accessories: Extra set of throwaway filters to install after final acceptance; relays; transformers for control wiring; unit thermostat control as described in Temperature Control Section; precharged refrigerant lines when applicable for distance and routing.
- F. Acceptable Manufacturers:
 1. Lennox, no substitutions.

2.12 REFRIGERANT PIPING:

- A. Precharged and factory insulated refrigerant lines shall be installed for distances less than 50 feet and direct, unconcealed pipe routing. Refrigerant piping shall be type "L" copper, refrigerant grade with wrought copper fittings and insulated per Section 15400, item 2.12.
- B. Pipe sizes shown on the Drawings are for estimating purposes only. Equipment Manufacturer shall verify size of refrigerant piping for system installation.
- C. Refrigerant system shall include liquid filter dryer, strainer, charging valves, relief valves, check valves, sight glass, solenoid valves, and thermostatic expansion valves.

2.13 TEMPERATURE CONTROL:

- A. Contractor shall coordinate with TPS assigned controls contractor for a complete and operational control system based on TPS criteria.
- B. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect/Engineer.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS:

- A. Examine the areas and Conditions under which Work of this Section will be performed. Correct Conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory Conditions are corrected.

3.2 COORDINATION:

- A. Coordinate as required with other trades to assure proper and adequate provision in the Work of those trades for interface with the Work of this Section.
- B. Slots, Chases, Openings, and Recesses: Through walls, ceilings, and roofs as specified in new structure will be provided by the various trades in their respective materials, but the trade requiring them shall see that they are properly located and shall do any cutting and patching caused by the neglect to do so. No cuts shall be made into any structural element, beam or column, without written approval. Opening in existing structures will be provided by the trade requiring same.
- C. Locations: Of pipes, ducts, switches, panels, equipment, fixtures, etc., shall be adjusted to accommodate the work to interferences anticipated and encountered. The contractor shall determine the exact route and location of each pipe, duct and electrical raceway prior to fabrication.
 - 1. Right-of-Way: Lines which pitch shall have the right-of-way over those which do not pitch. For example, plumbing drains shall normally have right-of-way. Lines whose elevations cannot be changed shall have the right-of-way over lines whose elevations can be changed.
 - 2. Offsets, transitions and changes in direction in pipes and ducts shall be made as required to maintain proper head room and pitch of sloping lines whether or not indicated on the drawings. The contractor shall furnish and install all traps and sanitary vents, etc., as required to effect these offsets, transitions and changes in direction.

3.3 PREPARATION:

- A. Flashing:
 - 1. Where items of this Section penetrate the roof, outer walls or waterproofing of any kind, provide under this Section all base flashing and counterflashing required at such penetration.
 - 2. Provide on each pipe passing through the roof a 4 lb. seamless lead flashing and counterflashing assembly. Penetrations through sheet metal roofs shall be installed per roofing Manufacturer's recommendations.

3.4 EQUIPMENT INTERFACE:

AEG

HEATING, VENTILATING AND AIR CONDITIONING 230600 - 12

- A. Provide all required shutoff valves, unions, and final connections of piping to the Work of this Section.
- B. For electrically operated equipment, verify the electrical characteristics actually available for the Work of this Section and provide equipment meeting those characteristics.

3.5 DUCTWORK INSTALLATION:

- A. Rigidly support all interior ductwork using angle iron and galvanized threaded rods or galvanized strap hangers spaced to carry the load but not less than 5'-0" on centers and secured to the building structure in a method approved by the Architect. All hangers shall be installed truly vertical. Ductwork shall be hung level except where Architectural or structural Conditions dictate otherwise.
- B. Flexible ductwork shall not exceed 8'-0" runout total length from tapping to diffuser connection. Make smooth radius bends and secure duct at each end using a method of mechanical fastening with air tight seal. Support duct from resting on ceiling using strap hangers.
- C. Clean duct system of dirt and debris prior to operating any fan connected to the duct system. Cap all floor outlets and open ductwork during construction until final connections are made.
- D. Duct sizes shown on the Drawings are internal clear dimensions. The Contractor shall adjust for thickness of duct liner required.

3.6 DUCT HANGER AND SUPPORT INSTALLATION:

- A. Duct hangers and supports to be secured to the building structure via a method approved by the Architect.
- B. Hanger Minimum Sizes:
 - 1. Up to 30" wide: 1" x 16 ga. at 5 feet spacing.
 - 2. 31" to 48" wide: 1-1/2" x 16 ga. at 5 feet spacing.
- C. Horizontal Duct on Wall Supports Minimum Sizes:
 - 1. Up to 18" wide: 1-1/2" x 16 ga. galvanized steel strap or 1" x 1" x 1/8" angles at 8 feet spacing.
 - 2. 19" to 40" wide: 1-1/2" x 1-1/2" x 1/8" angles at 4 feet spacing.

3.7 INSULATION:

- A. Duct liner shall be adhered to interior sides of ductwork with minimum 50% coverage of fire retardant adhesive. Coat all exposed edges with adhesive. Use mechanical fasteners, (12-gauge impale anchor tabs or equal) maximum 16" on centers. Cut off

excess fastener length and cover with brush coat of mastic. Liner shall be cut to fit and be without gaps at all joints. Just before sections of ductwork are hung, coat end butt joints of duct liner with adhesive and hang immediately.

- B. Ductwrap shall be firmly secured to ductwork with adhesive applied in 6" widths on 16" centers. Securely fasten insulation in place with 16-gauge annealed tie wire spirals wound 16" on center for straight duct runs and half hitched around duct on 4" centers for elbows and fittings OR tape longitudinal seams on straight duct runs with 2" tape. Butt insulation and seal joints and breaks with 2" tape or foil adhered to vapor barrier. Do not stretch or compress insulation excessively during application.
- C. Duct liner to be installed as noted and indicated on the drawings. All other duct installations to be externally insulated with ductwrap.
- D. All supply air, return and outside air ductwork and plenums shall be insulated. Exhaust air shall be insulated from point of intake to location of backdraft damper.

3.8 DUCTWORK ACCESSORIES:

- A. Install items in accordance with Manufacturer's instructions and accepted methods.

3.9 AIR OUTLETS:

- A. Install all grilles, registers, and diffusers and their accessories in accordance with Manufacturer's instructions and accepted methods.
- B. Paint interior of all ductwork visible behind air outlets matt black.
- C. Review requirements of outlet sizes, finish, mounting, and air patterns prior to installation. Coordinate location of outlets and make necessary adjustments to conform with Architectural features, symmetry, and light locations. Refer to grille, register and diffuser list for additional requirements.

3.10 ROOF HOODS:

- A. Set roof hoods on factory or field built curbs and connect to ductwork as shown on the Drawings. Flash, caulk, and seal weather tight per Manufacturer's instructions and Architectural details.

3.11 VIBRATION ISOLATION:

- A. Install vibration isolators in accordance with Manufacturer's instructions.

3.12 FANS:

- A. Install fans in accordance with Manufacturer's instructions and accepted methods.
- B. Set roof mounted fans on factory or field-built curbs and connect to ductwork as shown on the Drawings. Fans manufactured for sloped roofs to be flashed into roofing per Manufacturer's instructions. Flash, counterflash, caulk, and seal water tight per Manufacturer's instructions and Architectural details.
- C. Vibration isolation shall be included in all fan mounting methods as required in the "Vibration Isolation" Section of these Specifications above and as detailed on the Drawings.

3.13 MINI-SPLIT SYSTEM HEAT PUMP:

- A. Install in accordance with code requirements and Manufacturer's instruction, adhering to required clearances for operation and servicing. Division 23 Contractor to complete ductwork, refrigerant piping, mounting and condensate connections for a fully functional system. Division 26 Contractor to rough-in and make final connections of required electrical and control wiring.
- B. Refrigerant system to be tested and fully charged and complete for a fully functional system.

3.14 REFRIGERANT PIPING:

- A. Install refrigerant piping parallel and perpendicular to building structure. Route piping as directly between equipment as possible, using only the minimum number of bends required. Support and hang piping as described in Section 220400, Item 2.05 A and 3.06 C. Joints and fittings to be sweat with SIL-FOS or equivalent silver bearing solder.
- B. Test refrigerant system with Nitrogen at 300 psi.

3.15 TEMPERATURE CONTROL:

- A. Division 26 Contractor shall furnish and install all control wiring. Coordinate and verify control requirements with unit Manufacturer and description of control shown on the Drawings. Locate thermostats as shown on the Drawings.

3.16 SEQUENCE OF OPERATION:

- A. PACKAGED ROOF TOP UNIT CONTROL SEQUENCES
 - 1. Room thermostat with fan on/auto switch, heat/cool/auto/off switch, heating and cooling set points.

2. Local selection of fan operation and temperature active during occupied periods only. Unit operational control shall be through manufacturer provided, factory installed self contained control module.
3. Heat-Auto-Cool selection shall be capable at the face of the thermostat. Selection of fan on-auto shall be capable at the face of the thermostat. Thermostat operation shall be capable of being overridden by the building management system.
4. Smoke Detector shall shut unit "off", close outside air damper, and initiate alarm signal to building fire alarm system.
5. Fan Control: System starts fan to cycle during a call for heating or cooling.
6. Smoke Control: Smoke detector, located in return air, signals alarm, stops fan when products of combustion are detected in airstream. Provide fire-stat for furnaces with cfm capabilities less than 2000 cfm.
7. Upon a call for cooling, the unit shall initiate operation of the unit fan, condensing fans, and refrigerant compressor(s) to provide cooling. The unit controller shall sequence the unit operation and safeties.
8. Upon a call for heating, the unit shall initiate operation of the gas fired heater and unit fan to provide heating. The unit controller shall sequence the unit operation and safeties.
9. Outside Air Control:
10. When fan is running, open outside-air dampers to minimum position. Damper spring returns to closed position when fan is "off".

B. VENTILATION SEQUENCES

1. Exhaust Fans: Refer to fan schedule on the drawings for description of fan controls.
 - a. Main toilet fans to be operated through the building management system scheduled control. Verify hours of occupancy with the Owner to establish schedule of operation.
 - b. Individual janitor closet and single toilet exhaust fans shall be individually operated as described in the fan schedule and will not be controlled through the BMS control system.

3.17 TESTING AND ADJUSTING:

- A. Test and adjust each piece of equipment and each system as required to assure proper air balance and operation.
 1. Test and regulate ventilation and air conditioning systems to conform to the air volumes shown on the design Drawings.
 2. Make tests and adjustments in apparatus and ducts for securing the proper volume and face distribution of air for each grille and ceiling outlet.
 3. Where required, provide pulleys for fans at no additional cost to the Owner, and set to drive the fan at the speed to give the indicated volume.
 4. For each system, take the following data in tabulated form:
 - a. Air volumes at all supply, return, and exhaust outlets
 - b. Total cfm supplied
 - c. Total cfm returned

- d. Total outdoor air cfm supplied
- e. Total cfm exhausted

- B. Submit two sets of test and balance reports to the Architect for approval.

- C. Eliminate noise and vibration, and assure proper function of all controls, maintenance of temperature, and operation in accordance with the approved design.

3.18 INSTRUCTIONS:

- A. Upon completion of this portion of the Work, and prior to its acceptance by the Owner, provide a qualified representative and fully instruct the Owner's maintenance personnel in the proper operation and maintenance of items provided under this Section.

- B. Demonstrate the contents of the approved operation and maintenance manual required in the "Submittals" Section of these Specifications.

END OF SECTION



T U L S A

PUBLIC SCHOOLS

260400
Electrical Systems

SECTION 260400 - ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. Work Included: Provide Design, Engineering and Construction Documents incorporating the Owner's Guidelines and Specifications defined herein, with proper installation of materials, assemblies and equipment including, but not limited to:
 - 1. Basic Materials and Methods.
 - 2. Control-Voltage Electrical Power Cables
 - 3. Low-Voltage Electrical Power Conductors and Cables.
 - 4. Grounding and Bonding.
 - 5. Hangers and Supports.
 - 6. Raceways and Boxes.
 - 7. Panelboards.
 - 8. Wiring Devices.
 - 9. Other items and services required to complete the systems.

- B. Drawings:
 - 1. These Design Guidelines and Specifications are accompanied by floor plans of the building showing the general location of the work. Exact locations shall be subject to the approval of the Owner who reserves the right to make any reasonable changes in locations indicated, prior to rough-in, without cost to the Owner. While the general run of feeders, branches, and conduits are indicated on the Drawings, it is not intended that the exact routing of circuits or locations of conduits be determined by Conceptual Drawings. Detailed arrangements of all Work shall be subject to the Owner's approval.

- C. Related Work:
 - 1. Documents affecting Work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

- D. Temporary Power:
 - 1. Arrange, provide and pay for the costs of installing temporary power to the site in accordance with the requirements of Division 1.

1.2 QUALITY ASSURANCE:

- A. Use adequate number of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this Section.

- B. Codes and Ordinances:
 - 1. The installation shall comply with requirements of all applicable laws, codes and ordinances including those of the state, county and city.

2. NFPA 70 - 2014.
 3. NFPA 72 – 2015 (including FM Directives)
 4. NFPA 101 – 2014.
 5. Where these Drawings, Design Guidelines and Specifications show more stringent requirements than required codes, the more stringent shall prevail.
 6. The Work shall comply with current standards of the serving utility companies.
- C. Permits, Fees and Licenses:
1. The Contractor shall obtain and pay for all permits, fees and licenses, for Work required under these Specifications.
- D. Utility Company Fees:
1. Coordination of existing utilities and easements including fees associated with the project shall be included in the Work.
- E. Without additional cost to the Owner, provide such other labor and materials as are required to complete the Work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.
- 1.3 EXAMINATION OF SITE:
- A. Visit the site, inspect the existing conditions and check the Drawings and Specifications to be fully informed of the requirements for completion of the Work.
 - B. Lack of such examination shall not justify a request for extra compensation to the Contract price.
- 1.4 MATERIAL AND EQUIPMENT:
- 1.5 SUBMITTALS:
- A. SHOP DRAWINGS AND SUBMITTAL DATA
1. Process shop drawings and submittal data to ensure that the proposed materials, equipment and devices conform to the requirements of the Contract Documents, and that there are no omissions or duplications. Provide layouts, fabrication information and data for systems, materials, equipment and devices proposed for the project.
 - a. Shop drawings shall be drawn on a scale not less than ¼ inch equals 1 foot showing actual dimensions. Shop drawings shall include, but not be limited to:
 - 1) Switchboards
 - 2) Distribution Panelboards
 2. Submittal data (manufacturer's catalog data) shall include Manufacturer's Specifications, product literature and other data needed to demonstrate compliance with the specified requirements, but not be limited to the following:

- a. Equipment: Switchboards, Panelboards, Transformers, Disconnect Switches, Enclosed Controller, Circuit Breakers, Fuses, etc.
 - b. Materials: conduit, conductors, connectors, supports, etc.
 - c. Lighting Fixtures and Lamps.
 - d. Wiring Devices.
 - e. Lighting Control Devices – Sensors, Dimming, etc.
 - f. Low-Voltage Data outlet devices and Cabling systems.
 - g. Low-Voltage Clock and Intercom System – (Existing).
 - h. Security and Camera Systems – (Existing)
 - i. Addressable Fire Alarm System – (Existing).
3. Manufacturer's recommended installation procedure which, when approved by the Owner, will become the basis for accepting or rejecting actual installation procedures used on the work.
 4. The submittal data shall not consist of manufacturer's catalogs or cut sheets that contain no indication of the exact item offered. The submission on individual items shall designate the exact item offered.
 5. Do not submit detailed quantitative listings of materials, equipment and devices. It is the Contractor's responsibility to provide proper sizes and quantities to conform to Contract Documents.
 6. Assemble submittals on related items procured from a single manufacturer in brochures or other suitable package form, rather than submitting a multiplicity of loose sheets.
 7. The Contractor shall submit shop drawings whenever equipment proposed varies in physical size and arrangement from that indicated thus causing rearrangement of equipment space, where tight spaces require extreme coordination between this work and other work, where called for elsewhere in these Specifications and where specifically requested by the Owner. Shop drawings shall be prepared at a scale of not less than ¼ inch equals 1 foot.

B. SUBSTITUTIONS

1. Where a single manufacturer is mentioned by trade name or manufacturer's name, it has been done to establish a standard rather than to discriminate against an equal product made by another manufacturer.
2. Where multiple manufacturers are listed in the Owner's drawings and/or specification, none other than those manufacturers will be accepted.
3. Substitute manufacturers will be considered prior to bid only. The substitute manufacturer shall submit a complete copy of the appropriate technical specification section minimum ten (10) business days prior to bid with each subparagraph noted with the comment, "compliance", "deviation" or "alternate". In the case of non-primary, vendor-supplied items, the name of the sub-vendor supplying said item, including model number, shall be indicated.
4. By noting the term "compliance" or "C", it shall be understood that the manufacturer is in full compliance with the item specified and will provide exactly the same with no deviations.
5. By noting the term "deviation" or "D", it shall be understood that the manufacturer prefers to provide a different component in lieu of that specified. Manufacturer shall indicate all deviations.
6. It shall be understood that space allocations have been made on the basis of present and known future requirements and the dimensions of items of equipment or

devices of a particular manufacturer whether indicated or not. If any item of equipment or device is offered in substitution which differs substantially in dimension or configuration from that indicated on the Drawings or specifications, provide as part of the submittal ¼ inch equals 1-foot scaled drawings showing that the substitute can be installed in the space available without interfering with other portions of the work or with access for operations and maintenance in the completed project.

7. Where substitute equipment or devices requiring different arrangement or connections from that indicated is accepted by the Owner, install the equipment or devices to operate properly and in harmony with the intent of the Contract Documents, making all incidental changes in piping, ductwork or wiring resulting from the equipment or device selection without any additional cost to the Owner. The Contractor shall pay all additional costs incurred by other portions of the work in connection with the substituted equipment or device.
8. The Owner reserves the right to call for samples of any item of material, equipment or device offered in substitution, together with a sample of the specific item when, in their opinion, the quality of the item and/or the appearance is involved, and it is deemed that an evaluation of the item may be better made by visual inspection.
9. When any request for a substitution of material, equipment or device is submitted and rejected, the item named in the Contract Documents shall be furnished. Repetitive submittal of substitutions for the same item will not be considered.

C. Samples:

1. When requested by the Owner, promptly provide samples of items scheduled to be exposed in the final structure.
2. When specifically, so requested by the Contractor and approved by the Owner, approved samples will be returned to the Contractor for installation on the Work.

D. Record Drawings:

1. Comply with pertinent provisions of Division 1.
2. Include a copy of the Record Drawings in each copy of the operation and maintenance manual described below.

E. Manual:

1. Upon completion of this portion of the Work, and as a Condition of its acceptance, deliver the operation and maintenance manual to the Owner complied in accordance with the provisions of Division 1 of these specifications. Include within each manual.
 - a. Copy of the approved Record Documents for this portion of the Work.
 - b. Copy of each circuit directories.
 - c. Copy of each warranty and guaranty.

1.6 GUARANTEE:

- A. The Contractor guarantees all Work against any defects due to faulty workmanship or material and that all raceways, ducts and piping are free from foreign material, obstructions, holes or breaks of any nature.

- B. Upon written notice from the Owner or Owner, the Contractor shall promptly remedy without cost to the Owner any defects occurring within a period of one (1) year from the date of final acceptance.

1.7 WARRANTY:

- A. The Contractor shall properly execute in the Owner's name all Manufacturers' standard warranty certificates applying to equipment installed on the project and shall deliver said certificates to the Owner at completion of the job. All warranty cards shall also be properly executed and delivered to the supplier or Manufacturer's representative for Manufacturer's records. Standard warranties for equipment shall be not less than one (1) year.

PART 2 - PRODUCTS

2.1 BASIC ELECTRICAL MATERIALS AND METHODS:

- A. Provide only materials that are new and of the type and quality specified. Where Underwriter's Laboratories, Inc. have established standards for such materials, provide only materials bearing the UL label.
- B. Materials and equipment shall be new, of the same type and manufacturer, of the best quality and design, free from defects and meet the requirements of UL and NFPA where standards are established for those items and assemblies.
- C. Manufacturer's nameplate affixed in a conspicuous place will be required on each major component of equipment stating Manufacturer's name, address and catalog number.
- D. Manufacturer's name and model number used herein and, on the Drawings, establish type and quality required. Equal products may be considered if submitted in writing to the Owner's Representative for approval 10 (ten) days prior to bid date. The Contractor shall be responsible for assuring the items and equipment substituted for those shown on the Drawings will physically fit in the space allocated.
- E. Fire stopping material shall be 3M Fire Seal Caulking, or approved substitution.
- F. Terminals and enclosures shall be marked for 75° C operation or conductor size shall be increased as required at no cost to the Owner.
- G. Steel Pipe Wall Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends. Comply with NECA 1.
- H. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work and roof manufacturer's requirements.

- I. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.
- J. Provide sleeves and chases where conduits pass through rated floors and walls, fire stopped in accordance with UL Listed assembly.
- K. When boring, cutting or drilling structural wood or wall members, drill only in locations as approved by the Owner.
- L. Immediately prior to final inspection, the Contractor shall make a final cleanup of dirt and refuse resulting from his Work and shall assist in keeping the premises clean at all times.
- M. Immediately prior to final inspection, the Contractor shall clean all material and equipment installed under this Contract. Dirt, dust, plaster, stains and foreign matter shall be removed from all surfaces. Damaged finishes shall be touched up and restored to their original Condition.
- N. Mechanism of all equipment shall be checked, adjusted and tested for proper operation. Protective devices and parts shall be checked and tested for specified and required application and adjusted as required to produce the intended performance.
- O. Service voltage and color codes for 480Y/277V: Phase A - Brown, Phase B - Orange, Phase C - Yellow, Neutral - White, and Ground - Green.
- P. Service voltage and color codes for 208/120V: Phase A - Black, Phase B - Red, Phase C - Blue, Neutral - White, and Ground - Green.

2.2 CONTROL-VOLTAGE ELECTRICAL POWER CABLES

- A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits, Classes 1, 2, and 3 control cables.
- B. Related Requirements:
 - 1. Section 270528 "Pathways for Communications Systems" for cabling used for voice and data circuits.
- C. Performance Requirements:
 - 1. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.
 - 2. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.
 - 3. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

- D. RS-485 Plenum-Rated Cable: NFPA 70, Type CMP.
 - 1. Paired, one pair, No. 22 AWG, stranded (7x30) tinned-copper conductors.
 - 2. Fluorinated ethylene propylene insulation.
 - 3. Unshielded.
 - 4. Fluorinated ethylene propylene jacket.
 - 5. Flame Resistance: Comply with NFPA 262.

- E. Low-Voltage Plenum-Rated, Paired Control Cable: NFPA 70, Type CMP.
 - 1. Multi-pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
 - 2. PVC insulation.
 - 3. Unshielded.
 - 4. PVC jacket.
 - 5. Flame Resistance: Comply with NFPA 262.

- F. Control-Circuit Conductors
 - 1. Class 1 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
 - 2. Class 2 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
 - 3. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
 - 4. Class 2 Control Circuits and Class 3 Remote-Control and Signal Circuits That Supply Critical Circuits: Circuit Integrity (CI) cable.
 - a. Smoke control signaling and control circuits.
 - b. Life Safety control systems listed in NFPA 72.

- G. Cable will be considered defective if it does not pass tests and inspections.

2.3 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS

- A. Related Requirements:
 - 1. Section 260400 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2, and 3 control cables.
 - 2. Section 270400 "Communications Horizontal Cabling" for cabling used for voice and data circuits.

- B. Copper Building Wire: Flexible, insulated and uninsulated, drawn copper current-carrying conductor complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors with an overall insulation layer or jacket, or both, rated 600 V or less.

- C. Basis-of-Design Product: Subject to compliance with requirements, provide Southwire Company or comparable product by one of the following:
 - 1. Alpha Wire Company.
 - 2. Cerro Wire LLC.
 - 3. Encore Wire Corporation.
 - 4. General Cable Technologies Corporation.
 - 5. Southwire Company.

- D. Service Entrance Conductors:
 - 1. For line voltages, provide 600 V THHN insulated copper wire with UL Label, listing, and color coded for voltage.

- E. Conductors:
 - 1. For line voltages, provide 600 V insulated copper wire and cable, with UL Label, listing, and color coded for voltage.
 - 2. Use type THHN/THWN color coded for voltage at interior, type THHN/THWN-2 for exterior.
 - 3. For wire No. 10 and smaller, provide solid wire: for wire larger than No. 10, provide stranded wire.
 - 4. Conductors No. 8 and larger, provide insulating bushings or insulating sleeves.
 - 5. Use only copper wires and cables.

- F. No. 12 AWG THHN conductors and larger for all branch circuits, protected by 20-amp circuit breakers. Where so indicated on the Drawings, by actual load, or by the N.E.C., use larger wires to limit voltage drops:
 - 1. Increase wire sizes to next largest AWG size for:
 - a. 120-volt circuits exceeding 150 feet in circuit length.
 - b. 208-volt circuits exceeding 200 feet in circuit length.
 - 2. Wire and conduit sizes shall be increased for the above conditions whether shown on the Drawings or not.

- G. Use identified (white) neutrals and colored-coded phase wires for all branch circuit wiring.

- H. Make splices electrically and mechanically secure with pressure-type. Push-in connectors shall not be allowed.
 - 1. For wires size 10 AWG and smaller, provide NSI twist-on connectors.
 - 2. For wires size 8 AWG and larger, provide NSI Polaris insulated connectors.

- I. Tape all joints with rubber tape 1-1/2 times the thickness of the conductor insulation, then cover with the friction tape or the vinyl-plastic electrical tape specified above.

2.4 GROUNDING AND BONDING ELECTRICAL SYSTEMS:

- A. Submittals:
 - 1. Product Data: For each type of product.
 - 2. Product Schedule: Indicate type, use, location, and termination locations.

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Burndy; Part of Hubbell Electrical Systems.
 - 2. ERICO International Corporation.
 - 3. TE Connectivity Ltd.
 - 4. ILSCO.
 - 5. O-Z/Gedney; a brand of Emerson Industrial Automation.

- C. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- D. Bare Copper Conductors:
 - 1. Stranded Conductors: ASTM B 8.
 - 2. Tinned Conductors: ASTM B 33.
 - 3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 5. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- E. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.
- F. Connectors: Listed and labeled by an NRTL as complying with NFPA 70, acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 467.
 - 1. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
 - 2. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
 - 3. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
 - 4. Cable-to-Cable Connectors: Compression type, copper or electroplated tinned copper, C and H shaped.
 - 5. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
 - 6. Conduit Hubs: Mechanical type, terminal with threaded hub.
 - 7. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
 - 8. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
 - 9. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.
 - 10. Straps: Solid copper, cast-bronze clamp. Rated for 600 A.
 - 11. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
 - 12. Water Pipe Clamps: Tin-plated aluminum or Silicon Bronze. Mechanical type, two pieces with zinc-plated bolts.

2.5 HANGERS AND SUPPORTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Material: Pre-galvanized steel.
 - 2. Channel Width: 1-5/8 inches.

3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 4. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- E. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. B-line, an Eaton business.
 - b. Empire Tool and Manufacturing Co., Inc.
 - c. Hilti, Inc.
 - d. MKT Fastening, LLC.
 2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 4. Toggle Bolts: All-steel springhead type.
 5. Hanger Rods: Threaded steel.
- F. Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- G. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter. Wire-ties and zip-ties shall not be an acceptable means of support to structure(s).
- H. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- I. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.
- J. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To Wood: Fasten with lag screws or through bolts.
 2. To New Concrete: Bolt to concrete inserts.
 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

4. To Existing Concrete: Expansion anchor fasteners.
 5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 6. To Light Steel: Sheet metal screws.
 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- K. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- L. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- 2.6 RACEWAYS AND BOXES
- A. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use. Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
- B. Raceways and Fittings:
1. Steel Electrical Intermediate Metal Conduit (IMC) - UL 1242 and UL Category Control Number DYBY: Exterior - Zinc coated; Interior - Zinc with organic top coated. Fittings: Steel, compression coupling.
 2. Steel Electrical Metal Tubing (EMT) and Elbows: UL 797 and UL Category Control Number FJMX: Exterior - Zinc coated; Interior - Zinc with organic top coated. Fittings: Steel, compression coupling.
 3. Aluminum Electrical Metal Tubing (EMT) and Elbows: UL 797A and UL Category Control Number FJMX: Exterior - Zinc coated; Interior - Zinc with organic top coated. Fittings: Steel, compression coupling.
 4. Flexible Metal Conduit (FMC): Steel. UL 1 and UL Category Control Number DXUZ. Fitting: UL 514B and UL Category Control Number ILNR.
 5. Liquidtight Flexible Metal Conduit (LFMC): Steel. UL 360 and UL Category Control Number DXHR. UL 514B and UL Category Control Number DXAS.
 6. Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings: UL 651 and UL Category Control Number DZYR. For use with maximum 90 deg C wire.
 7. Minimum raceway size: 3/4" raceway for power circuits and 1" raceways for low-voltage communication cable raceways.
- C. Surface mounted raceways: Wiremold or Owner approved equal, steel 500 or 700 Series with matching surface mount box and mounting accessories. Color as directed by Owner. EMT conduit is not an allowable method for surface raceways. Submit to Owner prior to installation.

- D. Surface mounted raceways on existing walls: 3/4" EMT maximum. Provide 1/2" EMT raceways for thermostat, HVAC sensors and control circuits anchored to wall system by approved method.
- E. Boxes, Enclosures and Cabinets:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crouse-Hinds, an Eaton business.
 - b. Hubbell Incorporated.
 - c. RACO; Hubbell.
 - d. Thomas & Betts Corporation; A Member of the ABB Group.
 - e. Wiremold / Legrand.
 2. General Requirements for Boxes, Enclosures, and Cabinets: Comply with NFPA 70 for intended location and use. UL 514A and UL CCN QCIT.
 3. Wireways and Auxiliary Gutters:
 - a. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system. Manufacturer's standard enamel finish.
 - b. Wireway Covers: Hinged, Screw-cover and Flanged-gasketed as indicated in drawings.
 4. Metallic Outlet, Device Boxes, Rings, Covers and Conduit Bodies:
 - a. Description: 4" square outlet box having pryout openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
 - b. Material: Sheet steel and Cast metal.
 - c. Sheet Metal Depth: 2-1/8" deep minimum to accommodate 1" knockout.
 - d. Cast-Metal Depth: 2.4 inch deep.
 - e. Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing 50 lb.
 - f. Paddle Fan and Large Luminaire Outlet Boxes and Covers: Nonadjustable, designed for attachment of paddle fan weighing up to 70 lb.
 - g. Conduit Bodies: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point.
 5. Metallic Floor Boxes and Floor Box Covers: RFB4 series with (4) independent compartments, stamped steel, and shallow steel for concrete 2 7/16" depths accepting 3/4" and 1" conduit.
 - a. Coverplates shall be scrub-proof with carpet in-lay and easy open handle. Activate all compartments with specified and approved wiring devices.
 6. Nonmetallic Outlet, Conduit Bodies and Device Boxes: UL 514C and UL CCN QCMZ.
- F. Termination Boxes: UL 1773 and UL Category Control Number XCKT.
1. Description: Enclosure for termination base consisting of lengths of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors or both.
 2. Listed and labeled for installation on line or load side of service equipment.

- G. Cabinets, Cutout Boxes, Junction Boxes and Pull Boxes: UL 50 and 50E.
 - 1. Sheet Metal Cabinets:
 - a. Description: Enclosure provided with frame, mat, or trim in which swinging door or doors are or can be hung. UL Category Control Number CYIV.
 - 2. Sheet Metal Cutout Boxes:
 - a. Description: Enclosure that has swinging doors or covers secured directly to and telescoping with walls of enclosure.
 - 3. Sheet Metal, Cast-Metal, and Polymeric Junction and Pull Boxes:
 - a. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable. UL Category Control Number BGUZ.

- H. Cover Plates for Devices Boxes: UL 514D and UL Category Control Numbers QCIT and QCMZ.
 - 1. Wallplate-Securing Screws: Metal with head color to match wallplate finish.
 - 2. Cover Plates for Device Boxes:
 - a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
 - b. Metallic Wallplate Material: 0.032-inch-thick Type 302/304 non-magnetic stainless steel with brushed finish. Coordinate with Owner.
 - c. Nonmetallic Wallplate Material: 0.060 inch thick high-impact thermoplastic (nylon) with smooth finish and color matching wiring device.
 - d. Color: As indicated on architectural drawings or selected by Owner/Architect.
 - 3. Hoods for Outlet Boxes:
 - a. Reference Standards:
 - 1) UL 514D and UL Category Control Numbers QCIT and QCMZ.
 - 2) Receptacle, hood, cover plate, gaskets, and seals comply with UL 498 Supplement SA when mated with box or enclosure complying with UL 514A, UL 514C, or UL 50E.
 - b. Mounts to box using fasteners different from wiring device.
 - 4. provide galvanized code-gauge sheet steel units with screwed-on covers, of size and shape required to accommodate wires without crowding, and to suit the location. Mark with permanent ink circuit designations on cover plate. If box is to be painted provide permanent ink marking on inside of box cover.
 - 5. For exterior pull boxes, provide fiberglass quazite box with sealed lid identified "ELECTRICAL" at size required to accommodate wires at 40% fill.
 - 6. Provide sleeves and chases where conduits pass through floors and walls, fire-stopped in accordance with NEC Article 300.21.
 - 7. For switches and receptacles, provide standard ganged switch boxes with plastic or stainless-steel covers as required by Architect; except for exposed Work, provide pressed steel boxes with galvanized or cadmium plated steel covers.
 - a. For telephone/communication outlets, provide 4" square boxes with single device cover. Route conduit to accessible ceiling cavity with end bushings and nylon pullstring.

- I. Junction boxes may not be installed back-to-back in walls and partitions. Consult with Owner for proper separation of boxes (typically, 12" in non-rated walls, 24" in rated walls).

- J. Securely and rigidly support boxes to super structure throughout the Work.

2.7 PANELBOARDS:

- A. Panelboards and Retrofit Panelboards: Comply with NEMA PB 1 and NFPA 70.
- B. Eaton - Cutler-Hammer Type "Pow-R-Line" or approved equal. Commercial Grade.
- C. Retrofit panelboards shall be Cutler-Hammer Pow-R-Line or equal. Commercial.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers or Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- E. Enclosures: Flush and Surface-mounted, dead-front cabinets as indicated in drawings.
 - 1. Indoor Dry and Clean Locations: NEM 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R:
 - 3. Wash-Down Areas: NEMA 250, Type 4X S.S.
 - 4. Kitchen Areas: NEMA 250, Type 1 with seal for Stainless Steel front cover.
 - 5. Cabinets, flush or surface mounted as indicated. Top and/or Bottom Entry.
 - 6. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 7. Gutters: Same gage and finish of panel enclosure; integral with body.
 - 8. Directory Card: Inside panelboard door, mounted in metal frame with transparent cover.
 - 9. Doors shall be as required, accurately fitted with catch-lock and two (2) keys. All front keys alike.
- F. Panel boards shall be rated for the voltage, 3 phase, 4 wire, solid neutral, UL 489 and rated 250 or 600 volts.
- G. Incoming Mains Location: Convertible between top and bottom and terminate in cable lugs or main circuit breaker.
- H. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Phase, Neutral and Ground Bus shall be hard drawn copper of 98 percent conductivity.
 - 2. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
 - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
 - 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device where indicated on drawings.
 - 5. Sub-feed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device where indicated on drawings.
- I. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

- J. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
- K. Surge Suppression: Comply with UL 1449 SPD for the following Types indicated on drawings and specified in "Surge Protection for Electrical Power Circuits":
 - 1. Type 1 for service equipment where the device is ahead of the service disconnect. Factory installed as an integral part of panelboard in segregated compartment.
 - 2. Type 2 for panelboards on the load side of the service disconnect. Provide SPD mounted in rated enclosure, exterior of panelboard.
- L. DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES (OCPDs):
- M. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 - 4. GFCI Circuit Breakers: Single- thru three-pole configurations with Class A ground-fault protection (6-mA trip).
 - 5. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - d. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 - e. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in "on" or "off" position.
 - f. Handle Clamp: Loose attachment, for holding circuit-breaker handle in "on" or "off" position.
- N. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- O. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder. Provide name and phone number of installing company.
- P. Provision for Future Devices: Equipment with mounting brackets, bus connections, and necessary appurtenances for the OCPD ampere ratings indicated for future installation of devices.
- Q. Tandem and mini-circuit breakers shall NOT be used. Multipole breakers shall have common trip.

2.8 WIRING DEVICES:

- A. UL Listed and labeled as defined in NFPA 70.
- B. Color of wiring devices shall match existing facility devices or per Owner's requirements. Color of isolated ground receptacles to be orange. Coordinate with Architect/Owner for final color of all devices.
- C. Duplex Convenience Receptacles: 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
- D. Industrial Heavy Duty, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement SD, and FS W-C-596.
- E. Twist-Locking Receptacles: Twist-Lock, Single Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration Heavy-duty, NEMA 5-20R, and UL 498.
- F. GFCI Receptacles: 125 V, 20 A, straight blade, 20 A feed-through type. Comply with NEMA WD 1, Heavy-duty NEMA 5-20R, UL CCN KCXX, UL 498, UL 943 Class A, and FS W-C-596.
 - 1. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
 - 2. Self-testing technology with indicators including disconnecting power if damaged.
 - 3. Receptacles shall be side wired feed-thru, Hubbell No. GFST20 or equal.
- G. Tamper-Resistant Duplex Straight-Blade Receptacle: 125 V, 20 A: Comply with NFPA 70, Heavy-duty NEMA 5-20R, UL CCN RTRT and UL 498, and FS W-C-596.
- H. Tamper-Resistant Duplex Straight-Blade Receptacle with USB Outlet to Power Class 2 Equipment: 125 V, 20 A: Comply with NFPA 70, Heavy-duty NEMA 5-20R, UL CCN RTRT and UL 498, and FS W-C-596.
- I. Duplex Straight-Blade Receptacle with Type 3 Surge Protective Device: 125 V, 20 A: Comply with color BLUE per NEMA WD 1, heavy-duty. Configuration NEMA 5-20R, UL 498, and FS W-C-596.
- J. Toggle Switches: Comply with NEMA WD 1, UL 20, and FS W-S-896. Commercial-industrial type, 20 amp, 120/277 V AC, from the following:
 - 1. Single Pole:
 - a. Cooper; AH1221.
 - b. Hubbell; HBL1221.
 - c. Leviton; 1221-2.
 - d. Pass & Seymour; CSB20AC1.
 - 2. Two Pole:
 - a. Cooper; AH1222.
 - b. Hubbell; HBL1222.
 - c. Leviton; 1222-2.
 - d. Pass & Seymour; CSB20AC2.

3. Three Way:
 - a. Cooper; AH1223.
 - b. Hubbell; HBL1223.
 - c. Leviton; 1223-2.
 - d. Pass & Seymour; CSB20AC3.
 4. Four Way:
 - a. Cooper; AH1224.
 - b. Hubbell; HBL1224.
 - c. Leviton; 1224-2.
 - d. Pass & Seymour; CSB20AC4.
- K. Cover plates for flush mounted receptacles and switches:
1. Mechanical, utility, kitchen and Exterior: provide 0.040" stainless steel cover plates in all areas and all devices.
 2. Office and classroom areas: Provide 0.040" stainless steel cover plates. Plastic cover plates matching the wiring devices specified for millwork.
 3. Where wiring devices are grouped, set in gangs with one cover plate.
 4. Where wiring devices are noted to be weatherproof, provide cast cover, gasketed & hinged, while-in-use rated and lockable cover.
 5. Use jumbo size plates, 302 stainless steel for outlets installed in masonry walls or as specified by Owner and existing facility standard installation.
- L. Manual motor starter: Square D "Class 2510" for 120V, 1ph motors.

2.9 SURGE PROTECTION FOR ELECTRICAL POWER CIRCUITS

- A. General SPD Requirements:
1. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Comply with NFPA 70.
 3. Comply with UL 1449.
 4. MCOV of the SPD shall be the nominal system voltage.
- B. PANELBOARD SUPPRESSORS
1. Type 2 for panelboards on the load side of the service disconnect.
 2. Include LED indicator lights for power and protection status.
 3. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
- A. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- B. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits shall not exceed the following:
1. Line to Neutral: 1200 V for 480Y/277 V.
 2. Line to Ground: 1200 V for 480Y/277 V.
 3. Line to Line: 2000 V for 480Y/277 V.

- C. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:
 - 1. Line to Neutral: 700 V for 208Y/120 V.
 - 2. Line to Ground: 1200 V for 208Y/120 V.
 - 3. Line to Line: 1000 V for 208Y/120 V.

- D. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits shall not exceed the following:
 - 1. Line to Neutral: 700 V.
 - 2. Line to Ground: 700 V.
 - 3. Neutral to Ground: 700 V.
 - 4. Line to Line: 1200 V.

- E. SCCR: Equal or exceed 200 kA.

- F. Inominal Rating: 20 kA.

- G. ENCLOSURES
 - 1. Indoor Enclosures: NEMA 250, Type 1.
 - 2. Outdoor Enclosures: NEMA 250, Type 3R.

PART 3 - EXECUTION

3.1 ELECTRICAL SITE COORDINATION AND PREPARATION

- A. Examine the areas and the Conditions under which Work of this Section will be performed. Correct conditions detrimental to timely and proper completion of this work. Do not proceed until unsatisfactory conditions are corrected.

- B. Coordinate with local utility company temporary and permanent power requirements for the project. Provide a request for all utilities to be located and marked at project site prior to the start of Work. Prepare site easements for saw-cutting, trenching and backfill. Coordinate power outages with Owner and utility company 10-days prior to outage.

- C. Coordination with Division Trades:
 - 1. Coordinate as necessary with other trades to assure proper and adequate provision in this Work of those trades for interface with the Work of this Section.
 - 2. Coordinate the installation of electrical items with the schedule for Work of other trades to prevent unnecessary delays in the total Work.
 - 3. Where lighting fixtures and other electrical items are shown in conflict with locations of structural members and mechanical or other equipment, provide required supports and wiring to clear the encroachment.
 - 4. Provide 110-volt temperature control, control transformers in enclosures and interlock wiring. Coordinate all requirements with mechanical contractor prior to rough-in and installation.
 - 5. Provide weatherproof ground-fault receptacles within 25'-0" of devices and equipment to be readily-accessible for maintenance.

- D. Coordinate arrangement, mounting and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. Provide for ease of disconnecting the equipment with minimum interference to other equipment installations.
 - 3. Allow right-of-way for piping and conduit installed at required slope.
 - 4. Connecting raceways, cables, wireways, cable trays and busways to be clear of obstructions and allow working clearances of other equipment.
- E. Where outlets are not specifically located on the Drawings, locate as determined in the field by the Architect. Where outlets are installed without such specific direction, relocate as directed by the Architect and at no additional cost to the Owner.
- F. The Electrical Drawings are diagrammatic but are required to be followed as closely as actual construction and Work of other trades will permit. Where deviations are required to conform with actual construction and the Work of other trades, make such deviations without additional cost to the Owner.

3.2 INSTALLATION OF CONTROL-VOLTAGE ELECTRICAL POWER CABLES

- A. Comply with requirements in Section 260400 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.
 - 1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.
 - 2. Outlet boxes for optical-fiber cables shall be no smaller than 4 inches square by 2-1/8 inches deep with extension ring sized to bring edge of ring to within 1/8 inch of the finished wall surface.
 - 3. Flexible metal conduit shall not be used.
- B. Comply with TIA-569-C for pull-box sizing and length of conduit and number of bends between pull points.
- C. Install manufactured conduit sweeps and long-radius elbows if possible.
- D. Raceway Installation in Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
 - 2. Secure conduits to backboard if entering the room from overhead.
 - 3. Extend conduits 3 inches above finished floor.
 - 4. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- E. General Requirements for Cabling:
 - 1. Comply with TIA-568-C Series of standards and BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems".
 - 2. Cables may not be spliced.

3. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
 5. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 6. Support: Do not allow cables to lay on removable ceiling tiles.
 7. Secure: Fasten securely in place with hardware specifically designed and installed to not damage cables.
- F. Installation of Control-Circuit Conductors:
1. Install wiring in raceways. Comply with requirements specified in Section 260400 "Raceways and Boxes for Electrical Systems."
- G. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 30 inches apart.
 3. Cable shall not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.
- H. Installation of Cable Routed Exposed under Raised Floors:
1. Install plenum-rated cable only.
 2. Install cabling after the flooring system has been installed in raised floor areas.
 3. Below each feed point, neatly coil a minimum of 72 inches of cable in a coil not less than 12 inches in diameter.
- I. Minimum Control-Circuit Conductor Sizes:
1. Class 1 remote-control and signal circuits; No 14 AWG.
 2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
 3. Class 3 low-energy, remote-control, alarm, and signal circuits; No 12 AWG.
- J. Identification: Identify data and communications system components, wiring, and cabling according to TIA-606-A; label printers shall use label stocks, laminating adhesives, and inks complying with UL 969.

3.3 INSTALLATION OF LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS

- A. Conductor Material Applications:
1. Feeders: Copper for feeders smaller than No. 250 MCM; copper or aluminum for feeders No. 250 MCM and larger. Conductors shall be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger. Adjust raceway sizes accordingly where use of aluminum material is allowed.

2. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
 3. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.
- B. Conductor Insulation and Multiconductor Cable Applications and Wiring Methods:
1. Service Entrance: Type THHN/THWN-2, single conductors in raceway.
 2. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
 3. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
 4. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
 5. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
 6. Branch Circuits Concealed in Millwork and Wall Partitions: Metal-clad cable, Type MC.
 7. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- C. Installation of Conductors and Cables:
1. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
 2. Complete raceway installation between conductor and cable termination points according to Section 260400 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
 3. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
 4. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
 5. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
 6. Support cables according to Section 260400 "Hangers and Supports for Electrical Systems."
- D. Connections:
1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
 2. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.
- E. Identification: Identify and color-code conductors and cables according to NFPA 70. Identify each spare conductor at each end with identity number and location of other end of conductor and identify as spare conductor.
- F. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- G. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260400 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

- H. Other Requirements:
1. Conductors No. 4 and larger, provide insulating bushings or insulating sleeves.
 2. Provide barriers in boxes where different voltages and conductor insulation exist.
 3. Install control wiring for equipment or as required by other Division Trade Work.
 4. Tape all joints with rubber tape 1-1/2 times the thickness of the conductor insulation, then cover with a minimum of two half-lapped layers of Scotch Brand No. 33 vinyl-plastic electrical tape.
 5. Provide expansion fittings in conduits which are non-continuous and exposed to the weather.
- I. Wire Sizes:
1. Increase wire sizes and raceway to next largest AWG size for: (Size shown of 60% load, increase as required for larger loading)
 - a. 120 volt circuits exceeding 150 feet in circuit length.
 - b. 208 volt circuits exceeding 250 feet in circuit length.
 2. Wire sizes shall be increased for the above conditions whether indicated on the Drawings.
- J. Use identified (white) neutrals and colored-coded phase wires for all branch circuit wiring.
1. Make splices electrically and mechanically secure with pressure-type ILSCO Snapblock connectors, or LSI lugs to make splices electrically and mechanically secure. Soldering is not permitted for grounding equipment.
 - a. For wires size 6 AWG and smaller, provide "Scotch-lock" connectors.
 2. For wires size 4 AWG and larger, provide Burndy "Versitaps" and heavy-duty connectors, or T&B "lock-tite" connectors.

3.4 INSTALLATION OF GROUNDING SYSTEMS

- A. Coordinate existing conditions and wiring configurations to assure proper grounding systems are installed per NEC Art. 250. Where existing system grounding means are not known or clearly identifiable, contact Owner to provide as-built documents prior to start of Work.
- B. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- C. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
1. Bury at least 24 inches below grade.
- D. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- E. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 4. Connections to Structural Steel: Welded connectors.
- F. Grounding at The Service: Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.
- G. Comply with IEEE C2 grounding requirements.
- H. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- I. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.
- J. Equipment Grounding: Install insulated equipment grounding conductors with all feeders and branch circuits.
- K. Water Heater, Heat-Tracing, and Anti-frost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- L. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- M. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
- N. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- O. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- P. Perform tests and inspections as listed in "Testing and Inspections".
- Q. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm(s).
 5. Substations and Pad-Mounted Equipment: 5 ohms.
 6. Manhole Grounds: 10 ohms.
- R. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

3.5 HANGERS AND SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70 utilizing listed beam clamps and supports. Tie-wires shall not be an acceptable method of securing raceways.
- C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

- D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
- E. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.
- F. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb .
- G. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 - 6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 - 7. To Light Steel: Sheet metal screws.
 - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- H. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.
- I. Concrete Bases:
 - 1. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
 - 2. Use 3000-psi , 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements as specified by equipment manufacturer.
 - 3. Anchor equipment to concrete base:
 - a. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - b. Install anchor bolts to elevations required for proper attachment to supported equipment.

- c. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.6 RACEWAYS AND BOXES INSTALLATION

- A. Selection of Raceways: Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of raceways. Consult Architect for resolution of conflicting requirements.
- B. Outdoors:
 1. Exposed and Subject to Physical Damage: RMC.
 2. Exposed and Not Subject to Physical Damage: IMC.
 3. Concealed Aboveground: EMT.
 4. Direct Buried: PVC-40.
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
- C. Indoors:
 1. Hazardous Classified Locations: RMC.
 2. Exposed and Subject to Physical Damage: IMC.
 3. Exposed and Not Subject to Physical Damage: EMT.
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 5. Damp or Wet Locations: IMC.
 6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC.
- D. Raceway Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.
 1. RMC and IMC: Provide threaded type fittings unless otherwise indicated.
- E. Installation of Raceways:
 1. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for installation of raceways. Consult Architect for resolution of conflicting requirements.
 2. Comply with requirements in Section 260400 "Hangers and Supports for Electrical Systems" for hangers and supports.
 3. Install raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
 4. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4" and insulated throat metal bushings on 1-1/2" and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
 5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 6. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
 7. Support conduit within 12" of enclosures to which attached.
 8. MC Cable or FMC is allowed in limited uses: Lighting whips, interior partition walls, and millwork. MC Cable is NOT allowed for homerun branch circuits.

9. Adjust raceway sizes required for derating and ambient temperatures.
 10. Provide necessary sleeves and chases where conduits pass through floors and walls, and provide other necessary openings and spaces, arranging to prevent unnecessary cutting.
 11. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of raceways at the following points:
 - a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - b. Where an underground service raceway enters a building or structure.
 - c. Conduit extending from interior to exterior of building.
 12. Do not install conduits within 2" of the bottom side of a metal deck roof.
 13. Keep raceways at least 6" away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
 14. Install pull wires in empty raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb tensile strength.
 15. Do not install aluminum raceways or fittings in contact with concrete or earth.
- F. Underground conduit installations where open trenching occurs and accessible to public, shall require barriers and warning tape per OSHA guidelines.
- G. Where conduit or wiring is exposed, run parallel to, or at right angles with, lines of the building.
 1. Make bends with standard conduit elbows or conduit bent to not less than the same radius.
 2. Make bends free from dents and flattening.
 3. Where outlets and devices are installed exposed on masonry walls, contractor shall route conduit up to highest point on wall to junction box serving the device vertically.
- H. Where conduits pierce the roof, provide 24-gauge galvanized iron roof jacks and flashing collar brazed onto the conduits and covering the top of the roof jacks. Any brazing shall occur prior to installation of conductors.
- I. When boring, cutting or drilling structural wood or wall members, drill only in locations as approved by the Architect.
- J. Installation of Boxes and Enclosures:
 1. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
 2. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
 3. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.
 4. Locate boxes so that cover or plate will not span different building finishes.
 5. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
 6. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.

7. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
8. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.

3.7 PANELBOARD INSTALLATION

- A. Comply with NECA 1.
- B. Install panelboards and accessories according to NECA 407.
- C. Mount top of trim 90 inches above finished floor where top-most operating handle is not higher than 79 inches above finished floor unless otherwise indicated.
- D. Mount panelboard cabinet plumb and rigid without distortion of box.
- E. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- F. Install overcurrent protective devices and controllers not already factory installed.
 1. Set field-adjustable, circuit-breaker trip ranges.
- G. Provide breakers with ground-fault protection of equipment for listed areas:
 1. Kitchens.
 2. Garages.
 3. Bathrooms and Locker Rooms.
 4. Exterior equipment not supplied with integral ground-fault protection.
 5. Mechanical and Janitorial closets for equipment not supplied with integral ground-fault protection.
 6. Locations where equipment is located within 6'-0" of water source or listed wet locations.
- H. Make grounding connections and bond neutral for service entrance and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- I. Install filler plates in unused spaces.
- J. Stub three 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or floor below slab not on grade.
- K. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- L. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with OSHA and NFPA 70E.
- M. Panelboard Nameplates: Label each switchboard compartment with a nameplate.

- N. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate.
- O. Test and Inspections: Section 260400 "Testing and Inspections."
 - 1. Panelboards will be considered defective if they do not pass tests and inspections.

3.8 INSTALLATION OF WIRING DEVICES

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
 - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 - 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.

3.9 INSTALLATION OF SURGE PROTECTION FOR ELECTRICAL POWER CIRCUITS

- A. Comply with NECA 1.
- B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.
- C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
- D. Use crimped connectors and splices only. Wire nuts are unacceptable.

- E. Complete startup checks according to manufacturer's written instructions. Energize SPDs after power system has been energized, stabilized, and tested.
- F. Test and Inspections: Section 260400 "Testing and Inspections."
- G. Prepare test and inspection reports.
- H. Train Owner's maintenance personnel to operate and maintain SPDs.

3.10 INSTALLATION OF POWER EQUIPMENT

- A. FLOOR-MOUNTED EQUIPMENT CONCRETE PAD: Install switchboards, transformers and enclosed controllers on concrete bases, 4-inch nominal thickness. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
 - 1. Install conduits entering under the vertical section where the conductors will terminate. Install with couplings flush with the concrete base. Extend 2 inches above concrete base after equipment is anchored in place.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from enclosures and components.
- C. Provide power and control wiring for HVAC, switchboards, panelboards, motor starters and safety switches as shown on the Drawings.
- D. Connections to miscellaneous building equipment:
 - 1. Wire to, and connect to, all items of building equipment not specifically described but to which line-voltage electrical power is required.
 - 2. Coordinate as necessary with other trades and suppliers to verify types, numbers and locations of equipment.
 - 3. Make final connections to all kitchen equipment per manufacturer's instructions.
 - 4. Mark each pull-box/junction box with a permanent ink marker the panel designation and circuit number contained.
- E. Mounting Heights:
 - 1. Install light switch at 48 inches to center of device above finished floor. Unless otherwise noted.
 - 2. Install convenience receptacle at 18 inches to center of device above finished floor. Unless otherwise noted.

3. Install convenience receptacle at 4 inches to center of device, above back splash of counter top. Unless otherwise noted.
4. Install telephone jack rough in at 18 inches to center of device above finished floor. Unless otherwise noted.
5. Install telephone jack for side-reach wall telephone, to position top of telephone at 54 inches to center of device, above finished floor. Unless otherwise noted.

3.11 MATERIAL AND EQUIPMENT

- A. All materials and equipment shall be new, of the same type and manufacture, and shall be of the best quality and design and free from defects.
- B. A Manufacturer's nameplate affixed in a conspicuous place will be required on each major component of equipment stating Manufacturer's name, address and catalog number.

3.12 MISCELLANEOUS ITEMS

- A. The Contractor shall provide all miscellaneous items that would normally be required for proper installation of all electrical systems specified herein.
- B. Completed wiring systems shall be free from short circuits. After completion, this Division 26 shall perform tests for insulation resistance in accordance with the requirements of the National Electrical Code.
- C. Complete temperature control wiring rough-in is the responsibility of this Division 26. Coordinate with Division 23 to provide all locations for rough-in box and conduit requirements. Temperature control wiring shall be installed in conduit as specified by Division 23. Final terminations shall be by Division 23 unless system is 110 volts or greater.
- D. Provide all disconnects and safety switches for mechanical and plumbing equipment. Where safety switches serve equipment with multiple motors, switches shall be fused according to the nameplate of the equipment, or the breaker serving the equipment shall be "HACR" type.

3.13 CUTTING AND PATCHING

- A. The Electrical Contractor shall be responsible for cutting all floors, walls, partitions, ceilings or other construction required for proper installation of his Work. No cutting shall be done without prior approval of the Architect and all cutting shall be performed as directed by the Architect. Compacting of soil shall be provided in accordance to Division 2 Work. Concrete and Asphalt Work shall be provided in accordance to Division 2 Work.
- B. The Electrical Contractor shall provide and install fire-safing material in penetrations through fire rated walls, floors, and ceilings in accordance with local codes.

3.14 CLEANING AND PLACING IN SERVICE

- A. Immediately prior to final inspection, the Contractor shall make a final cleanup of dirt and refuse resulting from his Work and shall assist in keeping the premises clean at all times.
- B. Immediately prior to final inspection, the Contractor shall clean all material and equipment installed under this Contract. Dirt, dust, plaster, stains and foreign matter shall be removed from all surfaces. Damaged finishes shall be touched up and restored to their original Condition.
- C. Mechanism of all equipment shall be checked, adjusted and tested for proper operation. Protective devices and parts shall be checked and tested for specified and required application and adjusted as required to produce the intended performance.

3.15 ADJUSTMENT AND INSTRUCTION

- A. Energize all systems, equipment, and fixtures and check for proper operation. Check electrical feeders for proper phasing and balance loads between phases.
- B. Position adjustable light fixtures to meet approval of Architect.

3.16 TESTING AND INSPECTION:

- A. Provide personnel and equipment, make required tests, and secure approvals from the Owner and governmental agencies having jurisdiction.
- B. Make written notice to the Owner adequately in advance of each of the following stages of construction:
 - 1. Underground electrical system installation is complete, but not covered.
 - 2. Rough-in installation of electrical systems are complete, but not covered.
 - 3. At final completion of the Work of this Section 260400.
- C. When material and/or workmanship is found to not comply with the specified requirements, within three days after receipt of notice of such non-compliance, remove the non-complying items from the job site and replace them with items complying with the specified requirements, all at no additional cost to the Owner.
- D. Provide personnel and equipment to perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Acceptance Testing:
 - a. Test insulation resistance for each distribution bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within the enclosure and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
 - b. Test continuity of each circuit. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Values shall not deviate more than 50 percent of lowest value tested.

- c. Test ground-fault protection for service equipment per NFPA 70.
 - d. Use suitable test instrument to measure resistance to ground system. Test in accordance with test instrument manufacturer's specified fall-of potential method.
 - 2. Tests and Inspections:
 - a. Perform each visual, accessible bolted electrical connection, mechanical inspection and electrical test for component type stated in NETA Acceptance Testing Specification including Tables. Certify compliance with test parameters.
 - b. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - c. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
 - d. Prior to energizing motors, verify voltages are within plus or minus 10 percent of nameplate rated voltages at motor.
 - e. Test each connected motor for proper phase rotation.
 - E. In the Owner's Presence:
 - 1. Test all parts of the electrical system and prove that all such items provided under this Section function electrically in the required manner.
 - 2. Measure voltages between phases and between phase wires and neutrals, and report these voltages to the Owner.
 - 3. Immediately submit to the Owner a report of maximum and minimum voltages, and a copy of the recording volt-meter chart.
 - F. Adjust and set all time clocks in accordance with Owner's instructions.
 - G. When material and/or workmanship is found to not comply with the specified requirements, within three days after receipt of notice of such non-compliance, remove the non-complying items from the job site and replace them with items complying with the specified requirements, all at no additional cost to the Owner.
- 3.17 PROJECT COMPLETION:
- A. Upon completion of the Work of this Section, thoroughly clean all exposed portions of the electrical installation, removing all traces of soil, labels, grease, oil, and other foreign material, and using only the type cleaner recommended by the Manufacturer of the item being cleaned.
 - B. Thoroughly indoctrinate the Owner's operation and maintenance personnel in the contents of the operations and maintenance manual required to be submitted under Article 1.05 of this Section of these Specifications.

END OF SECTION 260400

SECTION 260450 - ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 024100 – Minor Demolition for Remodeling.
- C. Refer to drawings outlining the scope of work and general conditions and requirements in addition to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Demolition and removal of selected portions of the building electrical distribution system as well as portions of the building telecommunications and data systems, fire alarm systems and security systems. In addition, associated controls, electrical wiring, specialty system interfaces, and other building infrastructure is affected by this work.
 - 2. Patching and repairs to adjacent surfaces and adjoining spaces not specifically included in the demo drawings but affected by the removal of systems and or sub-systems related to or served by systems serving affected areas.
 - 3. Contractor shall provide Temporary Electrical Service and lighting for all trades during course of demolition and construction.
 - 4. Maintain existing fire alarm system in service to include Fire Alarm pull station at all exit egress stairwells and corridors and magnetic door releases for separation of smoke compartments. All smoke detection will be covered during daytime working hours and uncovered by completion of work shift.
 - 5. This section does not include the demolition of asbestos or other hazardous materials identified during the process of demolition of the building and building systems. The Contractor shall notify the Architect and Owner when suspicious materials are identified which might be hazardous and request the Owner to test the identified materials and remove materials if found to be hazardous before the Contractor continues with demolition of the building.

1.3 DEFINITIONS

- A. Remove: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain the Owner's property.
- B. Remove and Salvage: Items indicated to be removed and salvaged remain the Owner's property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and deliver to Owner's designated storage area.

- C. Remove and Reinstall: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Reinstall items in the same locations or in locations indicated.
- D. Existing to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by the Architect, items may be removed to a suitable, protected storage location during selective demolition and then cleaned and reinstalled in their original locations.

1.4 MATERIALS OWNERSHIP

- A. **The Owner has exclusive rights to all salvage and shall be asked prior to removal of any salvage item.** Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain the Owner's property, demolished materials shall become the Contractor's property and shall be removed from the site with further disposition at the Contractor's option.
 - 1. **The Owner's representative shall identify in addition to those items noted on the drawings, any other equipment or materials which he has interest in retaining or salvaging.**
 - 2. **The Contractor shall review and coordinate with the Owner to identify materials to be salvaged and the location that salvaged materials are to be moved for Owner's storage.**

1.5 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections, for information only, unless otherwise indicated.
- B. Inventory of items to be removed and salvaged.
- C. Inventory of items to be removed by Owner.
- D. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by selective demolition operations.
- E. Record drawings at Project closeout according to Division 1 Section "Contract Closeout."
 - 1. Identify and accurately locate capped utilities and other subsurface structural, electrical, or mechanical conditions.

1.6 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: Engage an experienced firm that has successfully completed selective demolition Work similar to that indicated for this Project.

- B. Regulatory Requirements: Comply with governing EPA notification regulations before starting selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

1.7 PROJECT CONDITIONS

- A. Owner will occupy portions of the building immediately adjacent to selective demolition area. Conduct selective demolition so that Owner's operations will not be disrupted. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations. Provide temporary electrical services to adjacent areas that might be affected per Owner's directive.
- B. Owner assumes no responsibility for actual condition of buildings to be selectively demolished.
 - 1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 - 2. Asbestos will be selectively removed by Owner before start of Work.
- C. Storage or sale of removed items or materials on-site will not be permitted.

1.8 SCHEDULING

- A. Arrange selective demolition schedule so as not to interfere with Owner's on-site operations.

1.9 WARRANTY

- A. Existing Special Warranty: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in Section 01700.
- B. Include required temporary equipment to maintain existing electrical power to facility with complete coordination with the Owner's representative for time of work and outages scheduled without disruption to daily operations.
- C. Include required temporary materials and equipment to maintain existing fire protection system within area of remodel and construction. Notify Owner and coordinate with Owner's safety personnel times during the work when areas of the existing building are not fully protected by the building fire protection system. A fire watch shall be provided during all hours of building occupancy (24 hours per day, 7 days per week) whenever fire protection system is not fully operational within area of demolition and remodel.

- D. Include required temporary materials and equipment to maintain active portions of the building infrastructure systems that must stay in operation during demolition and remodel work to serve adjacent spaces. All temporary work shall be suitable for continued operation even if the proposed remodel work is not completed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Survey existing conditions and correlate with requirements indicated to determine extent of demolition.
- B. Coordinate with owner to determine which security system devices such as; cameras, key pads, etc to remove for reuse in remodel phase of contract.
- C. Verify that abandoned wiring and equipment serve only abandoned facilities and remove all abandoned wiring from the floor.
- D. Demolition Drawings are based on casual non-destructive field observation. Report discrepancies to Owner before disturbing existing installation.
- E. Beginning of demolition means installer accepts existing conditions.
- F. Verify that building systems serving the area of demolition have been disconnected, terminated, and capped to prevent damage to the building or harm to personnel.
- G. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- H. When unanticipated mechanical, electrical, or structural elements that conflict with the intended function or design are encountered, investigate and measure the nature and extent of the conflict. Promptly submit a written report to the Architect.
- I. Survey the condition of the building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of the structure or adjacent structures during selective demolition.
- J. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 BUILDING INFRASTRUCTURE SYSTEMS

- A. Maintain existing building infrastructure systems indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Do not interrupt existing building systems serving occupied or operating facilities, except when authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions, as acceptable to Owner and to governing authorities.

2. Provide not less than 72 hours' notice to Owner if shutdown of service is required during changeover.
- B. Building Systems Requirements: Locate, identify, disconnect, and seal or cap off indicated building infrastructure systems services serving building to be selectively demolished.
1. Owner will arrange to shut off indicated building systems when requested by Contractor.
 2. Where building systems are required to be removed, relocated, or abandoned, provide bypass connections to maintain continuity of service to other parts of the building before proceeding with selective demolition.
 3. Remove existing branch systems noted to be demolished back to the active main remaining in service. Cap, valve, or plug and seal, or terminate the remaining portion of pipe or conduit after bypassing.

3.3 PREPARATION

- A. Disconnect all electrical systems in walls, floors, and ceilings scheduled for removal. Verify that removal of systems will not impact adjacent areas that are to remain in use.
- B. Maintain existing fire alarm system in operation until new system components and devices have been installed and approved by local authorities having jurisdiction.
- C. Maintain existing systems serving areas adjacent to area of demolition so as to not affect Owner operations.
- D. In the event that it becomes necessary to interrupt electrical systems serving areas adjacent to demolition area, contractor shall notify owner not less than 72 hours prior to shutdown.
- E. Provide temporary services during interruptions to existing utilities or building infrastructure, as acceptable to Owner and to governing authorities.
- F. Contractor shall inform Owner prior to bid of required upgrading of existing fire alarm system to accept new work and provide line item bid for work.

3.4 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Provide temporary lighting and GFI protected power, during demolition and remodel phases of contract. Utilize existing to be relocated normal power, panelboard feeders for temporary power panels.
- B. Verify that removal of branch circuit conductor feeders will not disrupt services in adjacent spaces prior to taking offline for removal. Coordinate any required shutdown with Owner a minimum of 72 hours in advance of shutdown and do not proceed without written acknowledgement from owner. Provide temporary services during shutdown per Owner's direction.
- C. Ensure complete removal of all abandoned conduit and conductors in area of demolition. Remove abandoned conduit, except abandoned conduit above all ceiling finishes within the demo area. Cut conduit flush with walls and floors indicated to remain, and patch surfaces.

- D. Remove abandoned wiring to junction box in ceiling and terminate in areas of partial demolition. Tag and identify all circuits that are abandoned in panels that are to remain that are in adjacent areas not specifically covered in these documents or scheduled for demolition. Provide new temporary panel schedule for affected electrical panels indicating all spare circuits.
- E. Identify and tag all circuits that are fed from or to adjacent floors or spaces, indicating from where they are fed or where they feed.
- F. Repair adjacent construction and finishes damaged during demolition and extension work.
- G. Remove completely all abandoned Lighting in all areas of demolition. Identify capacity of existing system feeders and all spare circuits in panels that are to remain.
- H. Identify on record drawings the locations of existing panelboard feeders, locations of panelboards in adjacent areas that serve demolition area, and circuits and or locations served by equipment in the demolition area.
- I. Provide written report to the Owner, Architect, and Engineer of Record detailing all above required identification requirements.

3.5 DEMOLITION AND EXTENSION OF EXISTING FIRE ALARM, AND SECURITY SYTEMS

- A. Do not interrupt existing building fire alarm system serving areas adjacent to demolition area without Owners written approval. Maintain existing fire alarm system devices in service and on floors where work is being done to include maintaining fire alarm manual pull stations at all exit egress stairwells and corridors. Coordinate any interruptions in service with Owner and Authorities Having Jurisdiction a minimum of 72 hours in advance of required shutdown. All smoke detection will be covered during daytime working hours and uncovered by completion of work shift.
- B. Verify that removal of branch circuit conductor feeders will not disrupt services in adjacent spaces prior to taking offline for removal.
- C. Identify on record drawings all locations of existing fire alarm distribution points, control panels, annuciators, and devices to remain in operation throughout construction.
- D. Identify on record drawings the location of all security cameras removed and there model #'s and note what type of cabling is used to interconnect camera system.
- E. Provide written report to the Owner, Architect, and Engineer of Record detailing all above required identification requirements.

3.6 DEMOLITION AND EXTENSION OF EXISTING TELECOMMUNICATION
DISTRIBUTION SYSTEMS

- A. Schedule removal of existing MDF closet low-voltage systems with TPS Representative Tim Youngblood prior to Work. Removal shall be done prior to the HVAC systems being turned "OFF". Removal of the existing systems shall be provided by the contractor. Equipment shall be de-commissioned per TPS Standards, removed from service, packaged and returned to Owner in working order.
- B. Identify and tag all telecommunications feeders feeding this floor for future use in remodel phase of contract. Identify capacity and number of circuits available for use in remodel phase of contract.
- C. Identify all telecommunication feeders that pass-through demolition area that may or may not require relocation during remodel phase of contract. Identify type and style of distribution cable for coordination during remodel phase of project.
- D. Identify all telecommunication lines that emanate from areas to be demolished that provide communication to other adjoining floors or spaces.
- E. Remove to junction box in ceiling and terminate all abandoned Data, and Telephone, wiring in all areas of demolition.
- F. Identify on record drawings all locations of existing telecommunications lines that have been terminated but remain active and those that pass through, stop at, or start in areas of demolition. Identify where Fiber Optic Cable distribution systems pass through areas of demolition and where distribution points are located for future reuse during remodel phase of contract.
- G. Provide written report to the Owner, Architect, and Engineer of Record detailing all above required identification requirements.

END OF SECTION 260450