

SECTION 210010 – FIRE PROTECTION GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provision of the Contract, including General and Supplementary Conditions and Division 01 specifications, apply to the work specified in this Section.

1.2 SUMMARY

- A. This section describes the general provisions for the fire protection work included in Division 21. This section applies to all sections of Division 21.

1.3 RESPONSIBILITY

- A. The General Contractor shall be responsible for all work included in the Fire Protection Division and the delegation of work to Subcontractors shall not relieve him of this responsibility. Subcontractors who perform work under these Sections shall be responsible to the General Contractor. The term "Contractor" is used throughout this Division and shall mean the General Contractor, although the actual performance of the work may be by a Subcontractor.
- B. Delegated Design – Contractor is responsible to provide a complete design, including drawings and calculations prepared by a Licensed Professional Engineer or technician holding a NICET Level IV Certification for the fire protection system.

1.4 REFERENCES AND DEFINITIONS

- A. Following are definitions of terms and expressions used in the Fire Protection Sections in addition to those included in Division 01 Sections:
 - 1. Owner: UPMC Western Maryland
 - 2. Architects: Lakeside Architecture Inc
 - 3. Engineers: WSP USA Inc. (Formerly Leach Wallace Associates, Inc.)
 - 4. Concealed - "hidden from normal sight"; includes items in shafts, pipe and duct spaces, and above ceilings.
 - 5. Exposed - "not concealed" - Work within Equipment Rooms and all visible (normal sight) work shall be considered exposed".
 - 6. Piping - includes pipes, fittings, valves, hangers and accessories comprising a system.
 - 7. Directed- "directed by the Architect"
 - 8. Indicated- "indicated in Contract Documents"

1.5 STANDARD SPECIFICATION:

- A. References to catalogs, standards, codes, specifications, and regulations are the latest edition in effect at date of invitation to bid.

1.6 CODES, REGULATIONS AND PERMITS

- A. Give all necessary notices and obtain all required permits. Pay all fees and other costs, including utility connections or extensions in connection with the work. File all necessary plans, prepare all documents and obtain all necessary approvals of all governmental departments

having jurisdiction. Obtain all required certificates of inspection and deliver same to the Architect before request for acceptance and final payment for the work.

- B. All materials furnished and all work installed shall comply with the latest rules, regulations, and recommendations of the following bodies:

International Building Code (IBC)

International Mechanical Code (IMC)

Allegany Plumbing Code

National Fire Protection Association (NFPA)

National Electrical Code (NEC)

All State & Municipal Ordinances, Codes, and Regulations having Jurisdiction

1.7 Materials List and Shop Drawings

- A. See General Requirements.
- B. Within 15 working days after the award of the contract, the contractor shall submit to the Architect for approval a list of Submittals to be included in the Submittal Schedule in accordance with Section 013300 Submittal Procedures. The list shall include the manufacturers of materials and equipment he proposes to provide. In the event any items of material or equipment contained in the list fail to comply with the specification requirements, such items will be rejected. Rejected items shall be resubmitted within 15 days. Substitution requests shall be submitted in accordance with specified procedure.
- C. After receiving approval of equipment manufacturers and prior to delivery of any material to job site and sufficiently in advance of requirements to allow the Architect ample time for checking, submit for approval dimensioned drawings or cuts showing construction size, arrangement, operating clearances, performance characteristics and capacity of materials and equipment. Each item of equipment proposed shall be a standard catalog product of the approved manufacturer.
- D. Samples, drawings, specifications, catalogs, etc., submitted for approval shall be properly labeled indicating specific service for which material or equipment is to be used, section and article number of specifications governing, and Contractor's name, name of job, and date.
- E. Catalogs, pamphlets or other documents submitted to describe items on which approval is being required shall be specific and identification on catalog pamphlet, etc., of the item submitted shall be clearly made in ink. Data of a general nature will not be accepted. Any deviations or exceptions taken in the specification by the Contractor shall be noted.
- F. Any deviations or exceptions taken in the specification by the Contractor shall be so noted.
- G. If material or equipment is installed prior to receipt by the Contractor of approved shop drawings, marked "Approved", "No Exception Taken, or "Make Corrections Noted", the Contractor shall be liable for its removal and replacement at no extra charge to the Owner.
- H. The acceptance of shop drawings shall not relieve the Contractor from his responsibility to furnish material, equipment and systems and to perform work required by the contract documents. Neither the Owner nor the Architect will be responsible for errors or omissions on

shop drawings furnished by the Contractor even though such shop drawings containing errors or omissions are inadvertently accepted.

- I. The Contractor is further advised that the Architect will not act as coordinator between suppliers and subcontractors. All required coordination shall be the responsibility of the Contractor.
- J. Calculations and shop drawings shall be submitted to the Architect and Owner's insurance carrier prior to being submitted to city and/or state agencies.

1.8 CONTRACTOR'S USE OF CAD/REVIT FILES

- A. At the Contractor's written request, copies of the Engineer's CAD / Revit files may be made available for Contractor use in connection with the project, subject to following conditions:
 - 1. Submit written request to the Architect listing the specific drawings the Contractor intends to use. Provide a specific list of submittals that the files will be used in preparing, and the list of names of subcontractors or suppliers.
 - 2. The Contractor shall request in writing the electronic transfer agreement. Prior to transfer of files, the Contractor shall prepare a separate electronic transfer agreement for each subcontractor or supplier who will be using the electronic files.
 - 3. Data contained on the electronic files is part of WSP USA Buildings Inc. (WSP USA) instruments of service and shall not be used for any purpose other than as a convenience in the preparation of shop drawings for the referenced project. Any other use or reuse will be at the Contractor's sole risk and without liability or legal exposure to WSP USA.
 - 4. The electronic files are not contract documents. Significant differences may exist between the electronic files and the corresponding hard copy contract documents. Because of the possibility the information and data delivered in machine readable form may be altered, whether inadvertently or otherwise, WSP USA reserves the right to retain hard copy originals of the electronic documentation delivered to the contractor, in machine readable form, which the original shall be referred to and shall govern in the event of any inconsistency between the two.
 - 5. The use of the electronic files, does not relieve the Contractor of their duty to fully comply with the contract documents, including and without limitation, the need to check confirm and coordinate all dimensions and details, take field measurements, verify field conditions and coordinate work with that of other Contractors for the project.
 - 6. All "internal" calculations integral to / performed by the Revit model shall not be utilized for any purpose by the Contractor. This includes, but shall not be limited to, voltage drop calculations, duct static pressure calculations, air system airflow summary calculations, piping system pressure drop calculations, etc.
 - 7. All Revit "families" are the property of WSP USA and shall not be re-used on any other project for any purpose by the Contractor.

1.9 GUARANTEE

- A. The Contractor guarantees by his acceptance of the Contract that all work provided shall be free from defects in workmanship and materials for a period of one year after date of certification of completion and acceptance of work. Any defects in workmanship, materials or performance which appear within the guarantee period shall be corrected by the Contractor without cost to the Owner within a reasonable time to be specified in notice from the Architect. In default thereof, Owner may have such work done and charge the cost of same to the Contractor.

1.10 SITE VISIT

- A. Prior to preparing the bid, the fire protection subcontractors shall visit the site and familiarize themselves with all existing conditions. Make all necessary investigations as to locations of existing equipment, ductwork, piping, utilities, etc., work to be removed, and all other matters

which can affect the work under the Contract. No additional compensation will be made to the contractor as result of his failure to familiarize himself with the existing conditions under which the work must be performed.

- B. Refer to Section 002113 Instructions to Bidders, and Section 002213 Supplementary Instructions to Bidders.

1.11 DRAWINGS

- A. The contract drawings are diagrammatic and indicate the general arrangements of systems and work included in the Contract. Do not scale the drawings. Consult the architectural and structural drawings and details for exact location of structure and equipment; where same are not definitely located, obtain this information from the Architect.

1.12 RECORD DRAWINGS

- A. The Contractor shall keep accurate records of all deviations in work are actually installed from work indicated. One complete set of contract documents shall be available at the construction site for indicating said deviations.
- B. When work is complete, make one (1) complete "AS Built" set of PDF files, certifying the accuracy of each drawing by endorsement and signature thereon and deliver to the Architect who will, after approval, deliver the record drawings to the owner.
- C. Refer to Section 017839 Project Record Documents for specific requirements.

1.13 OPERATION AND MAINTENANCE INSTRUCTIONS

- A. Contractor shall furnish to the Engineer two (2) complete bound sets of typewritten or blueprinted instructions and one (1) PDF set for operating and maintaining all systems and equipment included in this Contract. Each set of instructions shall be contained in a hard-back ring binder properly indexed and labeled. Also provide two complete bound sets and one PDF set of approved shop drawings for all items of equipment utilized on the project. All instructions shall be submitted in draft for approval prior to the final issue. Manufacturers' advertising literature or catalogs will not be acceptable for operating and maintenance instructions.
- B. Instructions shall include a general description of each system together with specific instructions describing routine and emergency procedures required of the building maintenance personnel for operating and maintaining each system. The instructions shall include the name or label, location, and function of all operating equipment and controls, and the location of the electrical service and breaker I.D. numbers. Operating modes and the procedures for indexing each mode shall be clearly described. Include lubrication charts and schedules of frequency of lubrication for all equipment designating each point of lubrication and type of lubricant to be used. A listing of names, addresses, and phone numbers of the service organizations for each item of equipment and a typewritten maintenance schedule for same shall be included.
- C. Contractor shall prepare Operations and Maintenance Data and submit in accordance with the requirements of Section 017823 Operation and Maintenance Data.

1.14 WORK SITE FIRE PROTECTION

- A. As minimum, one five-pound CO2 extinguisher shall be provided with each work crew at all times when working within the building.

1.15 SCHEDULE OF WORK:

- A. Refer to project schedule. Specific phasing requirements are to be incorporated into project schedule. Contractor shall coordinate all work included in this section, including maintaining fire protection coverage for existing spaces.

1.16 SERVICE AGENCIES

- A. All fire protection equipment suppliers shall have an established authorized service agency located within the Western Maryland area. Within 30 days after award of the Contract, the Contractor shall submit to the Architect for approval a list of manufacturers' material and equipment names, including their respective service agency, he proposes to use. In the event any service agency in the list fails to comply with the specification requirement, such service agency will be rejected.

1.17 SINGULAR NUMBER

- A. Where any device or part of equipment is herein referred to in the singular number (such as "valve"), such reference applies to as many such devices as are required to complete the installation, shown, implied or otherwise, as indicated on the drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All materials shall be new, the best of their respective kinds, suitable for the conditions and duties imposed on them at the building and shall be of reputable manufacturers. The description, characteristics, and requirements of materials to be used shall be in accordance with qualifying conditions established in the sections following.
- B. Refer to Division 01 for General Requirements.
- C. All component parts of each item of equipment or device shall bear the manufacturers' name plate, giving name of manufacturer, description, size, type, serial or model number, electrical characteristics, etc., in order to facilitate the maintenance or replacement. The name plate of a subcontractor or distributor will not be acceptable. All equipment requiring electrical service shall be U.L. labeled, or if a U.L. label is not available from the manufacturer, the equipment shall be tested by an approved electrical testing company in accordance with NEC, and at no additional cost to the Owner. Submit data indicating compliance with standards prior to installation.
- D. In specifying materials, four general procedures are used. The four classifications are as follows:
 1. GROUP 1: When the material or equipment is specified by name of other identifying information and one name brand only is used, it is considered that the use of that particular item is essential to the project, and the Contractor shall base his proposal on the uses of that item.
 2. GROUP 2: When a material or equipment is specified by brand name and other identifying information and two or more brand names are named, it is considered that any one of the brands so named will be performed as desired, and the Contractor shall base his proposal on one of the named brands.
 3. GROUP 3: When the material or equipment is specified with the phrase "... or equal..." after a brand name and other identifying information, it is intended that the brand name is used for the purpose of establishing a minimum acceptable standard of quality and performance and Contractor may base his bid proposal on any item which is in all respects equal to that specified and presents essentially the same appearance, size,

operation and performance. The Contractor shall be responsible for coordination of the equal product.

4. GROUP 4: When material is specified as complying with the requirements of published "Standard Specification" of trade associations, American Society for Testing and Material, government specifications, etc., the Contractor shall base his proposal on any item which can be shown to comply in all respects to the referred to "Standard Specification."

- E. All substitutions shall be submitted in accordance with Section 012500 Substitution Procedures. It is distinctly understood: (1) that the Architect will use his own judgment in determining whether or not any materials, equipment or methods offered in substitution are equal to those specified and will fit within the space available; (2) that the decision of the Architect on all such questions of equality is final; and (3) that all substitutions will be made at no increases in cost to the Owner.
- F. Upon receipt of written approval from the Architect, Contractor may proceed with substitution providing the Contractor assumes full responsibility for and makes, at his expense, any change or adjustment in construction or connection with any work that may be required by the substitution of such materials, equipment or methods. In the event of any adverse decisions by the Architect, no claim of any sort shall be made or allowed against the Owner.

2.2 PIPING SUPPORTS, GENERALLY

- A. Comply with NFPA 13 Requirements for installation of sprinkler piping.
- B. Piping shall be run parallel with the lines of the building unless otherwise shown or noted on drawings. The different service pipes, valves, and fittings shall be so installed that after the covering is applied there will not be less than 1/2 inch clear space between the finished covering of parallel adjacent pipes. Hangers on different service lines running parallel with each other and nearly together shall be in line with each other and parallel to the lines of the building. Exact location of electric outlets, piping, ducts, and conduits shall be coordinated among the trades so that there will be no interference between lighting fixtures, piping, ducts, and conduits. Where conflicts between the trades result, they shall be resolved by the Contractor to the Architect's satisfaction and at no expense to the Owner.
- C. In general hangers shall be spaced so as to prevent sag and permit proper drainage and shall not be spaced more than 10 feet apart unless otherwise indicated herein, in Section 210050, or on the drawings. Hangers shall be placed within one foot of each horizontal elbow. Provide hangers and supports in accordance NFPA 13.
- D. Vertical runs of pipe and conduit not over 15 feet long shall be supported by hangers placed not over one foot from the elbows on the connecting horizontal runs. Vertical runs of pipe and conduit over 15 feet long but not over 60 feet long and not over 6 inches in size shall be supported on heavy steel clamps. Clamps shall be bolted tightly around the pipes and conduits and shall rest securely on the building structure without blocking.
- E. Hangers shall be of manufacturers hereinafter specified in Section 210050. Unless otherwise specified, pipe and conduit hangers and hanger supports shall conform with the following Anvil International figures:
 1. Hangers generally shall be Fig. 69, 104, 212, 260 and 300.
 2. Hangers Figs. 295 and 212 shall be provided with tumblers and eye rods or rods with eye nuts.
 3. Tumblers shall be Fig. 230 and 114, shall have not less than 1-1/2 inch adjustment, and shall be provided with lockouts.
 4. Clamps shall be Fig. 261 or CT-121.

5. Wherever the movement of pipe due to expansion exceeds 3/4 inch per foot of hanger rod length, hangers shall be Figs. 171, 174 and 181.
 6. Roller supports shall be adjustable.
 7. Concrete inserts shall be Fig. 282 or 281.
- F. Hanger attachments shall be suitable for each type of hanger and shall be compatible with the building material to which it is secured. Under no circumstances shall pipe support be secured to any other mechanical, electrical or fire protection equipment. Support shall be suspended from building structure only. The type of attachments which shall be used for the various types of building construction encountered are as follows:
1. Steel beams - Fig. 226, or 66 attachments.
 2. Bar joists - Fig. 225, or 60.
 3. Brick or block walls - Fig. 194, 195, 199 or 202 fastened as follows: For light duty, self-drilling anchors in brick and toggle bolts in block; for heavy duty, through bolts with backing plates.
 4. Concrete (Existing) - Phillips "Redhead" or Rawl self-drilling anchors or expansion bolts.
- G. Welded attachments for securing hangers to piping or to structural steel may be provided in lieu of other attachments specified if prior approval is obtained in the field from the Architect. Welded attachments shall be designed so that the fiber stress at any point in the weld or attachment will not exceed the fiber stress in the hanger rod. Generally, welding shall not be permitted in finished spaces.
- H. In no case shall wire or perforated strap be used for pipe support.
- I. Secure all hangers for piping to joist and beams. In no case shall supports be secured to underside of metal or wood deck unless otherwise directed in the field by the Architect. Contractor shall submit details of method of attachments for approval to the Architect.

2.3 SLEEVES AND PLATES

- A. Pipe sleeves through concrete and masonry construction shall be Schedule 40 galvanized steel pipes unless otherwise indicated on the drawings. Openings that cannot be sleeved before slab or wall is poured shall be core drilled. Pipe sleeves through drywall and similar construction shall be sized to pass both pipe and insulation, and where permitted by code, may be Schedule 40 PVC.
- B. Sleeves in existing concrete or masonry walls shall be set and secured with mortar grout and fast drying bitumastic sealant. Caulk the annular space of pipe sleeves with an elastic caulk compound to make installation air and watertight.
- C. Escutcheon plates shall be provided for all exposed pipes and conduits passing through walls, floors, and ceilings in finished areas. Plates shall be chrome plated brass of the split ring type, of size to match the pipe or insulation where installed. Where plates are provided for pipes passing through sleeves which extend above the floor surface, provide deep recessed plates to conceal the pipe sleeves.
- D. Utilize U.L. approved resilient sealant for all penetration seals. Submit method of sealing for approval.
- E. Where watertight sleeves are indicated or required to suit the installation, provide Link Seal rubber seals, as manufactured by Thunderline Corporation, between pipes and sleeves.

PART 3 - EXECUTION

3.1 WORKMANSHIP

- A. Each subcontractor shall furnish the services of an experienced superintendent who shall be constantly in charge of the installation of the work.
- B. The quality of workmanship required for each trade in the execution of its work shall be the finest and highest obtainable in that trade working with the materials specified. Workmanship shall be satisfactory to the Architect and his decision as to acceptable quality if final.

3.2 EQUIPMENT CONNECTIONS

- A. All equipment shall be installed and connected in accordance with the best engineering practice and in accordance with manufacturer's instructions and recommendations. Auxiliary piping, valves, and electric connections recommended by the manufacturer or required for proper operation shall be provided.

3.3 WATERPROOFING

- A. Under no circumstances shall waterproofing be damaged or penetrated. Should conditions arise which indicate such necessity, notify the Architect.

3.4 CUTTING AND PATCHING

- A. Cutting and patching associated with the work in the existing structure shall be performed in a neat and workmanlike manner. Existing surfaces which are damaged by the Contractor shall be repaired or provided with new materials and methods similar to existing adjacent work, subject to approval of the Architect. Structural members shall not be cut or penetrated unless otherwise indicated on the drawings. Verify in the field with the Architect. Holes cut through concrete and/or masonry to accommodate new work shall be cut by reciprocating or rotary non-percussive methods. Existing masonry block walls shall be patched with new masonry or gypsum board attached and sealed to both block faces.

3.5 SURVEYS AND MEASUREMENTS

- A. Base all measurements (both horizontal and vertical) from established benchmarks. All work shall agree with these established lines and levels. Verify all measurements at site and check correctness of same as related to the work. Verify locations of existing utilities and inverts of same prior to the start of any systems shown connecting to utilities.
- B. Should the Contractor discover any discrepancy between actual measurements or conditions and those indicated which prevent following good practice or the intent of the drawings and specifications, he shall notify the Architect and shall not proceed with his work until he has received instruction from the Architect.

3.6 HANDLING AND STORAGE OF MATERIALS

- A. Proper and suitable tools, equipment and appliances for the safe and convenient handling and placing of all materials and equipment shall be used. During loading, unloading, and placing, care shall be taken in handling the equipment and materials so that no equipment or materials, including Owner furnished, are damaged.
- B. All equipment delivered to the job site shall be stored under roof or other approved covering, on pedestals above the ground. All enclosures for equipment shall be weatherproof. All valves shall be stored under roof on wood pedestals above ground. All insulation shall be stored under roof or in trailers, adequately protected from the weather. The Contractor shall follow all written

instructions and recommendations of the manufacturer and all requirements of the Architect in oiling, protection and maintenance of equipment during storage. It shall be the Contractor's complete responsibility for the storage and care of the equipment and materials.

- C. If any materials and/or equipment are found to be in poor condition at the time of being installed, the Architect may, at his discretion, order the Contractor to furnish and install new equipment at no cost to the Owner.

3.7 COOPERATION WITH OTHER TRADES

- A. Exact location of sprinkler heads, drains, piping and valves shall be coordinated with all other trades so that there will be no interference between lighting fixtures, piping, ducts, and conduits. Where conflicts between the trades result, they shall be resolved by the Contractor to the Architect's satisfaction and at no expense to the Owner.
- B. Fire Protection trades shall give full cooperation to other trades and shall furnish in writing, with copies to the Architect, all information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.
- C. Prior to the installation of all fire protection equipment and materials coordinate installation with all other trades.

3.8 CLEANING AND PAINTING

- A. Thoroughly clean all exposed surfaces of equipment and material and leave in a neat, clean condition ready for painting. Restore and touch-up factory finishes which have been damaged during construction. Finished painting will be performed under another Division.
- B. Miscellaneous requirements include:
 - 1. Provide complete new finish if, in the opinion of the Architect, the factory finishes are severely damaged.
 - 2. Touch up threads of zinc coated screwed pipe with Rustoleum primer and one coat of enamel conforming to painting specification.
 - 3. All exposed hangers, steel supports and miscellaneous components, and cast iron pipe hangers shall be field painted with Rustoleum primer and one coat of enamel conforming to painting specification.
 - 4. All steel support and miscellaneous components shall be painted with Rustoleum primer and one coat of enamel conforming to the painting specification.

3.9 ACCESSIBILITY

- A. Locate all equipment which must be serviced, operated or maintained, in fully accessible positions including valves and drains. Where required and where directed, provide 14 gauge steel access panels, Milcor or equal, to suit material in which installed. Doors installed in fire rated walls or shafts shall be labeled and shall match rating of the construction. Door shall be of sufficient size to allow access to all components, except minimum size shall be 24" x 24", unless otherwise noted.
- B. Equipment deemed inaccessible by the Architect shall be reworked by the Contractor at no expense to the Owner. All doors shall have cylinder locks operable from same key. Submit shop drawings for approval.

3.10 SLEEVES AND PLATES

- A. Sleeves shall be provided by the trade installing the pipe. The sleeves shall be carefully located in advance of the construction of walls and floors where new construction is involved. Provide all cutting and patching necessary to set sleeves which are not placed prior to construction. All cutting and patching necessary to set sleeves which are not placed prior to construction shall be the responsibility of the trade providing the sleeves.
- B. Sleeves shall be provided for all piping passing through concrete, masonry, plaster and gypsum wallboard construction. Caulk the annular space of pipe sleeves with an elastic caulking compound to make installation air and watertight.
- C. Fasten sleeves securely in the construction so that they will not become displaced when concrete is poured or when other construction is built around them. Take precautions to prevent concrete, plaster or other materials being forced into space between pipe and sleeve during construction.
- D. Sleeves required in existing concrete or masonry walls shall be set and secured with mortar grout and fast drying bitumastic sealant.
- E. At all sleeves where objectionable noise can be transmitted (e.g. Mechanical and Electrical Rooms), at smoke barriers, at walls above ceilings that extend to the underside of the structure of the floor above, or at fire rated separations, seal all openings between pipes and corresponding sleeves to prevent sound transmission and to maintain fire rating. Use U.L. approved resilient sealant for penetration seals.
- F. Where pipe motion due to expansion and contraction will occur, provide sleeves of sufficient diameter to permit free movement of pipe. Check construction to determine proper length for various locations; make actual lengths to suit the following:
 - 1. Terminate sleeves flush with walls, partitions and ceilings.
 - 2. Terminate sleeves 2 inches above finished floor in equipment rooms, and wet floor areas.
 - 3. In all other areas, terminate sleeves 1/2 inch above finished floor unless otherwise noted on the drawings or directed in the field.

3.11 ALTERATIONS AND DEMOLITION

- A. All existing piping, equipment and materials which are required to be removed shall be removed. All existing materials and equipment which are removed and are desired by the Owner, or are indicated to remain as the property of the Owner, shall be delivered to him on the premises by the Contractor where directed by the Architect. All other materials and equipment which are removed shall become the property of the Contractor and shall be promptly removed by him from the premises.
- B. Remove all indicated work by hand as far as possible. Power-driven equipment shall be used as a last resort, and shall not be employed without consent of the Owner. Schedule all demolition work to the satisfaction of the Owner. The Contractor shall execute the removal work as quietly as practicable to avoid unnecessary disturbances to occupied areas.
- C. Existing conditions, i.e. ductwork, piping, equipment, etc., may be obtained from available record drawings and are not warranted to be complete or correct. Contractor shall verify exact location of all ductwork, piping, etc., in the field prior to starting any work.
- D. Existing pipe sizes noted on the available record drawings are for the convenience of the Contractor only. Contractor shall verify sizes in the field.

- E. Existing piping no longer required to remain in service shall be disconnected and removed back to service mains, including existing piping hangers and supports. Existing pipe indicated or required to remain in service shall be capped.
 - F. Existing piping that remains concealed, buried, or otherwise contained in or below the remaining slabs and walls shall be capped, plugged, or otherwise sealed. All pipes shall be cut so that their capped or plugged ends will be far enough behind finished surfaces to allow for the installation of the normal thickness of finished material.
 - G. When existing fire protection work is removed, all related pipes, valves, and materials shall also be removed.
 - H. When the work specified herein connects to existing piping, the Contractor shall perform all necessary alterations, cutting, or fitting of the existing work as may be necessary or required to make satisfactory connections between the new and existing work and to leave the completed work in a finished and workmanlike condition, to the entire satisfaction of the Architect.
 - I. When the work specified herein or under other divisions of the contract necessitates relocation of existing equipment or piping, the Contractor shall perform all work and make all necessary changes to existing work as may be required to leave the completed work in a finished and workmanlike condition, to the entire satisfaction of the Architect, and at no additional cost to the Owner.
 - J. Existing piping affected by removal or new work installation and required to remain in service shall be reinstalled or supported as required in accordance with new work specification. All work shall be completed to the Architect's satisfaction and at no additional cost to the Owner.
 - K. Valve off or disconnect live services as required for removal work.
 - L. Refer to drawings for additional requirements.
- 3.12 CLOSE OUT PROCEDURES:
- A. Refer to Section 017700 Close Out Procedures for specific requirements.

END OF SECTION 210010

SECTION 210050 – FIRE PROTECTION BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provision of the Contract, including General and Supplementary Conditions and Division 01 specifications, apply to the work specified in this Section.

1.2 SUMMARY

- A. This section includes requirements for fire protection equipment, materials and procedures which are common to more than one section of Division 21 and which are general in nature and use. This section applies to all sections of Division 21.
- B. The requirements of Section 210010, Fire Protection General Provisions, shall apply to all work specified under this section.

1.3 SUBMITTALS

- A. Submit shop drawings for all items of materials specified in this section in accordance with the Section 210010.
- B. At a minimum manufacturer's product data shall include specifications, installation instructions and general recommendations for each type of material required. Include data substantiating that proposed materials comply with specified requirements for each type.

1.4 TESTS AND ADJUSTMENTS

- A. The Contractor shall furnish labor, instruments, equipments, and materials required to perform tests prescribed in the sections describing the various systems.
- B. Replace or repair defects found during inspection or test with new materials. Caulking of welded joints, screwed joints, cracks, or holes is not acceptable. Correct leaks in screwed fittings by remaking joints. In welded systems leaks in joints shall be cutout and rewelded. Repeat tests after defects have been eliminated.
- C. Where reasonable doubt exists as to a system's ability to comply with contract requirements, perform any reasonable test required by the Architect.
- D. Make static pressure tests and prove to the satisfaction of the Architect that the piping is tight before pipes are concealed or insulated. Tests shall be provided as hereinafter specified.
- E. Use test instruments for accuracy by an approved laboratory or by the instrument manufacturer and furnish certificates showing degree of accuracy to the Architect when requested. Make calibration histories for each instrument available for examination.
- F. Where gauges, thermometers and other instruments which are to be left permanently installed are used for tests, do not install until just prior to the tests to avoid possible changes in calibration.

PART 2 - PRODUCTS

2.1 HANGERS

- A. Refer to Section 210010. Provide hangers and supports in accordance with requirements of NFPA 13.
- B. Hangers and accessories shall be Anvil International, Fee and Mason, Modern, National, or B-Line of the types specified in Section 210010.
- C. It shall be the responsibility of the Contractor to provide an adequate pipe suspension system in accordance with recognized engineering practices, using standard, commercially accepted pipe hangers and suspension equipment.
- D. The design of all hangers and support shall be in accordance with the provision of the current issue of MSS-SP-58 document developed as a standard by the Manufacturers' Standardization Society.
- E. Hangers for steel pipe, except as noted otherwise shall be spaced at least every ten (10') feet.
- F. Where concentrated loads of valves, fittings and similar items occur, or if recommended by the piping manufacturer, closer hanger spacing will be necessary.
- G. Generally, hangers shall be clevis type, standard weight.
- H. Vibration hangers shall be provided as specified. Where required or indicated provide seismic restraint devices.
- I. Provide surge restraint as required by NFPA 13 where system working pressure exceeds 100 psi.

2.2 IDENTIFICATION AND EQUIPMENT TAGS

- A. All control devices, i.e. panels, switches, starters, push button stations, controls, etc., shall be clearly identified as to their function and the equipment controlled.
- B. All equipment such as pumps, packaged systems, etc., shall be marked to clearly identify said equipment and space or duty they serve.
- C. Equipment herein specified shall be identified using engraved laminated black and white phenolic legend plates. Letters shall be minimum, 3/4" high white on surrounding black. Plates shall be mounted by means of sheet metal screws. Submit nameplate list to Architect for approval.
- D. Piping shall be identified with colored, pre-rolled, semirigid plastic labels as manufactured by Seton, Marking Services, Inc., or approved equal. For indoor installations, labels shall be Seton "Set Mark" system. For outdoor installations, labels shall be "Ultra Mark" system. Labels shall be set around pipes with a field installed high strength cement around pipes with a field installed high strength cement compound applied along their longitudinal edge. Labels shall be placed around the piping or insulation every forty feet (40) and with one (1) label on each pipe in rooms smaller than fifteen feet (15). A label shall be placed at every major valve and at least six feet (6) from exit or entrance to an item of equipment. At Contractor's option, piping concealed above suspended ceilings only, may be identified by stenciling with black paint and taped color bands in accordance with the coding system herein specified.
 - 1. Labels shall be provided in accordance with the following table with color coding and stencil designations as indicated:

SIZE OF LEGEND LETTERS

<u>Outside Diameter of Pipe (Inches)</u>	<u>Length of Color Field (Inches)</u>	<u>Size of Letters (Inches)</u>
3/4" to 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"
2-1/2" to 6"	12"	1-1/4"

- E. In addition to labeling as specified hereinbefore, all piping exposed within mechanical and electrical equipment spaces, utility spaces, janitor's closets, and piping elsewhere "exposed" as defined in Section 210010, shall have full color coding, painted in a color identifying system type. Fire protection piping shall have additional full color coding within stairwells and at all risers. Paint colors shall conform to the following schedule:

Fire Protection	Red
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- F. All valves, except as specified below, shall be provided with colored plastic or brass valve tags with stamped-in numbers. Tags shall be secured to valve wheels with metal chain. Stop valves on individual fixtures or equipment where their function is obvious, or where the fixture or equipment is immediately adjacent, need not be so equipped. Care shall be exercised in selecting valve numbers to be prepared on a drawing showing locations, details of arrangements, etc., of all service and control valves indicating identity and function. One black line print of each drawing shall be mounted under glass where directed. Valve tags shall be Seton or approved equal minimum 1-1/2" round tags with white characters describing system and valve designation. Submit valve number list for approval.

2.3 PIPE, FITTINGS, AND JOINTS

A. General

1. Piping materials shall conform to state and local code requirements. Pressurized piping systems shall conform to American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME) B31.9, "Code for Pressure Piping, Building Services Piping". High-pressure piping shall conform to ANSI/ASME Section I, B31.1, "Code for Pressure Piping, Power Piping".
2. Quality and weight of materials shall comply with requirements of applicable American Society of Testing Materials (ASTM), ANSI, ASME, and Cast Iron Soil Pipe Institute (CISPI) standards. ASTM number and wall thickness shall be indicated on each pipe length.
3. Provide pipe and fittings for systems as hereinafter specified. All references to codes shall apply to the latest year. Grooved products may be as manufactured by Victaulic or Grinnell. All piping and fittings shall be made in America.
4. All piping shall bear a continuous repeating label along the entire length of the pipe indicating the manufacture's name, manufacture's pipe designation, pipe schedule (or wall thickness), pipe size and mark of listing agency.
5. All fittings shall be listed and shall be installed in accordance with NFPA 13 and manufacture's recommendations.

B. Pipe Materials

1. Fire Protection Service
 - a. Above ground pipe 2" and below - Black steel pipe, ASTM A53A, ANSI Schedule 40, assembled with malleable iron screwed fittings class 150 or 300 ANSI B16.3.

- b. Above ground pipe 2-1/2" to 6" - Black steel pipe, ASTM A53A, ANSI Schedule 40 or Schedule 10, assembled with malleable iron screwed fittings class 150 or 300 ANSI B16.3, or welded flanged connections.
- c. At Contractor's option (for all sizes), pipe shall be assembled with mechanically grooved couplings Victaulic Style 107N and 009N (rigid) and Style 177 (flexible) with center-leg gasket including pipe stop to ensure proper groove engagement, alignment, and pipe insertion depth. Fittings shall be Victaulic FireLock™, ASTM-A-395 and ASTM-A-536, short-pattern with flow equal to standard pattern fittings. UL listed and FM approved for service to 300 psig with Schedule 10 pipe.
 - 1) Rigid Type: Housings cast with offsetting, angle-pattern, bolt pads to provide system rigidity and support and hanging in accordance with NFPA 13, fully installed at visual pad-to-pad offset contact. (Couplings that require exact gapping at specific torque ratings are not permitted).
 - 2) Flexible Type: For use in locations where vibration attenuation and stress relief are required only.
 - 3) Fittings for Schedule 40 grooved end steel piping in fire protection applications sizes 1-¼" thru 2½" shall consist of a ductile iron housing conforming to ASTM A-536, Grade 65-45-12, with prelubricated Grade "E" EPDM Type 'A' gasket; and ASTM A449 electroplated steel bolts and nuts. UL listed for working pressure of 300 psi (2065 kPa) and FM approved for working pressure 365 psi (2517kPa).

PART 3 - EXECUTION

3.1 CLEANING

- A. After completion of installation, thoroughly clean dirt, rust, loose scale, oils and grease, and other foreign matter from metal surfaces, painted or unpainted, specified under Division 21 of the specification.
- B. Clean all internal and external surfaces of the equipment. Remove all mill scale, loose metal particles, weld splatter, slag, dirt, and other foreign matter. Remove all burrs and ease all sharp edges.
- C. Flushing procedures found in NFPA 13 are to be used in flushing the system. Minimum flushing velocity is to be 10 ft. per second.
- D. Restore, to its original condition, any completed construction or construction work in progress which is not part of the work of this Specification and which is damaged during installation. All such damaged areas, which are repaired, are subject to the Architect's acceptance.

3.2 FABRICATION

- A. Sprinkler piping may be shop-fabricated in accordance with the requirements of NFPA 13.
- B. Threaded, grooved, or flanged fittings may be utilized, in accordance with the requirements of the appropriate NFPA standard, and with the requirements of this Specification.
- C. Pipe lengths are to contain the minimum number of fittings and connections practicable.
- D. Pipe may be welded at the Contractor's discretion.
 - 1. Conduct welding operations outside of the plant buildings, and away from hazardous locations wherever practical.

2. When welding must be conducted inside the building, the Contractor shall establish an acceptable fabrication shop location with the Architect.
3. Obtain permission and a welding permit from the AHJ prior to final welding of pipe.
4. Provide a fire watch outfitted with fire hose and extinguisher during all welding operations.
5. Comply with NFPA 13 for all welding methods and requirements.
6. Maximum length of welded section of pipe is 20 feet.

3.3 PIPING INSTALLATION

- A. Install piping without undue stress or strain in locations shown and run parallel to the lines of the building, except to grade them as specified in a neat and workmanlike manner using a minimum of fittings. Provide such fittings, valves, and accessories as may be required to meet the conditions of the installation. Contractor shall inform himself fully regarding any peculiarities and limitations of space available for installation of material under each section of specifications. Install piping to suit necessities of clearance with ducts, conduits, structure, and other work, and so as not to interfere with any passages or doorways and allow sufficient head room at all places. Use proper reducing fittings for changing piping sizes.
- B. Cut pipes accurately to measurements established in the field in a neat and workmanlike manner without damage or without forcing or springing. Perform cutting by means of an approved type of mechanical cutter of the wheel type where practicable. Ream pipe after cutting to remove all burrs.
- C. Install unions and flanges where shown and on each side of all pieces of equipment and other similar items, and in such a manner that the unions or flanges can be readily disconnected. Do not place any union or flange in a location which will be inaccessible after completion of the project.
- D. Joints between dissimilar piping material shall be made with appropriate adapters in accordance with the respective manufacturer's printed instruction and recommendations.
- E. Grade pipe minimum 1" in 40 feet to low points, unless otherwise specified or indicated. Provide drain valves at all low points.
- F. All piping shall be so installed so that it will in no way be distorted or strained by expansion or contraction.
- G. Use full pipe lengths; random lengths joined by couplings will not be accepted.
- H. All piping shall be arranged to drain to the system's main drain valve. **The use of auxiliary drains for trapped sections is not acceptable unless approved in writing by the Architect.**
- I. Piping shall not be routed directly above electrical switchgear, battery rack, electrical distribution panels, transformer, power distribution unit, or IT equipment racks.
- J. Install piping in accordance with NFPA 13.

3.4 WORKMANSHIP

- A. Cut pipes accurately to measurements established at structure. Install pipes without springing or forcing.
- B. Clear windows, doors and other openings with all pipes. Arrange pipes to permit expansion and contractions without misalignment or damage.

- C. During construction all openings in piping and equipment shall be closed with caps or plugs to keep out all foreign matter indicated.
- D. All piping in finished spaces shall be run concealed unless otherwise indicates.

3.5 PHASING

- A. The contractor shall schedule phasing to minimize the disruption of patient services. This phasing is essential to ensure a safe environment in patient care areas. Phasing shall include assurance for clean to dirty airflow, emergency procedures, criteria for interruption of protection, written notification of interruptions, and communication authority. Procedures must be developed for noise and vibration that will affect patients, and planned accordingly. The renovation areas shall be isolated from the occupied areas during construction using airtight barriers, and exhaust airflow shall be sufficient to maintain negative air pressure in the construction zone.

3.6 WELDING

- A. Refer to Section 210010

3.7 SLEEVES AND PLATES

- A. Refer to Section 210010.

3.8 TESTS

- A. The following tests shall be conducted by the Contractor and all piping shall be proven tight in the presence of the Architect or his representative. Notify Architect prior to tests. These tests shall be conducted before any insulation is installed and any insulation installed prior to test shall be removed. Provide all equipment and labor required. Tests shall be at least four hours in duration. Piping may be tested in sections as approved by the Architect. Tests shall be specified herein.
- B. Fire protection piping shall be tested in accordance with NFPA 13.
- C. All pressure piping systems, unless otherwise specified herein, shall be filled with water and thoroughly flushed clean of foreign matter after erection and before connection of equipment.

END OF SECTION 210100

SECTION 211000 –SPRINKLER AND STANDPIPE SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provision of the Contract, including General and Supplementary Conditions and Division 01 specifications, apply to the work specified in this Section.

1.2 SUMMARY

- A. This section includes the new wet pipe sprinkler systems.
- B. The requirements of Section 210010 and 210050 shall apply to work specified under this section.
- C. Modify existing wet type automatic sprinkler system where indicated and make connection to the water supply main as indicated, all in accordance with NFPA Standards 13 and Factory Mutual Standards.
- D. All requirements of the State of Maryland, State Fire Marshal's office and City and Local authorities' Fire Prevention Bureaus shall apply to this specification.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Meet all requirements in accordance with Section 210010, Fire Protection General Provisions.
- A. Provide all piping as required by NFPA and approved plans in accordance with all applicable standards. Piping installation and hangers shall be in accordance with Section 210050, Fire Protection Basic Materials and Methods, unless specified otherwise in this Section.

1.4 CODES AND REGULATIONS

- A. All requirements of the State of Maryland, and the City and Local Fire Prevention Bureau(s), shall apply to this specification and design requirements, including the latest edition of the following codes and regulations:

- State of Maryland Fire Prevention Code
- Underwriters Laboratories Fire Protection Equipment Directory
- Standard for the Installation of Sprinkler Systems (NFPA 13)
- Standard for the Installation of Standpipe and Hose Systems (NFPA 14)
- Standard for the Installation of Centrifugal Fire Pumps (NFPA 20)
- Standard for the Installation, Maintenance, and use of Protective Signaling Systems (NFPA 72A)
- Code for Life Safety from Fire in Buildings and Structures (NFPA 101)
- Occupational Safety and Health Act
- International Building Code
- FM Global Standards

1.5 SUBMITTALS

- A. Eight (8) sets of calculations and shop drawings covering the sprinkler systems shall be prepared and submitted to the Engineer and owner's insurance company for approval prior to being submitted to any City and State agencies. All submittals required by this Specification shall be reviewed and approved by a Professional Engineer, licensed in the State of Maryland

or a technician holding a NICET Level IV Certification who is experienced in the work of this Specification. This review and approval shall be performed before the submittals are provided to the Architect. Submittals shall be signed and sealed by the qualified professional responsible for their preparation. Shop drawings shall show light fixtures, ducts, mechanical equipment, structural elements, and all other items which may affect the layout of sprinkler heads and pipes. Plans showing sprinkler work shall be not less than one-eighth inch (1/8") per foot and shall be prepared on sheets with dimensions the same as the contract drawings. No work shall be started until shop drawings are approved by all the reviewing agencies.

- B. The drawings shall indicate all areas to be sprinklered and type hazard, locations and sizes of water supply pipe, major drains and tests, zone values and other main piping and valves, and the location of fire department connections. Complete riser diagrams shall also be submitted. The drawings shall locate by dimension all fire protection piping and sprinkler heads. The layout shall be performed by a technician holding NICET Level IV Certification or a licensed Professional Engineer. Evidence of qualifications and certification must be submitted.
- C. Provide all electrical wiring diagrams of flow switches, alarms, and supervising equipment for coordination under Division 28. All wiring shall be provided under Division 28, ELECTRICAL.

1.6 SAMPLES

- A. Submit Architect if requested, samples of all sprinkler heads to be provided.

1.7 PROJECT REQUIREMENTS

- A. Layout and installation of the systems shall be accomplished by a licensed sprinkler contractor, who has been engaged in the installation of automatic sprinkler systems for a minimum of five years.
- B. Modify existing wet type automatic sprinkler system.
- C. The renovated area of the building shall be fully sprinklered throughout, and the sprinkler piping systems shall be either scheduled or hydraulically designed in accordance with NFPA 13 and the Hazard Occupancy requirements of the Owner's insurance carrier. Contractor shall verify the exact design requirements with the Owner's insurance carrier. Sprinkler system shall be divided into zones as indicated on the documents.
 - 1. The sprinkler system design for mechanical equipment rooms shall be based on ordinary hazard occupancy requirements of the Owner's insurance carrier hazard occupancy requirements, whichever is more stringent. Contractor shall verify the exact design requirements with the Owner's insurance carrier.
- D. Pipe sizes shall be as required by NFPA and Factory Mutual but in no case less than those shown on the drawings.
- E. Sprinkler heads shall be provided as required by NFPA. Sprinkler head locations shall be coordinated with the architectural reflected ceiling plans. Sprinkler shop drawings shall indicate the ceiling grid, lighting fixtures, air devices, etc. Generally, sprinkler heads shall be centered in ceiling tiles.
- F. Do not interrupt existing sprinkler service to facilities occupied by Owner or others unless permitted and then only after arranging to provide temporary sprinkler service or alternate fire protection measures.

1. Notify Owner no fewer than ten (10) days in advance of proposed interruption of sprinkler service
 2. Do not proceed with interruption of sprinkler service without Owner's written permission.
- G. All hose thread connections shall conform to the requirements of the local Fire Department for compatibility with their equipment.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All sprinkler and standpipe system materials and devices shall be listed for fire protection service. Each item of equipment shall be capable of performing its function over an extended period of time with a minimum of attention and maintenance. All equipment shall be constructed using new materials designed and built in accordance with the best practices of the industry. Each major item of equipment shall bear the manufacturer's name or trademark; serial numbers; U.L. label, Factory Mutual approval; operating instructions and hydraulic temperature characteristic conditions, etc., if applicable.
- B. Unless specified otherwise, the standard manufactured products of Tyco, Viking, Victaulic, Reliable, Central, Standard, or Star shall be provided. Equipment and installation shall comply with the latest edition of NFPA Standards 13 and 14.

2.2 PIPING

- A. Provide fire protection piping systems of materials as specified in Section 210050.

2.3 SPRINKLERS

- A. Sprinklers shall be listed by Underwriter's Laboratories and only new sprinklers shall be used. Any sprinkler that incurs damage, is painted, or is sprayed with any fire retardant or obstructive material shall be replaced at no cost to the Owner. Sprinklers shall be provided and installed in accordance with NFPA 13 and Factory Mutual and properly coordinated with other work including duct and light fixture installation. The correct type of sprinkler head shall be used in every location.
- B. The correct temperature rating of every sprinkler head shall be used according to the maximum ceiling temperature rating and requirements in NFPA 13. All sprinklers with the exception of specified decorative types shall have their frame arms colored at the factory in accordance with the standard table in NFPA 13.
- C. Sprinklers that may be subject to mechanical damage due to their location (under stairwells, or low hanging sprinklers in corridors, storage rooms or under ducts) shall be provided with approved guards (Reliable Model MA or equivalent). Sprinklers under open gratings shall be provided with approved shields.
- D. Sprinkler heads shall be provided as follows:
1. In all suspended tile or plaster ceilings, provide recessed sprinkler heads, Viking Microfast Model M quick response, VK302, Victaulic V27, or approved equal.
 2. All exposed heads in suspended ceiling shall be chrome plated. All others shall be brass.

PART 3 - EXECUTION

3.1 WATER-SUPPLY CONNECTIONS

- A. Connect sprinkler piping to building's existing sprinkler piping.

3.2 PIPING INSTALLATION

- A. Install piping as indicated on approved shop drawing submittals.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
 - 2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Use listed fitting to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- C. Install sprinkler piping with drains for complete system drainage.
- D. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
 - 1. Provide pipe hangers and supports for fire protection piping as hereinbefore specified in Section 210050, and in no case less than the requirements of NFPA.
 - 2. All sprinklered piping shall be substantial supported from the building structure which must support the total load of the water filled pipe plus a minimum of two hundred fifty pounds (250 lbs.) applied at the point of hanging in accordance with NFPA 13. All hanging apparatus and equipment shall be of an approved type installed in accordance with NFPA 13.
- E. Fill wet pipe sprinkler system piping with water.
- F. Install sleeves for piping penetrations of walls, ceilings, and floors.
- G. Install escutcheons for piping penetrations of walls, ceilings, and floors.
- H. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1 Cut thread full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compounds to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join Steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems..
- K. The work under this Section shall be coordinated with that of all other sections and trades so that all work may be installed in the most direct and workmanlike manner and so that interference between piping, ducts, equipment, architectural and structural features will be avoided.
- L. Piping shall run concealed in areas of drop ceilings. Piping shall be installed and arranged to protect it from freezing and corrosion, and shall be pitched for drainage. Installation of all piping

shall be in coordination with ducts, light fixtures, and any other work that may obstruct sprinklers.

3.3 INSTALLATION, TESTS, AND ACCEPTANCE

- A. Installation, tests, and acceptance shall be in accordance with all applicable codes and authorities.
- B. Installation shall be in accordance with all applicable codes. Installation of equipment and devices that pertain to other work in the contract shall be closely coordinated with the appropriate subcontractors.
- C. The complete installation shall be inspected by a technician holding a NICET Level IV Certification before the hydrostatic test is performed.
- D. All required tests shall be performed by the installer (contractor). The Contractor shall see that proper representative of the Owner, the Engineer, and any other authority having jurisdiction desiring to witness the test shall be notified at least forty-eight hours (48 hrs.) ahead of the scheduled test times. The following tests shall be witnessed:
 - 1. Lead-in connections to the system shall be flushed before connection is made to any system piping using the criteria required in NFPA 13.
 - 2. All piping shall be tested hydrostatically at not less than two hundred psi (200 psi) for two hours (2 hrs.). The hydrostatic test pressure shall be measured at the low point of the system. The hydrostatic test shall be for the entire system as installed and specified.
 - 3. The contractor shall furnish a written statement to the effect that all work covered in the contract has been completed and tested in accordance with the approved specifications and plans. Copies of the written statement shall be provided to the Owner and any other authority having jurisdiction.
- E. The following materials shall be furnished by the Contractor at the conclusion of the final acceptance test:
 - 1. Operating and maintenance instruction in accordance with Section 210010.
 - 2. The spare sprinklers hereinbefore specified.
 - 3. Any and all special tools noted by the manufacturer required for the fire protection items furnished.
- F. After completion of installation and tests clean interior and exterior surfaces of equipment and materials, painted or unpainted installed under this section of specification of dirt, rust, loose scale, oils, grease and other foreign matter.

END OF SECTION 211000

SECTION 220010 - PLUMBING GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provision of the Contract, including General and Supplementary Conditions and Division 01 specifications, apply to the work specified in this Section.

1.2 SUMMARY

- A. This section describes the general provisions for the mechanical and electrical work included in Division 22. This section applies to all sections of Division 22.

1.3 RESPONSIBILITY

- A. The General Contractor shall be responsible for all work included in the Plumbing Division and the delegation of work to Subcontractors shall not relieve him of this responsibility. Subcontractors who perform work under these Sections shall be responsible to the General Contractor. The term "Contractor" is used throughout this Division and shall mean the General Contractor, although the actual performance of the work may be by a Subcontractor.

1.4 REFERENCES AND DEFINITIONS

- A. Following are definitions of terms and expressions used in the Plumbing Sections in addition to those included in Division 01 Sections:

1. Owner: UPMC Western Maryland
2. Architects: Lakeside Architecture Inc
3. Engineers: WSP USA Inc. (Formerly Leach Wallace Associates, Inc.)
4. Directed - "directed by the Architect"
5. Indicated - "indicated or in Contract Documents"
6. Concealed - "hidden from normal sight"; includes items in shafts, pipe and duct spaces, and above ceilings.
7. Exposed - "not concealed" - Work within Equipment Rooms and all visible (normal sight) work shall be considered exposed".
8. Piping - includes pipes, fittings, valves, hangers and accessories comprising a system.

1.5 STANDARD SPECIFICATION

- A. References to catalogs, standards, codes, specifications, and regulations are the latest edition in effect at date of invitation to bid.

1.6 CODES, REGULATIONS AND PERMITS

- A. Give all necessary notices and obtain all required permits. Pay all fees and other costs, including utility connections or extensions in connection with the work. File all necessary plans, prepare all documents and obtain all necessary approvals of all governmental departments having jurisdiction. Obtain all required certificates of inspection and deliver same to the Architect before request for acceptance and final payment for the work.

- B. All materials furnished and all work installed shall comply with the latest rules, regulations, and recommendations of the following bodies:

International Building Code (IBC)

International Mechanical Code (IMC)

Allegany Plumbing Code

National Fire Protection Association (NFPA)

National Electrical Code (NEC)

All State & Municipal Ordinances, Codes, and Regulations having Jurisdiction

1.7 MATERIALS LIST AND SHOP DRAWINGS

- A. See General Requirements.
- B. Within 15 working days after the award of the contract, the contractor shall submit to the Architect for approval a list of Submittals to be included in the Submittal Schedule in accordance with Section 013300 Submittal Procedures. The list shall include the manufacturers of materials and equipment he proposes to provide. In the event any items of material or equipment contained in the list fail to comply with the specification requirements, such items will be rejected. Rejected items shall be resubmitted within 15 days. Substitution requests shall be submitted in accordance with specified procedure.
- C. After receiving approval of equipment manufacturers and prior to delivery of any material to job site and sufficiently in advance of requirements to allow the Architect ample time for checking, submit for approval dimensioned drawings or cuts showing construction size, arrangement, operating clearances, performance characteristics and capacity of materials and equipment. Each item of equipment proposed shall be a standard catalog product of the approved manufacturer.
- D. Samples, drawings, specifications, catalogs, etc., submitted for approval shall be properly labeled indicating specific services for which material or equipment is to be used, section and article number of specifications governing, and Contractor's name, name of job, and date.
- E. Catalogs, pamphlets or other documents submitted to describe items on which approval is being required shall be specific and identification in catalog, pamphlet, etc., of the item submitted shall be clearly made in ink. Data of a general nature will not be accepted. Any deviations or exceptions taken in the specification by the Contractor shall be so noted.
- F. Any deviations or exceptions taken in the specification by the Contractor shall be so noted.
- G. If material or equipment is installed prior to receipt by the Contractor of approved shop drawings, marked "Approved", "No Exception Taken" or "Make Corrections Noted", the Contractor shall be liable for its removal and replacement at no extra charge to the Owner.
- H. The acceptance of shop drawings shall not relieve the Contractor from his responsibility to furnish material, equipment and systems and to perform work required by the contract documents. Neither the Owner nor the Architect will be responsible for errors or omissions on shop drawings furnished by the Contractor even though such shop drawings containing errors or omissions are inadvertently accepted.

- I. The Contractor is further advised that the Architect will not act as coordinator between suppliers and subcontractors. All required coordination shall be the responsibility of the Contractor.

1.8 CONTRACTOR'S USE OF CAD/REVIT FILES

- A. At the Contractor's written request, copies of the Engineer's CAD / Revit files may be made available for Contractor use in connection with the project, subject to following conditions:
 1. Submit written request to the Architect listing the specific drawings the Contractor intends to use. Provide a specific list of submittals that the files will be used in preparing, and the list of names of subcontractors or suppliers.
 2. The Contractor shall request in writing the electronic transfer agreement. Prior to transfer of files, the Contractor shall prepare a separate electronic transfer agreement for each subcontractor or supplier who will be using the electronic files.
 3. Data contained on the electronic files is part of WSP USA Buildings Inc. (WSP USA) instruments of service and shall not be used for any purpose other than as a convenience in the preparation of shop drawings for the referenced project. Any other use or reuse will be at the Contractor's sole risk and without liability or legal exposure to WSP USA.
 4. The electronic files are not contract documents. Significant differences may exist between the electronic files and the corresponding hard copy contract documents. Because of the possibility the information and data delivered in machine readable form may be altered, whether inadvertently or otherwise, WSP USA reserves the right to retain hard copy originals of the electronic documentation delivered to the contractor, in machine readable form, which the original shall be referred to and shall govern in the event of any inconsistency between the two.
 5. The use of the electronic files, does not relieve the Contractor of their duty to fully comply with the contract documents, including and without limitation, the need to check confirm and coordinate all dimensions and details, take field measurements, verify field conditions and coordinate work with that of other Contractors for the project.
 6. All "internal" calculations integral to / performed by the Revit model shall not be utilized for any purpose by the Contractor. This includes, but shall not be limited to, voltage drop calculations, duct static pressure calculations, air system airflow summary calculations, piping system pressure drop calculations, etc.
 7. All Revit "families" are the property of WSP USA and shall not be re-used on any other project for any purpose by the Contractor.

1.9 GUARANTEE

- A. The Contractor guarantees by his acceptance of the Contract that all work provided shall be free from defects in workmanship and materials for a period of one year after date of certification of completion and acceptance of work. Any defects in workmanship, materials or performance which appear within the guarantee period shall be corrected by the Contractor without cost to the Owner within a reasonable time to be specified in notice from the Architect. In default thereof, Owner may have such work done and charge the cost of same to the Contractor.

1.10 SITE VISIT

- A. Prior to preparing the bid, the plumbing subcontractors shall visit the site and familiarize themselves with all existing conditions. Make all necessary investigations as to locations of existing equipment, ductwork, piping, utilities, etc., work to be removed, and all other matters which can affect the work under the Contract. No additional compensation will be made to the contractor as result of his failure to familiarize himself with the existing conditions under which the work must be performed.

- B. Refer to Section 002113 Instructions to Bidders, and Section 002213 Supplementary Instructions to Bidders.

1.11 DRAWINGS

- A. The contract drawings are diagrammatic and indicate the general arrangements of systems and work included in the Contract. Do not scale the drawings. Consult the architectural and structural drawings and details for exact location of structure and equipment; where same are not definitely located, obtain this information from the Architect.

1.12 RECORD DRAWINGS

- A. The Contractor shall keep accurate records of all deviations in work are actually installed from work indicated. One complete set of contract documents shall be available at the construction site for indicating said deviations.
- B. When work is complete, make one (1) complete "As-Built" set of PDF files, certifying the accuracy of each drawing by endorsement and signature thereon and deliver to the Architect who will, after approval, deliver the record drawings to the Owner.
- C. Refer to Section 017839 Project Record Documents for specific requirements.

1.13 OPERATION AND MAINTENANCE INSTRUCTIONS

- A. Contractor shall furnish to the Engineer two (2) complete bound sets of typewritten or blueprinted instructions and one (1) PDF set for operating and maintaining all systems and equipment included in this Contract. Each set of instructions shall be contained in a hard-back ring binder properly indexed and labeled. Also provide two complete bound sets and one PDF set of approved shop drawings for all items of equipment utilized on the project. All instructions shall be submitted in draft for approval prior to the final issue. Manufacturers' advertising literature or catalogs will not be acceptable for operating and maintenance instructions.
- B. Instructions shall include a general description of each system together with specific instructions describing routine and emergency procedures required of the building maintenance personnel for operating and maintaining each system. The instructions shall include the name or label, location, and function of all operating equipment and controls, and the location of the electrical service and breaker I.D. numbers. Operating modes and the procedures for indexing each mode shall be clearly described. Include lubrication charts and schedules of frequency of lubrication for all equipment designating each point of lubrication and type of lubricant to be used. A listing of names, addresses, and phone numbers of the service organizations for each item of equipment and a typewritten maintenance schedule for same shall be included.
- C. Contractor shall prepare Operations and Maintenance Data and submit in accordance with the requirements of Section 017823 Operation and Maintenance Data.

1.14 FIRE PROTECTION:

- A. As minimum, one five-pound CO2 extinguisher shall be provided with each work crew at all times when working within the building.

1.15 SCHEDULE OF WORK:

- A. Refer to project schedule. Specific phasing requirements are to be incorporated into the project schedule. Contractor shall coordinate all work included in this division.

1.16 SERVICE AGENCIES:

- A. All plumbing equipment suppliers shall have an established authorized service agency located within the Western Maryland area. Within 30 days after award of the Contract, the Contractor shall submit to the Architect for approval a list of manufacturers' material and equipment names, including their respective service agency, he proposes to use. In the event any service agency in the list fails to comply with the specification requirement, such service agency will be rejected.

1.17 SINGULAR NUMBER

- A. Where any device or part of equipment is herein referred to in the singular number (such as "valve"), such reference applies to as many such devices as are required to complete the installation, shown, implied or otherwise, as indicated on the drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All materials shall be new, the best of their respective kinds, suitable for the conditions and duties imposed on them at the building and shall be of reputable manufacturers. The description, characteristics, and requirements of materials to be used shall be in accordance with qualifying conditions established in the sections following.
- B. Refer to Division 01 for General Requirements.
- C. All component parts of each item of equipment or device shall bear the manufacturers' name plate, giving name of manufacturer, description, size, type, serial or model number, electrical characteristics, etc, in order to facilitate the maintenance or replacement. The name plate of a subcontractor or distributor will not be acceptable. All equipment requiring electrical service shall be U.L. labeled, or if a U.L. label is not available from the manufacturer, the equipment shall be tested by an approved electrical testing company in accordance with NEC, and at no additional cost to the Owner. Submit data indicating compliance with standards prior to installation.
- D. In specifying materials, four general procedures are used. The four classifications are as follows:
 - 1. GROUP 1: When the material or equipment is specified by name of the identifying information and one name brand only is used, it is considered that the use of that particular item is essential to the project, and the Contractor shall base his proposal on the uses of that item.
 - 2. GROUP 2: When a material or equipment is specified by brand name and other identifying information and two or more brand names are named, it is considered that any one of the brands so named will be performed as desired, and the Contractor shall base his proposal on one of the named brands.
 - 3. GROUP 3: When the material or equipment is specified with the phrase "...or equal..." after a brand name and other identifying information, it is intended that the brand name is used for the purpose of establishing a minimum acceptable standard of quality and performance and Contractor may base his bid proposal on any item which is in all respects equal to that specified and presents essentially the same appearance, size, operation and performance. The Contractor shall be responsible for coordination of the equal product.

4. GROUP 4: When material is specified as complying with the requirements of published "Standard Specification" of trade associations, American Society for Testing and Material, government specifications, etc., the Contractor shall base his proposal on any item which can be shown to comply in all respects to the referred to "Standard Specification".
- E. All substitutions shall be submitted in accordance with Section 012500 Substitution Procedures. It is distinctly understood: (1) that the Architect will use his own judgment in determining whether or not any materials, equipment or methods offered in substitution are equal to those specified and will fit within the space available; (2) that the decision of the Architect on all such questions of equality is final; and (3) that all substitutions will be made at no increases in cost to the Owner.
- F. Upon receipt of written approval from the Architect, Contractor may proceed with substitution providing the Contractor assumes full responsibility for and makes, at his expense, any change or adjustment in construction or connection with any work that may be required by the substitution of such materials, equipment or methods. In the event of any adverse decisions by the Architect, no claim of any sort shall be made or allowed against the Owner.

2.2 PIPING SUPPORTS, GENERALLY

- A. Piping shall be run parallel with the lines of the building unless otherwise shown or noted on drawings. The different service pipes, valves, and fittings shall be so installed that after the covering is applied there will not be less than 1/2 inch clear space between the finished covering of parallel adjacent pipes. Hangers on different service lines running parallel with each other and nearly together shall be in line with each other and parallel to the lines of the building. Exact location of electric outlets, piping, ducts, and conduits shall be coordinated among the trades so that there will be no interference between lighting fixtures, piping, ducts, and conduits. Where conflicts between the trades result, they shall be resolved by the Contractor to the Architect's satisfaction and at no expense to the Owner.
- B. In general, hangers shall be spaced so as to prevent sag and permit proper drainage and shall not be spaced more than 10 feet apart unless otherwise indicated herein, in Section 220050, or on the drawings. Hangers shall be placed within one foot of each horizontal elbow.
- C. Vertical runs of pipe and conduit not over 15 feet long shall be supported by hangers placed not over one foot from the elbows on the connecting horizontal runs. Vertical runs of pipe and conduit over 15 feet long but not over 60 feet long and not over 6 inches in size shall be supported on heavy steel clamps. Clamps shall be bolted tightly around the pipes and conduits and shall rest securely on the building structure without blocking.
- D. Hangers shall be of manufacturers hereinafter specified in Section 220050. Unless otherwise specified, pipe and conduit hangers and hanger supports shall conform with the following Anvil International figures:
 1. Hangers generally shall be Fig. 69, 104, 212, 260 and 300.
 2. Hangers Figs. 295 and 212 shall be provided with turnbuckles and eye rods or rods with eye nuts.
 3. Turnbuckles shall be Fig. 230 and 114, shall have not less than 1-1/2 inch adjustment, and shall be provided with lockouts.
 4. Clamps shall be Fig. 261 or CT-121.
 5. Wherever the movement of pipe due to expansion exceeds 3/4 inch per foot of hanger rod length, hangers shall be Figs. 171, 174 and 181.
 6. Roller supports shall be adjustable.
 7. Concrete inserts shall be Fig. 282 or 281.

- E. On copper pipes, hangers in contact with pipe shall be copper plated.
- F. In lieu of individual hangers, multiple (trapeze) hangers may be used for water pipes having same elevation and slope and for electrical conduits as specified hereinafter:
 - 1. Horizontal members shall consist of 1-1/2 inch by 1-1/2 inch No. 12 gauge, cold formed electro-galvanized dipped channels designed to accept special springheld hardened steel nuts for securing hanger rods and other attachments. Provide metal framing system with applicable fasteners, brackets, fittings, clamps, etc. Two or more such channels may be welded together forming horizontal members of greater strength than single channels. Members shall be Kindorf Series B-995, Unistrut, or approved equal.
 - 2. Each multiple hanger shall be designed to support a load equal to the sum of the weights of the pipes and liquid. The weight of the hanger rods shall be such that the stress at the root of the thread will not be over 10,000 psi at design load, except that no rod shall be smaller than 3/8 inch. The size of the horizontal members shall be such that the maximum stress will not be over 15,000 psi at design load.
 - 3. Horizontal runs of piping along walls, 4 inch and smaller, exposed or concealed, shall be secured to metal framing system as specified herein. Provide appropriate clamps, brackets and similar attachments to secure piping to vertical members in accordance with applicable sections of the specification.
 - 4. On copper pipes in contact with horizontal member, provide rubber strip (Vibra Strip or equal) between hanger attachment and copper pipe.
- G. Hanger attachments shall be suitable for each type of hanger and shall be compatible with the building material to which it is secured. Under no circumstances shall pipe support be secured to any other mechanical, electrical or fire protection equipment. Support shall be suspended from building structure only. The type of attachments which shall be used for the various types of building construction encountered are as follows:
 - 1. Steel beams - Fig. 226, or 66 attachments.
 - 2. Bar joists - Fig. 225, or 60.
 - 3. Brick or block walls - Fig. 194, 195, 199 or 202 fastened as follows: For light duty, self-drilling anchors in brick and toggle bolts in block; for heavy duty, through bolts with backing plates.
 - 4. Concrete (Existing) - Phillips "Redhead" or Rawl self-drilling anchors or expansion bolts.
- H. Welded attachments for securing hangers to piping or to structural steel may be provided in lieu of other attachments specified if prior approval is obtained in the field from the Architect. Welded attachments shall be designed so that the fiber stress at any point in the weld or attachment will not exceed the fiber stress in the hanger rod. Generally, welding shall not be permitted in finished spaces.
- I. On insulated piping at hangers, provide calcium silicate inserts and shields at each point of support, see Section 220050 and Section 220700.
- J. In no case shall wire or perforated strap be used for pipe or conduit support.
- K. Secure all hangers for piping and ductwork to joist and beams. In no case shall supports be secured to underside of metal or wood deck unless otherwise directed in the field by the Architect. Contractor shall submit details of method of attachments for approval to the Architect.
- L. Refer to Section 220050 for vibration hanger requirements.

2.3 SLEEVES AND PLATES

- A. Pipe sleeves through concrete and masonry construction shall be Schedule 40 galvanized steel pipes unless otherwise indicated on the drawings. Openings that cannot be sleeved before slab or wall is poured shall be core drilled. Pipe sleeves through drywall and similar construction shall be sized to pass both pipe and insulation, and where permitted by code, may be Schedule 40 PVC.
- B. Sleeves in existing concrete or masonry walls shall be set and secured with mortar grout and fast drying bitumastic sealant. Caulk the annular space of pipe sleeves with an elastic caulk compound to make installation air and watertight.
- C. Escutcheon plates shall be provided for all exposed pipes and conduits passing through walls, floors, and ceilings in finished areas. Plates shall be chrome plated brass of the split ring type, of size to match the pipe or insulation where installed. Where plates are provided for pipes passing through sleeves which extend above the floor surface, provide deep recessed plates to conceal the pipe sleeves.
- D. Utilize U.L. approved resilient sealant for all penetration seals. Submit method of sealing for approval.
- E. Where watertight sleeves are indicated or required to suit the installation, provide Link Seal rubber seals, as manufactured by Thunderline Corporation, between pipes and sleeves

2.4 DRIP PANS

- A. Where possible to run piping elsewhere, do not run piping directly above electrical (or electronic) work which is sensitive to moisture; otherwise provide drip pans under piping, sufficient to protect electrical work from leakage. Locate pan immediately below piping, and extend a minimum of 6" on each side of piping and lengthwise 12" beyond equipment protected. Fabricate pans 2" deep of reinforced metal with rolled edges and soldered or welded seams; 16 gauge steel with 2 oz. zinc finish hot dipped after fabrication. Provide 3/4" copper drainage piping, properly discharged, to nearest floor drain, service sink, or as directed in the field.

PART 3 - EXECUTION

3.1 WORKMANSHIP:

- A. Each subcontractor shall furnish the services of an experienced superintendent who shall be constantly in charge of the installation of the work.
- B. The quality of workmanship required for each trade in the execution of its work shall be the finest and highest obtainable in that trade working with the materials specified. Workmanship shall be satisfactory to the Architect and his decision as to acceptable quality if final.

3.2 EQUIPMENT CONNECTIONS

- A. All equipment shall be installed and connected in accordance with the best engineering practice and in accordance with manufacturer's instructions and recommendations. Auxiliary piping, valves, and electric connections recommended by the manufacturer or required for proper operation shall be provided.

3.3 WATERPROOFING

- A. Under no circumstances shall waterproofing be damaged or penetrated. Should conditions arise which indicate such necessity, notify the Architect.

3.4 CUTTING AND PATCHING

- A. Cutting and patching associated with the work in the existing structure shall be performed in a neat and workmanlike manner. Existing surfaces which are damaged by the Contractor shall be repaired or provided with new materials and methods similar to existing adjacent work, subject to approval of the Architect. Structural members shall not be cut or penetrated unless otherwise indicated on the drawings. Verify in the field with the Architect. Holes cut through concrete and/or masonry to accommodate new work shall be cut by reciprocating or rotary non-percussive methods. Existing masonry block walls shall be patched with new masonry or gypsum board attached and sealed to both block faces.

3.5 SURVEYS AND MEASUREMENTS

- A. Base all measurements (both horizontal and vertical) from established benchmarks. All work shall agree with these established lines and levels. Verify all measurements at site and check correctness of same as related to the work. Verify locations of existing utilities and inverts of same prior to the start of any systems shown connecting to utilities.
- B. Should the Contractor discover any discrepancy between actual measurements or conditions and those indicated which prevent following good practice or the intent of the drawings and specifications, he shall notify the Architect and shall not proceed with his work until he has received instruction from the Architect.

3.6 HANDLING AND STORAGE OF MATERIALS

- A. Proper and suitable tools, equipment and appliances for the safe and convenient handling and placing of all materials and equipment shall be used. During loading, unloading, and placing, care shall be taken in handling the equipment and materials so that no equipment or materials, including Owner furnished, are damaged.
- B. All plumbing equipment delivered to the job site shall be stored under roof or other approved covering, on pedestals above the ground. All enclosures for equipment shall be weatherproof. All valves shall be stored under roof on wood pedestals above ground. All insulation shall be stored under roof or in trailers, adequately protected from the weather. The Contractor shall follow all written instructions and recommendations of the manufacturer and all requirements of the Architect in oiling, protection and maintenance of equipment during storage. It shall be the Contractor's complete responsibility for the storage and care of the equipment and materials.
- C. If any materials and/or equipment are found to be in poor condition at the time of being installed, the Architect may, at his discretion, order the Contractor to furnish and install new equipment at no cost to the Owner.

3.7 COOPERATION WITH OTHER TRADES

- A. Exact location of fixtures, clean outs, access ports, piping and valves shall be coordinated with all other trades so that there will be no interference between lighting fixtures, piping, ducts, and conduits. Where conflicts between the trades result, they shall be resolved by the Contractor to the Architect's satisfaction and at no expense to the Owner.
- B. Plumbing trades shall give full cooperation to other trades and shall furnish in writing, with copies to the Architect, all information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay. Exact location of all plumbing equipment in finished spaces shall be coordinated with shop drawings and with elevations indicated on the architectural drawings.

3.8 CLEANING AND PAINTING

- A. Thoroughly clean all exposed surfaces of equipment and material and leave in a neat, clean condition ready for painting. Restore and touch-up factory finishes which have been damaged during construction. Finished painting will be performed under another Division.
- B. Miscellaneous requirements include:
 - 1. Provide complete new finish if, in the opinion of the Architect, the factory finishes are severely damaged.
 - 2. Touch up threads of zinc coated screwed pipe with Rustoleum primer and one coat of enamel conforming to painting specification.
 - 3. All exposed hangers, steel supports and miscellaneous components, and cast iron pipe hangers shall be field painted with Rustoleum primer and one coat of enamel conforming to painting specification.
 - 4. All steel support and miscellaneous components shall be painted with Rustoleum primer and one coat of enamel conforming to the painting specification.

3.9 ACCESSIBILITY:

- A. Locate all equipment which must be serviced, operated or maintained, in fully accessible positions including control valves, balancing valves and isolation valves. Where required and where directed, provide 14 gauge steel access panels, Milcor or equal, to suit material in which installed. Doors installed in fire rated walls or shafts shall be labeled and shall match rating of the construction. Door shall be of sufficient size to allow access to all components, except minimum size shall be 24" x 24", unless otherwise noted.
- B. Equipment deemed inaccessible by the Architect shall be reworked by the Contractor at no expense to the Owner. All doors shall have cylinder locks operable from same key. Submit shop drawings for approval.

3.10 SLEEVES AND PLATES

- A. Sleeves shall be provided by the trade installing the pipe or duct. The sleeves shall be carefully located in advance of the construction of walls and floors where new construction is involved. Provide all cutting and patching necessary to set sleeves which are not placed prior to construction. All cutting and patching necessary to set sleeves which are not placed prior to construction shall be the responsibility of the trade providing the sleeves.
- B. Sleeves shall be provided for all piping and ductwork passing through concrete, masonry, plaster and gypsum wallboard construction. Caulk the annular space of pipe sleeves with an elastic caulking compound to make installation air and watertight.
- C. Fasten sleeves securely in the construction so that they will not become displaced when concrete is poured or when other construction is built around them. Take precautions to prevent concrete, plaster or other materials being forced into space between pipe and sleeve during construction.
- D. Sleeves required in existing concrete or masonry walls shall be set and secured with mortar grout and fast drying bitumastic sealant.
- E. At all sleeves where objectionable noise can be transmitted (e.g. Mechanical and Electrical Rooms), at smoke barriers, at walls above ceilings that extend to the underside of the structure of the floor above, or at fire rated separations, seal all openings between pipes and

corresponding sleeves to prevent sound transmission and to maintain fire rating. Use U.L. approved resilient sealant for penetration seals.

- F. Where pipe motion due to expansion and contraction will occur, provide sleeves of sufficient diameter to permit free movement of pipe. Where sleeves pass insulated pipes, the sleeves shall be large enough to pass the pipe and the insulation. Check construction to determine proper length for various locations; make actual lengths to suit the following:
1. Terminate sleeves flush with walls, partitions and ceilings.
 2. Terminate sleeves 2 inches above finished floor in equipment rooms and wet floor areas.
 3. In all other areas, terminate sleeves 1/2 inch above finished floor unless otherwise noted on the drawings or directed in the field.

3.11 ALTERATIONS AND DEMOLITION

- A. All existing piping, equipment and materials which are required to be removed shall be removed. All existing materials and equipment which are removed and are desired by the Owner, or are indicated to remain as the property of the Owner, shall be delivered to him on the premises by the Contractor where directed by the Architect. All other materials and equipment which are removed shall become the property of the Contractor and shall be promptly removed by him from the premises.
- B. Remove all indicated mechanical work by hand as far as possible. Power-driven equipment shall be used as a last resort, and shall not be employed without consent of the Owner. Schedule all demolition work to the satisfaction of the Owner. The Contractor shall execute the removal work as quietly as practicable to avoid unnecessary disturbances to occupied areas.
- C. Existing conditions, i.e. ductwork, piping, equipment, etc, may be obtained from available record drawings and are not warranted to be complete or correct. Contractor shall verify exact location of all ductwork, piping, etc, in the field prior to starting any work.
- D. Existing pipe sizes noted on the available record drawings are for the convenience of the Contractor only. Contractor shall verify sizes in the field.
- E. Existing piping no longer required to remain in service shall be disconnected and removed back to service mains, including existing piping hangers and supports. Existing pipe indicated or required to remain in service shall be capped.
- F. Existing piping that remains concealed, buried, or otherwise contained in or below the remaining slabs and walls shall be capped, plugged, or otherwise sealed. All pipes shall be cut so that their capped or plugged ends will be far enough behind finished surfaces to allow for the installation of the normal thickness of finished material.
- G. When existing plumbing work is removed, all related pipes, valves, and materials shall also be removed.
- H. When the work specified herein connects to existing piping, the Contractor shall perform all necessary alterations, cutting, or fitting of the existing work as may be necessary or required to make satisfactory connections between the new and existing work and to leave the completed work in a finished and workmanlike condition, to the entire satisfaction of the Architect.
- I. When the work specified herein or under other divisions of the contract necessitates relocation of existing plumbing equipment or piping, the Contractor shall perform all work and make all necessary changes to existing work as may be required to leave the completed work in a

finished and workmanlike condition, to the entire satisfaction of the Architect, and at no additional cost to the Owner.

- J. Existing mechanical equipment and piping affected by removal or new work installation and required to remain in service shall be reinstalled or supported as required in accordance with new work specification. All work shall be completed to the Architect's satisfaction and at no additional cost to the Owner.
- K. Valve off or disconnect live services as required for removal work.
- L. Refer to drawings for additional requirements.

3.12 FLASHING

- A. Openings for pipes through waterproofed floors shall be flashed.

3.13 CLOSE OUT PROCEDURES

- A. Refer to Section 017700 Close Out Procedures for specific requirements.

END OF SECTION 220010

SECTION 220050 - PLUMBING BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications apply to the work specified in this Section.

1.2 SUMMARY

- A. This section includes requirements for plumbing equipment, materials and procedures which are common to more than one section of Division 22 and which are general in nature and use. This section applies to all sections of Division 22.
- B. The requirements of Section 220010, Plumbing General Provisions, shall apply to all work specified under this section.

1.3 LEAD CONTENT

- A. All plumbing products, materials of construction, and joining methods used in the installation or repair of plumbing intended to dispense water for human consumption shall be in compliance with the United States Safe Drinking Water Act and shall meet the limit of weighted average lead content as set forth in NSF/ANSI 372. All such products shall also meet the lead leaching requirements of NSF/ANSI 372.

1.4 SUBMITTALS

- A. Submit shop drawings for all items of materials specified in this section in accordance with Section 220010.
- B. At a minimum Manufacturer's product data shall include specifications, installation instructions and general recommendations for each type of material required. Include data substantiating that proposed materials comply with specified requirements for each type.

1.5 TESTS AND ADJUSTMENTS

- A. The Contractor shall furnish labor, instruments, equipment, and materials required to perform tests prescribed in the sections describing the various systems.
- B. Replace or repair defects found during inspection or test with new materials. Caulking of welded joints, screwed joints, cracks, or holes is not acceptable. Correct leaks in screwed fittings by remaking joints. In welded systems leaks in joints shall be cutout and re-welded. Repeat tests after defects have been eliminated.
- C. Where reasonable doubt exists as to a system's ability to comply with contract requirements, perform any reasonable test required by the Architect.
- D. Make static pressure tests and prove to the satisfaction of the Architect that the piping is tight before pipes are concealed or insulated. Tests shall be provided as hereinafter specified.
- E. Use test instruments for accuracy by an approved laboratory or by the instrument manufacturer and furnish certificates showing degree of accuracy to the Architect when requested. Make calibration histories for each instrument available for examination.

- F. Where gauges, thermometers and other instruments which are to be left permanently installed are used for tests, do not install until just prior to the tests to avoid possible changes in calibration.

PART 2 - PRODUCTS

2.1 HANGERS

- A. Refer to Section 220010.
- B. Hangers and accessories shall be Anvil International, Fee and Mason, Modern, National, or B-Line of the types specified in Section 220010.
- C. It shall be the responsibility of the Contractor to provide an adequate pipe suspension system in accordance with recognized engineering practices, using standard, commercially accepted pipe hangers and suspension equipment.
- D. The design of all hangers and support shall be in accordance with the provision of the current issue of MSS-SP-58 document developed as a standard by the Manufacturers' Standardization Society.
- E. Hangers for cast iron pipe shall be provided at each joint. Hangers for copper pipe shall be placed at least every eight (8') feet, except pipes 1¼ inch and smaller and shall have hangers at six (6') foot intervals.
- F. Where concentrated loads of valves, fittings and similar items occur, or if recommended by the piping manufacturer, closer hanger spacing will be necessary.
- G. Generally, hangers shall be clevis type, standard weight.
- H. Vibration hangers shall be provided as specified.
- I. On insulated piping systems, provide Pipe Shields, Inc., Model CS-CW or approved equal hanger shields at each point of support. Diameter of hanger shield shall match thickness of the insulation. In lieu of, provide wood dowel insert and minimum twenty-gauge protection shield at each point of support. Diameter of insert and shield shall match thickness of the insulation and encompass 50% of insulation surface. On cold systems seal insert vapor tight with appropriate coating.
- J. Hangers in direct contact with copper piping systems shall be copper plated.

2.2 IDENTIFICATION AND EQUIPMENT TAGS

- A. All control devices, i.e. panels, switches, starters, push button stations, controls etc., shall be clearly identified as to their function and the equipment controlled.
- B. All plumbing equipment shall be marked to clearly identify said equipment and space or duty they serve.
- C. Plumbing equipment herein specified shall be identified using engraved laminated black and white phenolic legend plates. Letters shall be minimum, 3/4" high white on surrounding black. Plates shall be mounted by means of sheet metal screws. Submit nameplate list to Architect for approval.

- D. Plumbing equipment, valves, etc., concealed above ceiling shall be identified as to location using clear plastic self-adhesive tape with black lettering, applied to ceiling tile "T" bars. Submit nameplate list to Architect for approval.
- E. Piping shall be identified with colored, pre-rolled, semirigid plastic labels as manufactured by Seton, Marking Services, Inc., or approved equal. For indoor installations, labels shall be Seton "Set Mark" system. For outdoor installations, labels shall be Seton "Ultra Mark" system. Labels shall be set around pipes with a field installed high strength cement around pipes with a field installed high strength cement compound applied along their longitudinal edge. Labels shall be placed around the piping or insulation every forty feet (40) and with one (1) label on each pipe in rooms smaller than fifteen feet (15). A label shall be placed at every major valve and at least six feet (6) from exit or entrance to an item of equipment. At Contractor's option, piping concealed above suspended ceilings only, may be identified by stenciling with black paint and taped color bands in accordance with the coding system herein specified.
 - 1. Labels shall be provided in accordance with the following table with color coding and stencil designations as indicated:

SIZE OF LEGEND LETTERS

Outside Diameter of Pipe (Inches)	Length of Color Field (Inches)	Size of Letters (Inches)
3/4" to 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"
2-1/2" to 6"	12"	1-1/4"

- 2. Color coding and stencil designations shall be as follows:

<u>Service</u>	<u>Color</u>	<u>Stencil Designation</u>
Domestic cold water	Green	Domestic cold water
Domestic hot water	Yellow	Domestic hot water
Sanitary	Brown	Sanitary sewer
Vent	Brown	Sanitary sewer

- F. All valves, except as specified below, shall be provided with colored plastic or brass valve tags with stamped-in numbers. Tags shall be secured to valve wheels with metal chain. Stop valves on individual fixtures or equipment where their function is obvious, or where the fixture or equipment is immediately adjacent, need not be so equipped. Care shall be exercised in selecting valve numbers to be prepared on tracing linen showing locations, details of arrangements, etc., of all service and control valves indicating identity and function. One black line print of each drawing shall be mounted under glass where directed. Valve tags shall be Seton or approved equal minimum 1-1/2" round tags with white characters describing system and valve designation. Submit valve number list for approval.

2.3 PIPE, FITTINGS, AND JOINTS

- A. General

1. Piping materials shall conform to state and local code requirements. Pressurized piping systems shall conform to American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME) B31.9, "Code for Pressure Piping, Building Services Piping". High-pressure piping shall conform to ANSI/ASME Section I, B31.1, "Code for Pressure Piping, Power Piping".
2. Quality and weight of materials shall comply with requirements of applicable American Society of Testing Materials (ASTM), ANSI, ASME, and Cast Iron Soil Pipe Institute (CISPI) standards. ASTM number and wall thickness shall be indicated on each pipe length
3. Provide pipe and fittings for systems as hereinafter specified. All references to codes shall apply to the latest year. Grooved products may be as manufactured by Victaulic or Grinnell. All piping and fittings shall be made in America. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer.

B. Pipe Materials

1. Sanitary Drainage
 - a. Above ground, within the building
 - 1) No-hub Cast Iron Soil Pipe
 - a) All sizes - service weight, ASTM A888-98 fittings shall be no-hub cast iron, fitting joints shall be no-hub neoprene gasket and stainless steel corrugated shield, four band, Anaco-Husky series 4000 meeting ASTM C 1540, C564, and CISPI 310.
2. Vent Piping:
 - a. No-hub cast iron soil pipe
 - a) All sizes - service weight, fittings shall be no-hub cast iron, fitting joints shall be no-hub neoprene gasket and stainless steel corrugated shield, Anaco-Husky series 4000 meeting ASTM C 1540, C564, and CISPI 310.
3. Domestic Cold Water:
 - a. Domestic cold water above ground, 2" and smaller
 - 1) Seamless copper water tube
 - a) All sizes - ASTM B88, Type L hard tempered with wrought copper solder joint fittings, rated for 150 lbs. (water) ANSI B16.22 with soldered joints Taramet Sterling "lead free" solder or equivalent.
 - b) Alternate fitting - Press Fitting: Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press ends shall have SC (Smart Connect) feature design (leakage path).
4. Domestic Hot Water:
 - a. Seamless copper water tube

- 1) All sizes - ASTM B88, Type L hard tempered with wrought copper solder joint fittings, 150 lbs. (water) ANSI B16.22 with soldered joints: Taramet Sterling "lead free" solder or equivalent. Galvanized steel pipe is not permitted.
 - a) Alternate fitting - Press Fitting: Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press ends shall have SC (Smart Connect) feature design (leakage path).

2.4 VALVES

A. General

1. Valves shall be provided where indicated on drawings and as herein specified.
2. Valves shall be placed in such a manner as to be easily accessible for handwheel operation and stuffing maintenance.
3. Valves in piping where shown and where listed herein:
 - a. To isolate all items of equipment.
 - b. To isolate branch lines and riser at mains.
4. Valve pipe connections shall be screw, solder, welded, flanged, press fit or Victaulic as required to be consistent with other parts of the piping system.
5. Where piping or equipment may subsequently need to be removed, provide valves with bodies having integral flanges or full lugs drilled and tapped to hold valve in place so that downstream piping or equipment can be disconnected and replaced with blank-off plate while valve is still in service.
6. Install valves in accessible locations and adjust for smooth and easy operation.
7. Valves for equipment and controls shall be installed full size of pipe before reducing size to make connection.
8. Where there is no interference, shut-off valves shall be installed with handwheel down on horizontal runs of pipe to prevent accumulation of foreign matter in packer between seats at closing end of wedge.

B. Ball Valves

1. Ball valves shall be used in lieu of gate valves in all domestic water piping systems size 3" and smaller for shut-off service. Ball valves shall be Apollo, Red White Valve Corp, Jomar or approved equal.
2. For valves up to 2½" in size the body and bonnet shall be ASTM B62 bronze. For valves 3" body shall be bronze or brass. Ball shall be Type 316 stainless steel. Stem shall be stainless steel. Seats shall be TFE.
3. Stem shall be blowout proof and externally adjustable to compensate for wear. Valve shall be equipped with vinyl covered lever handle which shall indicate position of ball orifice and shall have stops for fully open and closed position. Construction shall be such that power actuator can be used. Ball opening shall be full pipe size.
4. Valve shall be suitable for flow in either direction and shall be rated 150 psig SWP and 600 psi non-shock WOG.
5. Valve shall be so constructed with two piece cast bronze bodies, full port design, with adjustable stem packing. Valves used for domestic service shall be lead free.
6. Ball valves used for balancing shall have adjustable memory stop. For use in insulated piping systems provide 2" extended handles of non-thermal conductive material.
7. Vic-Press Ball Valves 2" and Smaller:

- a. Stainless Steel Body: CF8M stainless steel body, ball, and stem, PTFE seats, 304 stainless steel handle, nut, and stem washer, with Schedule 10S stainless steel type 316 Vic-Press™ and/or grooved ends. Rated for services to 400 psi (2750 kPa), Victaulic Series P569.

C. Valve Schedule

1. Unless otherwise specified, valves shall be Grinnell, Stockham, Crane, Jenkins, or Nibco equal to the Nibco figure numbers indicated herein:
2. Domestic Hot and Cold Water Systems:
 - a. Check - Solder end S-413

PART 3 - EXECUTION

3.1 CLEANING

- A. After completion of installation, thoroughly clean dirt, rust, loose scale, oils and grease, and other foreign matter from metal and insulated surfaces, painted or unpainted, specified under Division 22 of the specification.
- B. Clean all systems piping thoroughly of grease, metal shavings, welding beads, or other refuse. Flush piping by use of portable pump or separate water supply to prevent damage to existing or new system pumps. Before cleaning closed systems, all equipment shall be isolated by closing inlet and outlet valves and opening the by-pass valves. The system shall be filled with sufficient detergent and dispersant added to remove all dirt, oil, and grease. System shall be circulated for at least 48 hours after which a drain valve at the lowest point shall be opened and allowed to bleed while the system continues to circulate. Bleeding shall continue until water runs clear and all detergent is removed. A sample of the water shall be tested and, if PH exceeds the PH of the make-up water, draining shall be resumed. After flushing, clean strainers of debris, open coils and close by-passes. Remove dirty water filters and install new water filters. Turn over replacement bag filters to Owner. Refill and vent water systems being sure to add water after venting to completely fill system.

3.2 PIPING INSTALLATION

- A. Install piping without undue stress or strain in locations shown and run parallel to the lines of the building, except to grade them as specified in a neat and workmanlike manner using a minimum of fittings. Provide such fittings, valves, and accessories as may be required to meet the conditions of the installation. Contractor shall inform himself fully regarding any peculiarities and limitations of space available for installation of material under each section of specifications. Install piping to suit necessities of clearance with ducts, conduits, structure, and other work, and so as not to interfere with any passages or doorways and allow sufficient head room at all places. Use proper reducing fittings for changing piping sizes.
- B. Do not install piping through transformer vaults, elevator equipment rooms or other electrical or electronic equipment spaces. Do not route piping over electrical-distribution panels.
- C. Cut pipes accurately to measurements established in the field in a neat and workmanlike manner without damage or without forcing or springing. Perform cutting by means of an approved type of mechanical cutter of the wheel type where practicable. Ream pipe after cutting to remove all burrs.
- D. Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories which may be required. Carefully investigate the architectural, structural, and

existing conditions affecting the work, and arrange such work accordingly, providing such fittings, and accessories as may be required to meet such conditions.

- E. Install unions and flanges where shown and on each side of all pieces of equipment and other similar items, and in such a manner that the unions or flanges can be readily disconnected. Do not place any union or flange in a location which will be inaccessible after completion of the project.
- F. Unions in copper pipe 2" and smaller shall be wrought copper with red bronze ring nut. Use 150 lb. ASME copper flanges for piping 2-1/2" and larger.
- G. Use dielectric unions or couplings at all junctions of copper or brass piping and fittings with ferrous material to prevent electrolysis and galvanic corrosion. Dielectric fittings shall be a copper-silicon casting conforming to UNS C87850, and UL classified in accordance with ANSI / NSF-61 for potable water service. Fittings shall have threaded ends.
- H. Joints between dissimilar piping material shall be made with appropriate adapters in accordance with the respective manufacturer's printed instruction and recommendations.
- I. Use reducing fittings, eccentric where required to prevent pocketing of air and water or both, to make changes in pipe sizes.
- J. Grade pipe minimum 1" in 40 feet to low points, unless otherwise specified or indicated. Provide drain valves at all low points.
- K. All piping shall be so installed so that it will in no way be distorted or strained by expansion or contraction. Except as noted, all expansion and contraction shall be taken up by means of swing joints, loops, bends or long offsets. Swing joints made up with at least three fittings shall be provided in branches from mains to runouts. Size loops for the total pipe expansion without cold springing, but field cold spring one-half the pipe expansion corrected for ambient temperature.

3.3 WORKMANSHIP

- A. Cut pipes accurately to measurement established at structure. Install pipes without springing or forcing.
- B. Clear windows, doors, and other openings with all pipes. Arrange pipes to permit expansion and contractions without misalignment or damage.
- C. During construction all openings in piping and equipment shall be closed with caps or plugs to keep out all foreign matter indicated.
- D. All piping in finished spaces shall be run concealed unless otherwise indicated.

3.4 PHASING

- A. The contractor shall schedule phasing to minimize the disruption of existing patient services. This phasing is essential to ensure a safe environment in patient care areas. Phasing shall include assurance for clean to dirty airflow, emergency procedures, criteria for interruption of protection, written notification of interruptions, and communication authority. Procedures must be developed for noise and vibration that will affect patients, and planned accordingly. The renovation areas shall be isolated from the occupied areas during construction using airtight barriers, and exhaust airflow shall be sufficient to maintain negative air pressure in the construction zone.

3.5 SLEEVES AND PLATES

- A. Refer to Section 220010.

3.6 TESTS

- A. The following tests shall be conducted by the Contractor and all piping shall be proven tight in the presence of the Architect or his representative. Notify Architect prior to tests. These tests shall be conducted before any insulation is installed and any insulation installed prior to test shall be removed. Provide all equipment and labor required. Tests shall be at least four hours in duration. Piping may be tested in sections as approved by the Architect. Tests shall be specified herein.
- B. Domestic water piping shall be hydrostatically tested to 150 psig. All openings in the water piping shall be plugged throughout the system, or portion thereof, filled with water, and tested with a pump to a pressure of 150 psig.
- C. Sterilization
 - 1. Domestic water system piping shall be disinfected after tests in accordance with State or District Health Department requirements. Before placing the systems in service, contractor shall engage a qualified service organization to sterilize the new water lines.
- D. The sanitary and miscellaneous drain systems shall be hydrostatically tested. Tests shall be as required by code and as a minimum shall comprise the plugging of all openings in the line, filling the system (or portion thereof) with water until all joints are proven tight. Piping shall be tested with a minimum head of 10 feet of water.
- E. All pressure piping systems, unless otherwise specified herein, shall be filled with water and thoroughly flushed clean of foreign matter after erection and before connection of equipment.

END OF SECTION 220050

SECTION 220700 – PLUMBING SYSTEMS INSULATION

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2. SUMMARY

- A. Work included in this section consists of furnishing all labor, equipment, materials and accessories, and performing all operations required, for the correct fabrication and installation of thermal insulation applied to the following piping, equipment, and plumbing systems, in accordance with applicable project specifications and drawings:
 - 1. Domestic cold-water piping.
 - 2. Domestic hot-water piping.
 - 3. Supplies and drains for handicap-accessible lavatories and sinks.
- B. The requirements of Section 22010, Plumbing General Provisions, shall apply to the work specified under this Section.

1.3. DEFINITIONS

- A. The k factor means the number of British thermal units of heat transmitted per (sq. ft.) Fahrenheit temperature difference through a material with flat, parallel sides one inch (1") apart. The material shall be tested and rated according to ASTM Test Method C-177.
- B. The term "Mineral Fiber" as defined above specifications includes fibers manufactured of glass, rock or slag processed from a molten state, with or without binder.
- C. Unless otherwise specified, the term concealed, as used in this specification, shall include all furred spaces, accessible pipe and duct shafts, and spaces above suspended ceilings.
- D. Unless otherwise specified, the word exposed shall refer to all work other than "concealed" work.

1.4. REFERENCES

- A. Thermal insulation materials shall meet the property requirements of one or more of the following American Society for Testing of Materials (ASTM) specifications as applicable to the specific product or use:
 - 1. ASTM C 533-07: "Specification for Calcium Silicate Block and Pipe Thermal Insulation"
 - 2. ASTM C547: "Standard Specification for Mineral Fiber Pipe Insulation"
 - 3. ASTM C553 "Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications"
 - 4. ASTM C585 "Standard Practice for Inner and Outer Diameters or Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System)"
 - 5. ASTM C 612 "Standard Specification for Mineral Fiber Block and Board Thermal Insulation"
 - 6. ASTM C 795 "Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel"

7. ASTM C 1126-04: "Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation"
8. ASTM C 1136 "Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation"
9. ASTM C 1290 "Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts"
10. ASTM G-21 "Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi" (fungi resistance section only)
11. ASTM G 22 "Practice for Determining Resistance of Plastics to Bacterial (bacteria resistance section only)

1.5. SYSTEM PERFORMANCE

- A. Insulation materials furnished and installed hereunder should meet the minimum economic insulation thickness requirements of the North American Insulation Manufacturers' Association (NAIMA) to ensure cost-effective energy conservation performance. Alternatively, materials should meet the minimum thickness requirements of National Voluntary Consensus Standard 90.1, "Energy Standard for Buildings Except Low Rise Residential Buildings" of the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE). However, if other factors such as condensation control or personnel protection are to be considered, the selection of the thickness of insulation should satisfy the controlling factor. In no case shall the insulation thickness be less than that specified herein.
- B. Insulation materials furnished and installed hereunder shall meet the fire hazard requirement of any one of the following specifications:
 1. American Society of Testing of Materials ASTM E 84
 2. Underwriters' Laboratories, Inc. UL 723
 3. National Fire Protection Association NFPA 255

1.6. FIRE RESISTANCE

- A. Except for materials which are subsequently exempted, all materials used as part of the thermal insulation shall have a fire hazard rating not to exceed twenty-five (25) for flame spread and fifty (50) for fuel contributed and smoke developed.
- B. Test factory assembled materials as assemblies.
- C. Determine ratings by the Standard Method of Test for Surface Burning Characteristics of Building Materials, ASTM E-84 or NFPA No. 255.
- D. The following will be required to establish that fire hazard ratings for materials proposed for use do not exceed those specified: (1) label or listing by Underwriter's Laboratories, Inc., (2) certified test report from an approved testing laboratory.
- E. The following materials are exempt from the foregoing Fire Resistant Rating:
 1. Jackets of canvas, PVC and nylon.
 2. Polyurethane, polystyrene, cork and flexible, closed-cellular insulation.
 3. Nylon anchors for securing insulation to equipment.
 4. Factory pre-molded one (1) piece PVC fitting and valve covers

1.7. QUALIFICATIONS

- A. Materials submitted shall be standard products of a manufacturer who has been engaged in the production of the products for not less than three (3) years.
- B. The installing sub-contractor shall have at least five (5) years of successful installation experience on projects with similar insulation products.

1.8. QUALITY ASSURANCE

- A. Insulation materials and accessories furnished and installed hereunder shall, where required, be accompanied by manufacturers' current submittal or data sheets showing compliance with applicable specifications listed in Section 1.4 above.
- B. Insulation materials and accessories shall be installed in a workmanlike manner by skilled and experienced workers who are regularly engaged in commercial insulation work.

1.9. SUBMITTALS

- A. Provide shop drawings in accordance with Section 220010 and the General Requirements which shall include all insulation, jackets, finishes, corner beads, etc. Shop drawings shall additionally describe each system or component to be insulated, insulation type and thickness, and method of installation.

1.10. DELIVERY AND STORAGE OF MATERIALS

- A. All of the insulation materials and accessories covered by this specification shall be delivered to the job site and stored in a safe, dry place with appropriate labels and/or other product identification.
- B. The contractor shall use whatever means are necessary to protect the insulation materials and accessories before, during, and after installation. No insulation material shall be installed that has become damaged in any way. The contractor shall also use all means necessary to protect work and materials installed by other trades.
- C. If any insulation material has become wet because of transit or job site exposure to moisture or water, the contractor shall not install such material, and shall remove it from the job site. An exception may be allowed in cases where the contractor is able to demonstrate that wet insulation when fully dried out (either before installation, or afterward following exposure to system operating temperatures) will provide installed performance that is equivalent in all respects to new, completely dry insulation. In such cases, consult the insulation manufacturer for technical assistance.

1.11. COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220050 and Section 220010.
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.12. SCHEDULING

- A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1. GENERAL

- A. All insulating materials, including adhesives, jackets and coatings, to be used on the project must be delivered to the building in the manufacturer's unopened container and must bear the manufacturer, brand and description of material.
- B. After the necessary tests have been conducted to prove the water systems tight, all piping and equipment to be insulated shall be thoroughly cleaned and then covered. Insulation materials shall be the product of Owens Corning, Knauf, Manville or Armstrong equal to the products specified herein.
- C. Molded pipe insulations shall be manufactured to meet ASTM C 585 and ASTM C 547.

2.2. TYPES OF INSULATION

- A. Refer to insulation type schedule on drawings.

2.3. ADHESIVES, SEALERS AND COATINGS

- A. Provide all adhesives, sealers, vapor barrier coatings etc., compatible with the material to which they are applied. They shall not corrode, soften or otherwise attack such material in either the wet or dry state and must be suitable for the service temperatures.
- B. Any cement, sealer or coating used shall be resistant to vermin and mold and shall be durable. It shall not discolor on aging; and where applied on the final surface of the insulation, it shall be light in color and be capable of being painted.
- C. Adhesives, coatings and compounds shall be equal to the following:

- 1. Vapor barrier adhesive for sealing joints on pipe insulation - Foster 85-75.
- 2. Insulating cement - Owens Corning No. 110

2.4. FITTINGS AND VALVE COVERS

- A. Pipe fittings and valves shall be insulated with Owens Corning PVC pre-molded one (1) piece PVC insulated fitting cover and factory pre-cut insulation. Fittings shall have edges of one (1) piece cover sealed with Owens Corning vapor barrier pressure sensitive tape.

2.5. PROTECTIVE SHIELDING GUARDS:

- A. Protective Shielding Pipe Covers
 - 1. Plastic wraps for covering plumbing fixture. Hot- and cold-water supplies and trap and drain piping as manufactured by Truebro, McGuire Manufacturing, Zum Industries or Insul-Tect. Comply with Americans with Disabilities Act (ADA) requirements.
- B. Protective Shielding Piping Enclosures

1. Plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping as manufactured by Truebro, Zum Industries or equal. Comply with ADA requirements.

2.6. METALLIC COMPONENTS

- A. Staples shall be outward clinching type of Type 304 or Type 316 stainless steel.
- B. Bands shall be galvanized steel, aluminum, brass, or nickel-copper alloy, of three-quarter inch (3/4") nominal width. The band thickness, exclusive of coating, shall be not less than five thousandths inch (0.005") for steel and nickel copper alloy, seven thousandths inch (0.007") for aluminum, and one hundredth inch (0.01") for brass.
- C. Wire shall be 14-gauge, nickel-copper alloy or copper clad steel, or 16-gauge, soft annealed, galvanized steel.
- D. Wire netting used for exposed surfaces of insulation that is to be cement finished shall be 22-gauge, one- inch (1") galvanized mesh, with continuous 26-gauge galvanized steel corner beads having two and one-half inch (2-1/2") wings.

2.7. INSULATION SCHEDULE:

- A. Refer to insulation schedule on drawings.

PART 3 - EXECUTION

3.1. EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 1. Verify that systems to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3. GENERAL

- A. All insulation shall be installed by skilled workmen regularly engaged in this type of work.
- B. Insulation shall be continuous at all hangers, sleeves and openings. Vapor seals shall be provided for all cold surfaces and shall be continuous.
- C. Arrange to permit expansion and contraction without causing damage to insulation or surface.
- D. Actual insulation thickness must be at least equal to the minimum specified in the schedule. Where the manufacturer's rated or nominal thickness is less than the minimum specified, a

thicker material or more layers will be requested so that the stated minimum thickness will be attained or exceeded.

- E. Install insulation materials in a first class manner with smooth and even surfaces. Scrap pieces of insulation shall not be used where a full length section will fit.
- F. Unless otherwise specified herein, the application of all insulation materials, accessories and finishes shall be in accordance with the manufacturer's published recommendations.
- G. Insulation materials shall not be applied until all surfaces to be covered are clean and dry; all foreign material, such as rust, scale, dirt, etc., has been removed; and, where specified, surfaces have been painted. Insulation shall be clean and dry when installed and during the application of any finish. The insulation on pipe fittings, valves and pipe joints shall not be installed before the piping is tested and approved.
- H. Omit insulation on the following unless directed otherwise:
 - 1. Brass or copper pipe specified to be chrome plated.
 - 2. Traps and pressure reducing valves, relief piping from safety valves, and unions.
- I. Replace and repair insulation disturbed by testing and balancing procedures.

3.4. PIPE INSULATION

- A. High density pipe saddles shall be provided at all points of support as hereinbefore specified in Section 220010.
- B. Insulate all valves and strainers. Use pre-molded covers and factory precut insulation where applicable. Unions and flanges shall not be insulated except on cold service.
- C. Insulate valves up to and including bonnets, except for cold water valves which shall be insulated over packing nuts in a manner to permit removal for adjustment and repacking.
- D. Insulate strainers in a manner to permit removal of the basket without disturbing the insulation of the strainer. Obtain Engineer's approval of installation method.
- E. Application - Types I Insulation
 - 1. Insulate all pipes in a neat and workmanlike manner. Seal all longitudinal laps of jackets and staple every six inches (6"). Where the piping operates below ambient temperature, the staples shall be coated with vapor barrier adhesive. All butt joints shall be wrapped with a three inch (3") minimum wide strip of jacketing material securely sealed in place.
 - 2. Insulate valves and fittings with pre-cut blanket type fiberglass insulation and PVC covers as specified. Insulation shall be of the same thickness as that on adjoining pipe. The ends of the insulation shall be tucked snugly into the throat of the fitting and the edges adjacent to the pipe covering tufted and tucked in, fully insulating the pipe fitting. The one (1) piece PVC fitting cover shall then be secured by stapling, tack fastening, banding or taping the ends to the adjacent pipe covering. Cold-water systems piping shall be insulated as above and have all seam edges of the cover sealed with ZESTON vapor barrier adhesive mastic. The circumferential edges of cover shall be color matching tape. The tape shall extend over the adjacent pipe insulation and overlap itself at least two inches (2") on the downward side.
 - 3. Where fittings are operating above ambient they may, in lieu of the preceding paragraph, be covered with a three hour (3 hr.), hydraulic setting, combination insulating and finishing cement having k factor not greater than 0.87 at a mean temperature of two

hundred degrees Fahrenheit (200° F). The thickness of this cement shall be such that the surface is substantially flush with the pipe covering. Where the insulation terminates at a fitting that is not covered, the end of the insulation shall be beveled off with this same cement. All fittings insulated in this manner shall be covered by a fabric jacket as specified, which shall be cemented down with lagging adhesive.

4. Where expansion joints are required to be insulated, they shall be covered with readily removable sections of insulation of same composition and thickness as provided for adjacent piping.

F. Application - Type II Insulation

1. The material shall be slit lengthwise to permit installation or slipped over pipe before connections are made.
2. All joints and seams must be thoroughly bonded, both mechanically and hermetically, by the adhesive recommended by the insulation manufacturer. Also, the manufacturer's recommendations shall be followed as to the adhesive to use where the insulation needs bonding to metal or other material used for any surface treatment where a finish coat of paint is required.
3. All penetrations of the insulation must be thoroughly sealed so that the insulation itself will form a complete vapor barrier. Wherever the insulation terminates, the edges shall be sealed to the metal.

G. Application - Type X Insulation

1. The material shall be applied lengthwise by placing the slit tubing over pipe. Longitudinal joint is made by peeling release paper from adhesive surface and applying pressure along longitudinal joint. Butt ends shall be secured with Armstrong 520 adhesive.
2. All joints and seams must be thoroughly bonded, both mechanically and hermetically, by the adhesive recommended by the insulation manufacturer. Also, the manufacturer's recommendations shall be followed as to use where bonding to other materials or metal is required.
3. All penetrations of the insulation must be thoroughly sealed so that the insulation itself will form a complete vapor barrier. Wherever the insulation terminates, the edges shall be sealed to the metal.

END OF SECTION 220700

SECTION 221300 - PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cleanouts
 - 2. Plumbing specialties

1.3 SUBMITTALS

- A. Submit shop drawings for all materials specified in this section in accordance with section 220050.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the product.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories. Include plans, elevations, sections, and mounting or attachment details.
 - 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 4. Include diagrams for power, signal, and control wiring.
 - 5. Operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Cleanouts shall be placed in piping throughout the building, where noted and where required by code. Cleanouts on piping below floors, at ends of runs and changes of direction of piping shall consist of Y branches, the full size of pipes to which they are connected with cleanout plugs and covers as listed below or as detailed. Extend cleanouts on concealed piping to finished walls, floors and grade. Cleanouts shall be Josam, Jay R. Smith, Watts, or Zurn equal to Josam numbers indicated below.
 - 1. In concrete floor on grade (generally) - Series 58460A-AE-2 cleanout with scoriated round satin bronze top, bronze cleanout plug with lead seal, and adjustable housing. In carpeted areas, Josam Series 58460A-AE-2-14.

2.2 OTHER SPECIALTIES

- A. Provide Zurn or Josam shock absorbers equal to Josam Series No. 75000 where indicated, and sized in accordance with PDI Standard WH 201.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to 4". Use 4" for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping 4" and smaller and 100 feet for 5" and larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- E. Install wood-blocking reinforcement for wall-mounting-type specialties.
- F. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- G. Install piping adjacent to equipment to allow service and maintenance.

3.2 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.3 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221300

SECTION 224213 – PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This section includes all plumbing fixtures to be provided for the project.
- B. The requirements of Section 220010 Plumbing General Provisions shall apply to all work specified under this section.

1.3 SUBMITTALS

- A. Submit shop drawings for all materials specified in this section in accordance with section 220050.
 - 1. Include construction details, material descriptions, dimensions of individual components and finishes for the product.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories. Include plans, elevations, sections, and mounting or attachment details.
 - 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, methods of field assembly, components, and location and size of each field connection.
 - 4. Include diagrams of power, signal and control wiring.
 - 5. Operation and maintenance manuals.

1.4 CODES

- A. All plumbing products, materials of construction, and joining methods used in the installation or repair of plumbing intended to dispense water for human consumption shall be in compliance with the United States Safe Drinking Water Act and shall meet the limit of weighted average lead content as set forth in NSF/ANSI 372. All such products shall also meet the lead leaching requirements of NSF/ANSI 372.
- B. Provide all plumbing connections required by fixtures and equipment which are provided on this project. Certain items of equipment shall be provided under this section and certain items will be furnished and set under other sections of the specifications. In all cases, provide valved water supplies, waste and vent lines, and, unless noted otherwise, make final connections after the fixtures and equipment are in place.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Refer to schedule on contract drawings for description and composite for all plumbing fixtures.
- B. Fixtures shall be American Standard, Aquarius, Aqua Bath, Bradley, Crane, Eljer, Elkay, Fiat, Guardian, Just, Kohler, Speakman, Stern-Williams or Zurn equal to the composite models specified on the drawings.
- C. Trim shall be Chicago, McGuire, Omni, Powers, Speakman, Truebro, or T&S Brass and Bronze Works, equal to the composite models specified on the drawings.
- D. Flush valves shall be Sloan, Zurn or Delany. Flush valve handles shall be located on the "wide side" of the toilet areas for handicapped use.
- E. Toilet seats shall be Church or Olsonite, equal to the composite models specified on the drawings.
- F. Carriers shall be Josam, Jay R. Smith, Watts or Zurn, equal to the composite models specified on the drawings.
- G. Hospital equipment will be furnished by owner for installation by contractor unless specified otherwise.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls, floors, cabinets, and counters for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install plumbing fixtures level and plumb according to roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-mounted fixtures.
 - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install floor-mounted water closets on bowl-to-drain, connecting fitting attachments to piping or building substrate.
- D. Install counter-mounted fixtures in and attached to casework.

- E. Install water-supply piping with stop on each supply to each fixture to be connected to water-distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
- F. Each fixture and piece of equipment connected to the sanitary system shall be equipped with a trap. Provide traps for storm water lines where required by code. Each trap shall be placed as close to the fixture as possible and no fixture shall be double trapped. All traps on bell and spigot pipe shall be service weight cast iron and all traps on threaded pipe shall be galvanized cast iron recessed drainage type.
- G. Install flushometer valves on water closets.
- H. Install flushometer valves for accessible water closets, with lever handle mounted on wide side of compartment.
- I. Install toilet seats on water closets.
- J. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts. Include adapters if required.
- K. Install laminar-flow, faucet-spout fittings in faucet spouts where laminar-flow fittings are specified.
- L. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
- M. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220700 Plumbing systems insulation.
- N. Seal joints between plumbing fixtures, counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.
- O. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings.

3.3 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

3.4 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning plumbing fixtures, fittings, and controls.
- B. Adjust water pressure at faucets and flushometer valves to produce proper flow.

3.5 CLEANING AND PROTECTION

- A. After installing plumbing fixtures, inspect and repair damaged finishes.

- B. Clean plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed fixtures and fittings.
- D. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213

SECTION 230010 - MECHANICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications, apply to this Section.

1.2 SCOPE

- A. This section describes the general provisions for the mechanical and electrical work included in Division 23. This section applies to all sections of Division 23.

1.3 RESPONSIBILITY

- A. The General Contractor shall be responsible for all work included in the Mechanical Division and the delegation of work to Subcontractors shall not relieve him of this responsibility. Subcontractors who perform work under these Sections shall be responsible to the General Contractor. The term "Contractor" is used throughout this Division and shall mean the General Contractor, although the actual performance of the work may be by a Subcontractor.

1.4 REFERENCE AND DEFINITIONS

- A. Following are definitions of terms and expressions used in the Mechanical Sections. In addition to those used in Division 01 Sections.

1. Owner: UPMC Western Maryland
2. Architects: Lakeside Architecture Inc
3. Engineers: WSP USA Inc. (Formerly Leach Wallace Associates, Inc.)
4. Concealed - "hidden from normal sight"; includes items in shafts, pipe and duct spaces, and above ceilings.
5. Exposed - "not concealed" - Work within Equipment Rooms and all visible (normal sight) work shall be considered exposed".
6. Piping - includes pipes, fittings, valves, hangers and accessories comprising a system.
7. Ductwork- includes ducts, fittings, housings, plenums, dampers, hangers, and accessories comprising a system.
8. Directed- "directed by the Architect
9. Indicated- "indicated in Contract Documents"

1.5 STANDARD SPECIFICATION

- A. See General Requirements of the contract.
- B. References to catalogs, standards, codes, specifications, and regulations are the latest edition in effect at date of invitation to bid.

1.6 CODES, REGULATIONS AND PERMITS

- A. Give all necessary notices and obtain all required permits. Pay all fees and other costs, including utility connections or extensions in connection with the work. File all necessary plans, prepare all documents and obtain all necessary approvals of all governmental departments

having jurisdiction. Obtain all required certificates of inspection and deliver same to the Architect before request for acceptance and final payment for the work.

- B. All materials furnished and all work installed shall comply with the latest rules, regulations, and recommendations of the following bodies:

International Building Code (IBC)

International Mechanical Code (IMC)

Allegany Plumbing Code

National Fire Protection Association (NFPA)

National Electrical Code (NEC)

All State & Municipal Ordinances, Codes, and Regulations having Jurisdiction

1.7 MATERIAL LIST AND SHOP DRAWINGS

- A. See General Requirements.
- B. Within 15 working days after the award of the Contract, the Contractor shall submit to the Architect for approval a list submittal to be included in the submittal schedule in accordance with Section 013300 Submittal Procedures. The list shall include the manufacturers of material and equipment he proposes to provide. In the event any items of material or equipment contained in the list fail to comply with the specification requirements, such items will be rejected. Rejected items shall be resubmitted within 15 days. Substitutions requests shall be submitted in accordance with specified procedure.
- C. After receiving approval of equipment manufacturers and prior to delivery of any material to job site and sufficiently in advance of requirements to allow the Architect ample time for checking, submit for approval, dimensioned drawings or cuts showing construction size, arrangement, operating clearances, performance characteristics and capacity of materials and equipment. Each item of equipment proposed shall be a standard catalog product of the approved manufacturer.
- D. Samples, drawings, specifications, catalogs, etc., submitted for approval shall be properly labeled indicating specific service for which material or equipment is to be used, section and article number of specifications governing, and Contractor's name, name of job, and date.
- E. Catalogs, pamphlets or other documents submitted to describe items on which approval is being required shall be specific and identification in catalog, pamphlet, etc., of the item submitted shall be clearly made in ink. Data of a general nature will not be accepted. Any deviations or exceptions taken in the specification by the Contractor shall be so noted.
- F. If material or equipment is installed prior to receipt by the Contractor of approved shop drawings marked "Approved", "No Exception Taken" or "Make Corrections Noted", the Contractor shall be liable for its removal and replacement at no extra charge to the Owner.
- G. The acceptance of shop drawings shall not relieve the Contractor from his responsibility to furnish material, equipment and systems and to perform work required by the contract documents. Neither the Owner nor the Architect will be responsible for errors or omissions on shop drawings furnished by the Contractor even though such shop drawings containing errors or omissions are inadvertently accepted.

- H. The Contractor is further advised that the Architect will not act as coordinator between suppliers and subcontractors. All required coordination shall be the responsibility of the Contractor.

1.8 CONTRACTOR'S USE OF CAD/REVIT FILES

- A. At the Contractor's written request, copies of the Engineer's CAD / Revit files may be made available for Contractor use in connection with the project, subject to following conditions:
 1. Submit written request to the Architect listing the specific drawings the Contractor intends to use. Provide a specific list of submittals that the files will be used in preparing, and the list of names of subcontractors or suppliers.
 2. The Contractor shall request in writing the electronic transfer agreement. Prior to transfer of files, the Contractor shall prepare a separate electronic transfer agreement for each subcontractor or supplier who will be using the electronic files.
 3. Data contained on the electronic files is part of WSP USA Buildings Inc. (WSP USA) instruments of service and shall not be used for any purpose other than as a convenience in the preparation of shop drawings for the referenced project. Any other use or reuse will be at the Contractor's sole risk and without liability or legal exposure to WSP USA.
 4. The electronic files are not contract documents. Significant differences may exist between the electronic files and the corresponding hard copy contract documents. Because of the possibility the information and data delivered in machine readable form may be altered, whether inadvertently or otherwise, WSP USA reserves the right to retain hard copy originals of the electronic documentation delivered to the contractor, in machine readable form, which the original shall be referred to and shall govern in the event of any inconsistency between the two.
 5. The use of the electronic files, does not relieve the Contractor of their duty to fully comply with the contract documents, including and without limitation, the need to check confirm and coordinate all dimensions and details, take field measurements, verify field conditions and coordinate work with that of other Contractors for the project.
 6. All "internal" calculations integral to / performed by the Revit model shall not be utilized for any purpose by the Contractor. This includes, but shall not be limited to, voltage drop calculations, duct static pressure calculations, air system airflow summary calculations, piping system pressure drop calculations, etc.
 7. All Revit "families" are the property of WSP USA and shall not be re-used on any other project for any purpose by the Contractor.

1.9 GUARANTEE

- A. The Contractor guarantees by his acceptance of the Contract that all work provided shall be free from defects in workmanship and materials for a period of one year after date of certification of completion and acceptance of work. Any defects in workmanship, materials or performance which appear within the guarantee period shall be corrected by the Contractor without cost to the Owner within a reasonable time to be specified in notice from the Architect. In default thereof, Owner may have such work done and charge the cost of same to the Contractor.

1.10 SITE VISIT

- A. Prior to preparing the bid, the mechanical subcontractors shall visit the site and familiarize themselves with all existing conditions. Make all necessary investigations as to locations of existing equipment, ductwork, piping, utilities, etc., work to be removed, and all other matters which can affect the work under the Contract. No additional compensation will be made to the contractor as result of his failure to familiarize himself with the existing conditions under which the work must be performed.

- B. Refer to Section 002113 Instructions to Bidders and Section 002213 Supplementary Instructions to Bidders.

1.11 DRAWINGS

- A. The contract drawings are diagrammatic and indicate the general arrangements of systems and work included in the Contract. Do not scale the drawings. Consult the architectural and structural drawings and details for exact location of structure and equipment; where same are not definitely located, obtain this information from the Architect.

1.12 RECORD DRAWINGS

- A. The Contractor shall keep accurate records of all deviations in work are actually installed from work indicated. One complete set of contract documents shall be available at the construction site for indicating said deviations.
- B. When work is complete, make one (1) complete "As-Built" set of PDF files, certifying the accuracy of each drawing by endorsement and signature thereon and deliver to the Architect who will, after approval, deliver the record drawings to the Owner.
- C. Refer to Section 017839 Project Record Documents for Specific Requirements.

1.13 OPERATION AND MAINTENANCE INSTRUCTIONS

- A. Contractor shall furnish to the Engineer two (2) complete bound sets of typewritten or blueprinted instructions and one (1) PDF set for operating and maintaining all systems and equipment included in this Contract. Each set of instructions shall be contained in a hard-back ring binder properly indexed and labeled. Also provide two complete bound sets and one PDF set of approved shop drawings for all items of equipment utilized on the project. All instructions shall be submitted in draft for approval prior to the final issue. Manufacturers' advertising literature or catalogs will not be acceptable for operating and maintenance instructions.
- B. Instructions shall include a general description of each system together with specific instructions describing routine and emergency procedures required of the building maintenance personnel for operating and maintaining each system. The instructions shall include the name or label, location, and function of all operating equipment and controls, and the location of the electrical service and breaker I.D. numbers. Operating modes and the procedures for indexing each mode shall be clearly described. Include lubrication charts and schedules of frequency of lubrication for all equipment designating each point of lubrication and type of lubricant to be used. A listing of names, addresses, and phone numbers of the service organizations for each item of equipment and a typewritten maintenance schedule for same shall be included.
- C. Contractor shall prepare Operations and Maintenance Data and submit in accordance with the requirements of Section 017823 Operation and Maintenance Data.

1.14 ELECTRICAL WORK

- A. Under Division 23 MECHANICAL, provide the following items of electrical work which shall conform with the applicable requirements of the Electrical Division:
 - 1. Temperature control wiring.
 - 2. Interlock wiring for mechanical equipment.
- B. Under Division 26, 27 or 28, provide:

1. Power wiring complete from source to motor or equipment junction box, including power wiring through motor starters.
2. All miscellaneous individual motor starters, local wall mounted control devices, unless noted or specified otherwise.
3. All fire alarm interface wiring including smoke detectors located in mechanical systems.

1.15 EQUIPMENT STARTUP AND INITIAL OPERATION

- A. No equipment shall be operated for testing or trial use except after full compliance with the equipment manufacturers' specifications and instructions of the lubrication, alignment direction of rotation, balance, and other applicable considerations.
- B. Particular care shall be taken to see that all equipment is completely assembled and properly lubricated and all grease and oil cases and reservoirs have been filled to the correct level with the recommended lubricant.
- C. It is the Contractor's responsibility to place each item of equipment installed by him in operating condition, including all auxiliaries, piping, wiring, etc., and to start up each unit and check it for performance.

1.16 FIRE PROTECTION

- A. As minimum, one five pound CO2 extinguisher shall be provided with each work crew at all times when working within the building.

1.17 SCHEDULE OF WORK

- A. Refer to project schedule. Specific phasing requirements are to be incorporated into the project schedule. Contactor shall coordinate all work included in this division.

1.18 SERVICE AGENCIES

- A. All mechanical equipment suppliers shall have an established authorized service agency located within the Western Maryland area. Within 30 days after award of the Contract, the Contractor shall submit to the Architect for approval a list of manufacturers' material and equipment names, including their respective service agency, he proposes to use. In the event any service agency in the list fails to comply with the specification requirement, such service agency will be rejected.

1.19 SINGULAR NUMBER

- A. Where any device or part of equipment is herein referred to in the singular number (such as "valve"), such reference applies to as many such devices as are required to complete the installation, shown, implied or otherwise, as indicated on the drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All materials shall be new, the best of their respective kinds, suitable for the conditions and duties imposed on them at the building and shall be of reputable manufacturers. The description, characteristics, and requirements of materials to be used shall be in accordance with qualifying conditions established in the sections following.
- B. See Division 01 for General Requirements.

- C. All component parts of each item of equipment or device shall bear the manufacturers' name plate, giving name of manufacturer, description, size, type, serial or model number, electrical characteristics, etc, in order to facilitate the maintenance or replacement. The name plate of a subcontractor or distributor will not be acceptable. All equipment requiring electrical service shall be U.L. labeled, or if a U.L. label is not available from the manufacturer, the equipment shall be tested by an approved electrical testing company in accordance with NEC, and at no additional cost to the Owner. Submit data indicating compliance with standards prior to installation.
- D. In specifying materials, four general procedures are used. The four classifications are as follows:
1. GROUP 1: When the material or equipment is specified by name of other identifying information and one name brand only is used, it is considered that the use of that particular item is essential to the project, and the Contractor shall base his proposal on the uses of that item.
 2. GROUP 2: When a material or equipment is specified by brand name and other identifying information and two or more brand names are named, it is considered that any one of the brands so named will be performed as desired, and the Contractor shall base his proposal on one of the named brands.
 3. GROUP 3: When the material or equipment is specified with the phrase "... or equal..." after a brand name and other identifying information, it is intended that the brand name is used for the purpose of establishing a minimum acceptable standard of quality and performance and Contractor may base his bid proposal on any item which is in all respects equal to that specified and presents essentially the same appearance, size, operation and performance. The Contractor shall be responsible for coordination of the equal product.
 4. GROUP 4: When material is specified as complying with the requirements of published "Standard Specification" of trade associations, American Society for Testing and Material, government specifications, etc., the Contractor shall base his proposal on any item which can be shown to comply in all respects to the referred to "Standard Specification."
- E. All substitutions shall be submitted in accordance with Section 012500 Substitution Procedures. It is distinctly understood: (1) that the Architect will use his own judgment in determining whether or not any materials, equipment or methods offered in substitution are equal to those specified and will fit within the space available; (2) that the decision of the Architect on all such questions of equality is final; and (3) that all substitutions will be made at no increases in cost to the Owner.
- F. Upon receipt of written approval from the Architect, Contractor may proceed with substitution providing the Contractor assumes full responsibility for and makes, at his expense, any change or adjustment in construction or connection with any work that may be required by the substitution of such materials, equipment or methods. In the event of any adverse decisions by the Architect, no claim of any sort shall be made or allowed against the Owner.

2.2 SLEEVES AND PLATES

- A. Except above suspended acoustical tile ceilings, provide 24 gauge galvanized sheet metal sleeves for all ductwork passing through floor, ceiling or wall construction. Duct sleeves shall be large enough to pass duct with insulation and shall have 1/2 inch flanges returned against the construction material.
- B. Where fire dampers are required, provide sleeves in compliance with code requirements, minimum 18 gauge galvanized sheet metal.

- C. Utilize U.L. approved resilient sealant for all penetration seals. Submit method of sealing for approval.
- D. Where watertight sleeves are indicated or required to suit the installation, provide Link Seal rubber seals, as manufactured by Thunderline Corporation, between pipes and sleeves.

PART 3 - EXECUTION

3.1 WORKMANSHIP

- A. Each subcontractor shall furnish the services of an experienced superintendent who shall be constantly in charge of the installation of the work.
- B. The quality of workmanship required for each trade in the execution of its work shall be the finest and highest obtainable in that trade working with the materials specified. Workmanship shall be satisfactory to the Architect and his decision as to acceptable quality if final.

3.2 EQUIPMENT CONNECTIONS

- A. All equipment shall be installed and connected in accordance with the best engineering practice and in accordance with manufacturer's instructions and recommendations. Auxiliary piping, valves, and electric connections recommended by the manufacturer or required for proper operation shall be provided.

3.3 COMMISSIONING RESPONSIBILITIES

- A. The mechanical contractor, and all the sub-contractors and suppliers within Division 23, shall cooperate with the commissioning agency (CA), and other commissioning team members, to facilitate the successful completion of the commissioning process.
- B. The contractor shall assign a representative to the commissioning team, and submit the person's name to the commissioning agency, within one (1) month of the award of the contract. The representative shall have the authority to make decisions on behalf of the mechanical contractor as they relate to the organization and scheduling of HVAC commissioning. The representative shall ensure communications between Division 23 contractors and suppliers and all other commissioning team members, and shall foster the necessary cooperative action. One specific responsibility shall be to attend commissioning meetings, and ensure action items arising from them are attended to as required to allow the commissioning process to proceed on schedule.
- C. The Mechanical Contractor, and all mechanical sub-contractors and suppliers, shall cooperate with the Commissioning Agency in carrying out the HVAC commissioning process. In this context, the Mechanical Contractor shall:
 - 1. Each contractor and sub-contractor in this division shall include in their quotes the cost of participating in the commissioning process as specified herein.
 - 2. Ensure the automatic temperature controls (ATC) contractor performs HVAC commissioning responsibilities as listed in 230900.
 - 3. Provide instruction and demonstrations for the Owner's designated operating staff, in conjunction with the commissioning agency and mechanical engineer, and with the participation of qualified technicians from major equipment suppliers and the controls contractor.
 - 4. Include requirements for submittal data, O&M data, and training information in each purchase order or sub-contract written.

5. Ensure cooperation and participation of specialty sub-contractors such as sheet metal, piping, refrigeration, and water treatment as applicable.
6. Ensure participation of major equipment manufacturing in appropriate start-up, testing and training activities.
7. Attend HVAC commissioning meetings scheduled by the CA.
8. Notify the CA a minimum of two weeks in advance of scheduled equipment and system start-ups, so that the CA may witness system verifications, and equipment and system startups.
9. Provide sufficient personnel to assist the CA as required during system verification and functional performance testing.
10. Prior to startup, inspect, check and confirm the correct and complete installation of all equipment and systems for which system verification checklists are included in the commissioning plan. Document the results of all inspections and checks on the checklists and sign them. If deficient or incomplete work is discovered, ensure corrective action is taken and re-check until the results are satisfactory and the system is ready for safe startup.
11. Notify the CA a minimum of two weeks in advance, of the time for start of the TAB work. Attend the initial TAB meeting for review of the TAB procedures.
12. Provide equipment and systems startup resources as specified and required. If during an attempted equipment or system startup, deficient or incomplete work is discovered that would preclude safe operation, the startup shall be aborted until corrective action has been taken. Ensure such action is taken and verified before re-scheduling a new startup. Those responsible for deficient or incomplete work will be responsible for the costs associated with rescheduling.
13. Carry out performance checks to ensure that all equipment and systems are fully functional and ready for the CA to witness formal functional performance tests (FPTs).
14. Operate equipment and systems for FPTs in accordance with the commissioning plan and as directed by the commissioning agency. If improper functionality, incomplete work, or other deficiencies affecting system performance are discovered, the FPTs will be stopped by the CA. Those responsible for deficient or incomplete work will be responsible for costs associated with rescheduling. Ensure that all corrections necessary for full and complete system operation as specified are completed; then with the ATC contractor and other applicable sub-contractors, carry out functional performance checks to confirm correct operation before applying to the CA to reschedule the FPTs for the system in question.
15. Prepare preliminary schedule for mechanical system orientation and inspections, O&M manual submission, training sessions, pipe and duct system testing, flushing and cleaning, equipment startup, TAB, and task completion for use by the CA. Update schedule as appropriate throughout the construction period.
16. Attend initial O&M staff training session.
17. Conduct mechanical system orientation and inspection at the equipment placement completion stage.
18. Update drawings to as-built condition and review with the CA.
19. Prepare O&M manuals as specified herein.
20. Participate in the O&M staff training sessions with vendors and contractors.
21. Provide written notification to the general contractor [or construction manager] and CA that the following work has been completed in accordance with the contract documents and the equipment, systems and sub-systems are operating as required.
 - a. HVAC equipment including all fan powered terminal units, ductwork, dampers, terminals and all Division 23 equipment.
 - b. Fire stopping in the fire rated construction, including fire and smoke damper installation, caulking, gasketing and sealing of smoke barriers.
 - c. Fire detection and smoke detection devices furnished under other divisions of this specification as they affect the operation of the smoke control systems.

- d. That the building control system is functioning to control mechanical equipment and smoke control systems as specified.
- 22. Provide a complete set of as-built drawings and O&M manuals to the CA for review.
- 23. Integrate installation and programming scheduling with construction and commissioning schedules.
- 24. Inspect, check and confirm the correct installation and operation of input and output field points and devices through documented and signed off point-to-point checkouts.
- 25. Provide thorough training to operating personnel on hardware operations and programming, and the application program for the system, in accordance with the O&M staff training program in the commissioning plan.
- 26. In conjunction with the mechanical contractor, demonstrate system performance to the CA including all modes of system operation (e.g. occupied, unoccupied, emergency) during the functional performance tests (FPTs). If improper functionality, incomplete work, or other deficiencies affecting system performance are discovered, the FPTs will be stopped by the CA. Those responsible for deficient or incomplete work will be responsible for rescheduling costs.
- 27. Provide control system technician to assist during system verification and functional performance testing.
- 28. Provide support and coordination with TAB contractor on all interfaces between controls and TAB scopes of work. Provide, at no additional cost to the TAB and commissioning agencies, all devices, such as portable operator's terminals and all software for the TAB agency to use in completing TAB procedures.

3.4 WATERPROOFING

- A. Under no circumstances shall waterproofing be damaged or penetrated. Should conditions arise which indicate such necessity, notify the Architect.

3.5 CUTTING AND PATCHING

- A. Cutting and patching associated with the work in the existing structure shall be performed in a neat and workmanlike manner. Existing surfaces which are damaged by the Contractor shall be repaired or provided with new materials and methods similar to existing adjacent work, subject to approval of the Architect. Structural members shall not be cut or penetrated unless otherwise indicated on the drawings. Verify in the field with the Architect. Holes cut through concrete and/or masonry to accommodate new work shall be cut by reciprocating or rotary non-percussive methods. Existing masonry block walls shall be patched with new masonry or gypsum board attached and sealed to both block faces.

3.6 SURVEYS AND MEASUREMENTS

- A. Base all measurements (both horizontal and vertical) from established benchmarks. All work shall agree with these established lines and levels. Verify all measurements at site and check correctness of same as related to the work. Verify locations of existing utilities and inverts of same prior to the start of any systems shown connecting to utilities.
- B. Should the Contractor discover any discrepancy between actual measurements or conditions and those indicated which prevent following good practice or the intent of the drawings and specifications; he shall notify the Architect and shall not proceed with his work until he has received instruction from the Architect.

3.7 HANDLING AND STORAGE OF MATERIALS

- A. Proper and suitable tools, equipment and appliances for the safe and convenient handling and placing of all materials and equipment shall be used. During loading, unloading, and placing, care shall be taken in handling the equipment and materials so that no equipment or materials, including Owner furnished, are damaged.
- B. All mechanical and/or electrical equipment delivered to the job site shall be stored under roof or other approved covering, on pedestals above the ground. All enclosures for equipment shall be weatherproof. Any motors which are not totally enclosed, that are involved in the work, shall be stored in a heated area with a minimum temperature of 50 degrees Fahrenheit. All valves shall be stored under roof on wood pedestals above ground. All insulation shall be stored under roof or in trailers, adequately protected from the weather. The Contractor shall follow all written instructions and recommendations of the manufacturer and all requirements of the Architect in oiling, protection and maintenance of equipment during storage. It shall be the Contractor's complete responsibility for the storage and care of the equipment and materials.
- C. If any materials and/or equipment are found to be in poor condition at the time of being installed, the Architect may, at his discretion, order the Contractor to furnish and install new equipment at no cost to the Owner.

3.8 COOPERATION WITH OTHER TRADES

- A. Exact location of air outlets, electric outlets, piping, ducts, and conduits shall be coordinated with all other trades so that there will be no interference between lighting fixtures, piping, ducts, and conduits. Where conflicts between the trades result, they shall be resolved by the Contractor to the Architect's satisfaction and at no expense to the Owner.
- B. Mechanical trades shall give full cooperation to other trades and shall furnish in writing, with copies to the Architect, all information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay. Exact location of all mechanical equipment in finished spaces shall be coordinated with shop drawings and with elevations indicated on the architectural drawings.

3.9 CLEANING AND PAINTING

- A. Thoroughly clean all exposed surfaces of equipment and material and leave in a neat, clean condition ready for painting. Restore and touch-up factory finishes which have been damaged during construction. Finished painting will be performed under another Division.
- B. Miscellaneous requirements include:
 - 1. Provide complete new finish if, in the opinion of the Architect, the factory finishes are severely damaged.
 - 2. Touch up threads of zinc coated screwed pipe with Rustoleum primer and one coat of enamel conforming to painting specification.
 - 3. Paint behind grilles and registers in finished areas with two coats of flat black paint following surface preparation of the zinc coated metal.
 - 4. All exposed hangers, steel supports and miscellaneous components, and cast iron pipe hangers shall be field painted with Rustoleum primer and one coat of enamel conforming to painting specification.
 - 5. All steel support and miscellaneous components shall be painted with Rustoleum primer and one coat of enamel conforming to the painting specification.

3.10 ACCESSIBILITY

- A. Locate all equipment which must be serviced, operated or maintained, in fully accessible positions. Equipment shall include, but not be limited to, air terminal units, coils, valves, motors, controllers, dampers, drain points, etc. Where required and where directed, provide 14 gauge steel access panels, Milcor or equal, to suit material in which installed. Doors installed in fire rated walls or shafts shall be labeled and shall match rating of the construction. Door shall be of sufficient size to allow access to all components, except minimum size shall be 24" x 24", unless otherwise noted.
- B. Equipment deemed inaccessible by the Architect shall be reworked by the Contractor at no expense to the Owner. All doors shall have cylinder locks operable from same key. Submit shop drawings for approval.

3.11 SLEEVES AND PLATES

- A. Sleeves shall be provided by the trade installing the pipe or duct. The sleeves shall be carefully located in advance of the construction of walls and floors where new construction is involved. Provide all cutting and patching necessary to set sleeves which are not placed prior to construction. All cutting and patching necessary to set sleeves which are not placed prior to construction shall be the responsibility of the trade providing the sleeves.
- B. Sleeves shall be provided for all piping and ductwork passing through concrete, masonry, plaster and gypsum wallboard construction. Caulk the annular space of pipe sleeves with an elastic caulking compound to make installation air and watertight.
- C. Fasten sleeves securely in the construction so that they will not become displaced when concrete is poured or when other construction is built around them. Take precautions to prevent concrete, plaster or other materials being forced into space between pipe and sleeve during construction.
- D. Sleeves required in existing concrete or masonry walls shall be set and secured with mortar grout and fast drying bitumastic sealant.
- E. At all sleeves where objectionable noise can be transmitted (e.g. Mechanical and Electrical Rooms), at smoke barriers, at walls above ceilings that extend to the underside of the structure of the floor above, or at fire rated separations, seal all openings between pipes and ducts and corresponding sleeves to prevent sound transmission and to maintain fire rating. Use U.L. approved resilient sealant for penetration seals.
- F. Where pipe motion due to expansion and contraction will occur, provide sleeves of sufficient diameter to permit free movement of pipe. Where sleeves pass insulated pipes and ducts, the sleeves shall be large enough to pass the pipe or duct and the insulation. Check construction to determine proper length for various locations; make actual lengths to suit the following:
 - 1. Terminate sleeves flush with walls, partitions and ceilings.
 - 2. Terminate sleeves 2 inches above finished floor in equipment rooms and wet floor areas.
 - 3. In all other areas, terminate sleeves 1/2 inch above finished floor unless otherwise noted on the drawings or directed in the field.

3.12 ALTERATIONS AND DEMOLITION

- A. All existing piping, equipment, ductwork, and materials which are required to be removed shall be removed. All existing materials and equipment which are removed and are desired by the Owner, or are indicated to remain as the property of the Owner, shall be delivered to him on the premises by the Contractor where directed by the Architect. All other materials and equipment

which are removed shall become the property of the Contractor and shall be promptly removed by him from the premises.

- B. Remove all indicated mechanical work by hand as far as possible. Power-driven equipment shall be used as a last resort, and shall not be employed without consent of the Owner. Schedule all demolition work to the satisfaction of the Owner. The Contractor shall execute the removal work as quietly as practicable to avoid unnecessary disturbances to occupied areas.
 - C. Existing conditions, i.e. ductwork, piping, equipment, etc, may be obtained from available record drawings and are not warranted to be complete or correct. Contractor shall verify exact location of all ductwork, piping, etc, in the field prior to starting any work.
 - D. Existing duct and pipe sizes noted on the available record drawings are for the convenience of the Contractor only. Contractor shall verify sizes in the field.
 - E. Existing piping and ducts no longer required to remain in service shall be disconnected and removed back to service mains and trunk ducts, including existing piping hangers, supports, and air devices. Existing pipe and ducts indicated or required to remain in service shall be capped.
 - F. Existing piping that remains concealed, buried, or otherwise contained in or below the remaining slabs and walls shall be capped, plugged, or otherwise sealed. All pipes shall be cut so that their capped or plugged ends will be far enough behind finished surfaces to allow for the installation of the normal thickness of finished material.
 - G. When existing mechanical work is removed, all related pipes, valves, ducts, and materials shall also be removed.
 - H. When the work specified herein connects to existing piping, or ductwork, the Contractor shall perform all necessary alterations, cutting, or fitting of the existing work as may be necessary or required to make satisfactory connections between the new and existing work and to leave the completed work in a finished and workmanlike condition, to the entire satisfaction of the Architect.
 - I. When the work specified herein or under other divisions of the contract necessitates relocation of existing mechanical equipment, piping or ductwork, the Contractor shall perform all work and make all necessary changes to existing work as may be required to leave the completed work in a finished and workmanlike condition, to the entire satisfaction of the Architect, and at no additional cost to the Owner.
 - J. Existing mechanical equipment, piping and ductwork affected by removal or new work installation and required to remain in service shall be reinstalled or supported as required in accordance with new work specification. All work shall be completed to the Architect's satisfaction and at no additional cost to the Owner.
 - K. Valve off or disconnect live services as required for removal work.
 - L. Refer to drawings for additional requirements.
- 3.13 CLOSE OUT PROCEDURES:
- A. Refer to Section 017700 Close Out Procedures for specific requirements.

END OF SECTION 230010

SECTION 230050 – HVAC BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications apply to the work specified in this Section.

1.2 SUMMARY

- A. This section includes requirements for items of equipment, materials and procedures which are common to more than one section of Division 23 and which are general in nature and use. This section applies to all sections of Division 23.
- B. The requirements of Section 230010 HVAC, Mechanical General Provisions, shall apply to all work specified under this section.

1.3 COMMISSIONING

- A. Division 23 will be responsible to carry out the commissioning requirements specified in Section 230010.

1.4 SUBMITTALS

- A. Submit shop drawings for all items of materials specified in this section in accordance with the Section 230010 and Division 01 requirements.
- B. At a minimum, manufacturer's product data shall include specifications, installation instructions and general recommendations for each type of material required. Include data substantiating that proposed materials comply with specified requirements for each type.

1.5 TESTS AND ADJUSTMENTS

- A. The Contractor shall furnish labor, instruments, equipment, and materials required to perform tests prescribed in the sections describing the various systems.
- B. Replace or repair defects found during inspection or test with new materials. Caulking of welded joints, screwed joints, cracks, or holes is not acceptable. Correct leaks in screwed fittings by remaking joints. In welded systems leaks in joints shall be cutout and rewelded. Repeat tests after defects have been eliminated.
- C. Where reasonable doubt exists as to a system's ability to comply with contract requirements, perform any reasonable test required by the Architect.
- D. Make static pressure tests and prove to the satisfaction of the Architect that the piping is tight before pipes are concealed or insulated. Tests shall be provided as hereinafter specified.
- E. Use test instruments for accuracy by an approved laboratory or by the instrument manufacturer and furnish certificates showing degree of accuracy to the Architect when requested. Make calibration histories for each instrument available for examination.

- F. Where gauges, thermometers and other instruments which are to be left permanently installed are used for tests, do not install until just prior to the tests to avoid possible changes in calibration.

PART 2 - PRODUCTS

2.1 IDENTIFICATION AND EQUIPMENT TAGS

- A. All control devices, i.e. panels, switches, starters, push button stations, temperature controls etc., shall be clearly identified as to their function and the equipment controlled.
- B. All mechanical equipment shall be marked to clearly identify said equipment and space or duty they serve. All air terminal units and their corresponding thermostats shall be marked with sequential numbers to identify each terminal unit with its respective control thermostat.
- C. Mechanical equipment herein specified shall be identified using engraved laminated black and white phenolic legend plates. Letters shall be minimum, 3/4" high white on surrounding black. Plates shall be mounted by means of sheet metal screws. Submit nameplate list to Architect for approval.
- D. Mechanical and electrical equipment, i.e., air terminal units, valves, etc., concealed above ceiling shall be identified as to location using clear plastic self-adhesive tape with black lettering, applied to ceiling tile "T" bars. Submit nameplate list to Architect for approval.
- E. Ductwork shall be identified by stenciling. Stenciled lettering shall be minimum 3 inches high with adjacent direction of air flow arrows. Stenciled lettering shall be provided on all mains and principle duct branches. Mark each type of service every 30 feet with a marking of each shaft. Identify ductwork as follows:

Air Handling Units AC-3

Exhaust Systems EF-10 (Contractor to confirm the fan label on the roof)

PART 3 - EXECUTION

3.1 CLEANING

- A. After completion of installation, thoroughly clean dirt, rust, loose scale, oils and grease, and other foreign matter from metal and insulated surfaces, painted or unpainted, specified under Division 23 of the specification.

3.2 PHASING

- A. The contractor shall schedule phasing to minimize the disruption of existing patient services. This phasing is essential to ensure a safe environment in patient care areas. Phasing shall include assurance for clean to dirty airflow, emergency procedures, criteria for interruption of protection, written notification of interruptions, and communication authority. Procedures must be developed for noise and vibration that will affect patients, and planned accordingly. The renovation areas shall be isolated from the occupied areas during construction using airtight barriers, and exhaust airflow shall be sufficient to maintain negative air pressure in the construction zone.

3.3 SLEEVES AND PLATES

- A. See Section 230010.

END OF SECTION 230050

SECTION 230593 - TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to the work specified in this section.

1.2 SUMMARY

- A. This section includes all labor and materials necessary to adjust, balance and test [and commission] performance in accordance with design criteria and the equipment and components of systems included in Division 23 as follows:

1. Air Distribution
2. Equipment Performance and Commissioning

- B. Static pressure duct leakage tests will be performed under another section and shall be witnessed under this section.

1.3 COMMISSIONING

- A. Division 23 will be responsible to carry out the commissioning requirements specified in Division 01 Section 230010 and other sections.

1.4 QUALIFICATIONS

- A. Work included in this section shall be performed by a pre-approved air and water balancing firm, who shall test, adjust, balance, and commission the air and water systems for this project in accordance with NEBB or AABC Standard Procedures. Submit the name and qualifications of the air balance firm for approval within thirty (30) days after award of contract.
- B. Qualifications shall include the name of the technician that will be assigned to this project. The technician's qualifications shall be included and shall include successfully completed projects of similar size and complexity, references, and formal training.
- C. If the Contractor fails to submit the name of an acceptable agency within the specified time, the Architect will select a firm to accomplish the work, and the selection shall be binding at no additional cost to the Owner.
- D. All work shall be performed under direct supervision of a qualified engineer. All instruments used shall be accurately calibrated and maintained in good working order. If requested, calibration tests of equipment to be used shall be performed in the presence of the Engineer.

1.5 TEST REPORT

- A. The balancing agency shall prepare a written report which shall include diagrams and description of procedures together with all recorded test data. The report shall be submitted in bound volumes for a permanent record. Submit four (4) copies of report. A set of contract drawings shall also be submitted. Drawings shall have each air device, flow fitting, pump, fan, and traverse location identified in red ink by a number which shall match identification numbers utilized in the balancing report. Commissioning checklists and functional performance test

sheets shall be included in a separate section of final testing, balancing and commissioning report.

- B. Reports shall be submitted in accordance with requirements of Section 013300 Submittal procedures.

1.6 TEST PROCEDURE

- A. Systems may be tested in increments when approved by the Engineer.
- B. When testing and balancing involve the building temperature control systems, cooperate with the temperature control subcontractor to achieve the desired results. All setpoints shall be documented and included with test report.
- C. At the time of the final inspection, recheck in the presence and at the request of the Engineer not to exceed ten percent (10%) of the previously recorded readings from the certified report selected at random from the log by the Engineer.
- D. Permanently mark the settings of valves, dampers, and other adjustment devices so that adjustment can be restored if disturbed at any time. Do not permanently mark devices before final acceptance.
- E. Perform all tests in accordance with NEBB or AABC standard procedures. Any deviation from same must be approved by the Engineer.
- F. Should the basic system or any of its components fail to meet contract requirements, and thereby make the testing and balancing work invalid, notify the Engineer and stop the tests until such time that the failure is corrected.

PART 2 - PRODUCTS

2.1 TESTING AND COMMISSIONING INSTRUMENTS

- A. Use instruments of equal or better quality than those described in the technical portions of Associated Air Balance Council National Standards for Testing and Balancing, Heating, Ventilating and Air Conditioning Systems, Fifth Edition, 1989.
- B. Instruments used for balancing air and water systems must have been calibrated within a period of six (6) months prior to balancing. Submit serial numbers, and dates of calibration of all instruments to be used prior to the start of work.
- C. Instrumentation shall include, as a minimum, the following items of equipment:
 - 1. Pressure gauges and fittings.
 - 2. Dry bulb and wet bulb thermometers.
 - 3. Contact pyrometer.
 - 4. Portable flow meter and, if required, orifice plates.
 - 5. Pitot tube and manometers.
 - 6. Alnor Velometer with attachments.
 - 7. Amprobe.
 - 8. Tachometer.
 - 9. Data Loggers

PART 3 - EXECUTION

3.1 GENERAL

- A. Within fifteen (15) days of receipt of notice to proceed, review plans and specifications of systems to be tested, balanced, and commissioned to confirm that the arrangement, instrumentation and balancing devices will permit the system to be balanced and tested in the manner described in this section and report to the Engineer any devices which need to be added or any phase of the design which needs to be modified to permit the fulfillment of this contract.
- B. Conduct balancing and testing in accordance with technical portions of the Associated Air Balancing Council--"National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems, Fifth Edition, 1989". Test procedures not in accordance or not described in the standards, i.e., variable air volume systems shall be approved by the Engineer in writing.
- C. Provide all labor, testing equipment, and materials required to conduct tests and balance systems, and to perform the systems commissioning.
- D. System shall be operated at least four (4) hours after stabilized operating conditions have been established before conducting capacity tests. Capacity and performance tests of equipment and systems shall be performed only after balancing is complete.

3.2 AIR DISTRIBUTION SYSTEMS

- A. All air distribution systems including supply, return, and exhaust ductwork shall be tested and balanced and commissioned.
- B. Where the system cannot be properly balanced or equipment tested due to system deficiencies such as inability to properly adjust fan speeds, improperly sized motors, excessively noisy equipment, malfunctioning controls, excessively out of balance air distribution system branch runs, and similar item, furnish to the Engineer in writing a list of the deficiencies prior to the submission of the test report.
- C. Make openings in ducts required for pitot tube insertion and seal those openings with snap-in plugs. Neatly remove duct insulation as required for test. Replacement of insulation, after testing is completed, is included under Section 230700.
- D. Specific testing and balancing procedures shall include:
 - 1. Test and adjust speed of all air apparatus.
 - 2. Test and record motor voltage and amperage.
 - 3. Make Pitot tube traverse of main ducts and obtain design air quantity at fans.
 - 4. Test and record system static pressures, suction, and discharge as well as pressure drops across each system element; ie, filters, coils, silencers, etc. Test and record static pressure and record settings of variable volume systems at pressure controllers. Record temperature control air pressure setpoints for minimum outside air, and maximum and minimum supply air volumes for all variable air volume systems.
 - 5. Test and adjust systems for design supply, outside, exhaust, and return air quantities.
 - 6. Test and record air entering and leaving conditions at air unit on both heating and cooling modes.
 - 7. Adjust all main and branch ducts for supply, return and exhaust air. Set and "mark" all volume dampers. Identify, test, and adjust each grille, register, and diffuser to within ten percent (10%) of design quantities except as noted below:

For critical areas where differential pressures must be maintained:

For positive zones, supply air shall be balanced within 0 to 10% high and exhaust/return 0 to 10% low. For negative zones, supply air shall be balanced within 0 to 10% low and exhaust/return 0 to 10% high.

8. Verify operation of each room thermostat serving VAV terminal units over full range of heating and cooling to insure proper sequence of control of the VAV operator and reheat coil valve. Record results.
 9. Field test maximum and minimum air volumes of all variable air volume terminal units and record final settings. Check factory settings of regulators and controllers before tests. Reset to the scheduled air volumes if required.
 10. Verify accuracy of all duct air monitors by duct traverse.
 11. Work in conjunction with the ATC Contractor and Engineer to establish maximum and minimum settings on all variable air volume fans.
 12. Check operation of variable air volume system controls. Test supply and return fan and outside air volumes by duct traverse at maximum, midpoint, and minimum air volumes to verify that programmed volume differential is maintained.
 13. Verify installation of equipment, systems, and related controls and devices. Document on pre-commissioning checklists.
- E. Witness duct pressure tests as performed under Section 233300. Submit with balancing report test condition and results for each section of duct tested. Include diagrams if required to define tested sections. Submit preliminary test data as soon as possible after testing.
- F. Review ATC trend logs. Verify point-to-point and front end.
- 3.3 EQUIPMENT PERFORMANCE
- A. Conduct performance tests only after the air systems have been balanced and the proper flow rates established.
- B. Test and record capacity of heat transfer equipment including all coils. Include the manufacturer's rated capacity at the test operating conditions with the report. Perform tests where possible at design conditions. If tests are not performed under design conditions, interpolate results to determine capacity at full load operating conditions.
- C. Perform functional performance tests (FPTS) and document on FPT forms for:
1. VAVs (sample strategy)
 2. Fan Powered Terminal Units
 3. Other equipment and/or systems as required

END OF SECTION 230593

SECTION 230700 - MECHANICAL SYSTEMS INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Supplementary Conditions and Division 01 specifications, apply to the work specified in this Section.

1.2 SUMMARY

- A. Work included in this section consists of furnishing all labor, equipment, materials and accessories, and performing all operations required, for the correct fabrication and installation of thermal insulation applied to the following piping, equipment, and duct systems, in accordance with applicable project specifications and drawings:
 - 1. Air handling ductwork, shafts, and plenums, to 1200°F.
- B. Work excluded in this Section are the following:
 - 1. Thermal building insulation.
 - 2. Sound absorbing duct lining.
- C. The requirements of Section 230010, Mechanical General Provisions, shall apply to the work specified under this Section.

1.3 DEFINITIONS

- A. The k factor means the number of British thermal units of heat transmitted per (sq. ft.) Fahrenheit temperature difference through a material with flat, parallel sides one inch (1") apart. The material shall be tested and rated according to ASTM Test Method C-177.
- B. The term "Mineral Fiber" as defined above specifications includes fibers manufactured of glass, rock or slag processed from a molten state, with or without binder.
- C. Unless otherwise specified, the term concealed, as used in this specification, shall include all furred spaces, accessible pipe and duct shafts, and spaces above suspended ceilings.
- D. Unless otherwise specified, the word exposed shall refer to all work other than "concealed" work.

1.4 REFERENCES

- A. Thermal insulation materials shall meet the property requirements of one or more of the following specifications as applicable to the specific product or use:
 - 1. American Society for Testing of Materials Specifications:
 - a. ASTM C 533-07: Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - b. ASTM C 547 "Standard Specification for Mineral Fiber Pipe Insulation"
 - c. ASTM C553 "Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications"

- d. ASTM C585 "Standard Practice for Inner and Outer Diameters or Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System)"
- e. ASTM C-591 "Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation"
- f. ASTM C 612 "Standard Specification for Mineral Fiber Block and Board Thermal Insulation"
- g. ASTM C 795 "Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel"
- h. ASTM C 1126-04: Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.
- i. ASTM C 1136 "Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation"
- j. ASTM C 1290 "Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts"
- k. ASTM G-21 "Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi" (fungi resistance section only)
- l. ASTM G 22 "Practice for Determining Resistance of Plastics to Bacterial (bacteria resistance section only)

1.5 SYSTEM PERFORMANCE

- A. Insulation materials furnished and installed hereunder should meet the minimum economic insulation thickness requirements of the North American Insulation Manufacturers' Association (NAIMA) to ensure cost-effective energy conservation performance. Alternatively, materials should meet the minimum thickness requirements of Standard 90.1, "Energy Standard for Building Except Low Rise Residential Buildings," of the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE). However, if other factors such as condensation control or personnel protection are to be considered, the selection of the thickness of insulation should satisfy the controlling factor. In no case shall the insulation thickness be less than that specified herein.
- B. Insulation materials furnished and installed hereunder shall meet the fire hazard requirement of any one of the following specifications:
 - 1. American Society of Testing of Materials ASTM E 84
 - 2. Underwriters' Laboratories, Inc. UL 723
 - 3. National Fire Protection Association NFPA 255

1.6 FIRE RESISTANCE

- A. Except for materials which are subsequently exempted, all materials used as part of the thermal insulation shall have a fire hazard rating not to exceed twenty five (25) for flame spread and fifty (50) for fuel contributed and smoke developed.
- B. Test factory assembled materials as assemblies.
- C. Determine ratings by the Standard Method of Test for Surface Burning Characteristics of Building Materials, ASTM E-84 or NFPA No. 255.
- D. The following will be required to establish that fire hazard ratings for materials proposed for use do not exceed those specified: (1) label or listing by Underwriter's Laboratories, Inc., (2) certified test report from an approved testing laboratory.
- E. The following materials are exempt from the foregoing Fire Resistant Rating:

1. Jackets of canvas, PVC and nylon.
2. Polyurethane, polystyrene, cork and flexible, closed-cellular insulation.
3. Nylon anchors for securing insulation to ducts and equipment.
4. Factory premolded one (1) piece PVC fitting and valve covers.

1.7 QUALIFICATIONS

- A. Materials submitted shall be standard products of a manufacturer who has been engaged in the production of the products for not less than three (3) years.
- B. The installing sub-contractor shall have at least five (5) years of successful installation experience on projects with similar insulation products.

1.8 QUALITY ASSURANCE

- A. Insulation materials and accessories furnished and installed hereunder shall, where required, be accompanied by manufacturers' current submittal or data sheets showing compliance with applicable specifications listed in Section 1.4 above.
- B. Insulation materials and accessories shall be installed in a workmanlike manner by skilled and experienced workers who are regularly engaged in commercial insulation work.

1.9 SUBMITTALS

- A. Provide shop drawings in accordance with Section 230010 and the General Requirements which shall include all insulation, jackets, finishes, corner beads, etc. Shop drawings shall additionally describe each system or component to be insulated, insulation type and thickness, and method of installation.

1.10 DELIVERY AND STORAGE OF MATERIALS

- A. All of the insulation materials and accessories covered by this specification shall be delivered to the job site and stored in a safe, dry place with appropriate labels and/or other product identification.
- B. The contractor shall use whatever means are necessary to protect the insulation materials and accessories before, during, and after installation. No insulation material shall be installed that has become damaged in any way. The contractor shall also use all means necessary to protect work and materials installed by other trades.
- C. If any insulation material has become wet because of transit or job site exposure to moisture or water, the contractor shall not install such material, and shall remove it from the job site. An exception may be allowed in cases where the contractor is able to demonstrate that wet insulation when fully dried out (either before installation, or afterward following exposure to system operating temperatures) will provide installed performance that is equivalent in all respects to new, completely dry insulation. In such cases, consult the insulation manufacturer for technical assistance.

1.11 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230050 and Section 230010.

- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.12 SCHEDULING

- A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All insulating materials, including adhesives, jackets and coatings, to be used on the project must be delivered to the building in the manufacturer's unopened container and must bear the manufacturer, brand and description of material.
- B. After the necessary tests have been conducted to prove the water and air systems tight, all piping, ductwork and equipment to be insulated shall be thoroughly cleaned and then covered. Insulation materials shall be the product of Owens Corning, Knauf, Manville or Armstrong equal to the products specified herein.
- C. Molded pipe insulations shall be manufactured to meet ASTM C 585 and ASTM C 547.
- D. Light density glass fiber duct wrap shall be manufactured to meet the requirements of ASTM C 1290.
- E. Heavy density glass fiber duct board shall be manufactured to meet the requirements of ASTM C 612.

2.2 TYPES OF INSULATION:

- A. Refer to insulation type schedule on drawings.

2.3 ADHESIVES, SEALERS AND COATINGS

- A. Provide all adhesives, sealers, vapor barrier coatings etc., compatible with the material to which they are applied. They shall not corrode, soften or otherwise attack such material in either the wet or dry state and must be suitable for the service temperatures.
- B. Any cement, sealer or coating used shall be resistant to vermin and mold and shall be durable. It shall not discolor on aging; and where applied on the final surface of the insulation, it shall be light in color and be capable of being painted.
- C. Adhesives, coatings and compounds shall be equal to the following:
 1. Vapor barrier adhesive for sealing joints on pipe and duct insulation - Foster 85-75.
 2. Adhesive for installing duct insulation - Foster 85-20 and 81-91.
 3. Insulating cement - Owens Corning No. 110

2.4 FITTINGS AND VALVE COVERS

- A. Pipe fittings and valves shall be insulated with Owens Corning PVC premolded one (1) piece PVC insulated fitting cover and factory precut insulation. Fittings shall have edges of one (1) piece cover sealed with Owens Corning vapor barrier pressure sensitive tape.

2.5 METALLIC COMPONENTS

- A. Staples shall be outward clinching type of Type 304 or Type 316 stainless steel.
- B. Bands shall be galvanized steel, aluminum, brass, or nickel-copper alloy, of three-quarter inch (3/4") nominal width. The band thickness, exclusive of coating, shall be not less than five thousandths inch (0.005") for steel and nickel copper alloy, seven thousandths inch (0.007") for aluminum, and one hundredth inch (0.01") for brass.
- C. Wire shall be 14-gauge, nickel-copper alloy or copper clad steel, or 16-gauge, soft annealed, galvanized steel.
- D. Wire netting used for exposed surfaces of insulation that is to be cement finished shall be 22-gauge, one-inch (1") galvanized mesh, with continuous 26-gauge galvanized steel corner beads having two and one-half inch (2-1/2") wings.
- E. Protect external corners on insulation of ducts and equipment exposed in occupied spaces by corner beads two inches (2") by aluminum adhered to heavy duty Kraft paper.

2.6 INSULATION SCHEDULE:

- A. Refer to insulation schedule on drawings.
- B. Insulation thickness may be reduced on ducts with internal lining in an amount equal to the thickness of the lining. Refer to drawings for internal lining locations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL

- A. All insulation shall be installed by skilled workmen regularly engaged in this type of work.
- B. Insulation shall be continuous at all hangers, sleeves and openings. Vapor seals shall be provided for all cold surfaces and shall be continuous.
- C. Arrange to permit expansion and contraction without causing damage to insulation or surface.

- D. Actual insulation thickness must be at least equal to the minimum specified in the schedule. Where the manufacturers' rated or nominal thickness is less than the minimum specified, a thicker material or more layers will be requested so that the stated minimum thickness will be attained or exceeded.
- E. Install insulation materials in a first class manner with smooth and even surfaces. Scrap pieces of insulation shall not be used where a full length section will fit.
- F. Unless otherwise specified herein, the application of all insulation materials, accessories and finishes shall be in accordance with the manufacturer's published recommendations.
- G. Insulation materials shall not be applied until all surfaces to be covered are clean and dry; all foreign material, such as rust, scale, dirt, etc., has been removed; and, where specified, surfaces have been painted. Insulation shall be clean and dry when installed and during the application of any finish. The insulation on pipe fittings, valves and pipe joints shall not be installed before the piping is tested and approved.
- H. Omit insulation on the following unless directed otherwise:
 - 1. Traps and pressure reducing valves, relief piping from safety valves, and unions, flanges and expansion joints on hot water heating system.
 - 2. All fuel oil piping.
 - 3. Exposed ducts in air conditioned spaces.
- I. Replace and repair insulation disturbed by testing and balancing procedures.

3.4 DUCT INSULATION

- A. Provide accessories as required to prevent distortion and sagging of duct insulation. Provide welded pins, adhesive clips and wire ties as recommended by the manufacturer and directed by the Engineer.
- B. Insulation shall cover all standing seams and metal surface. Provide corner beading on all exposed ducts.
- C. Staples shall be sealed to maintain vapor barrier.
- D. Neatly cut insulation at dampers, temperature control sensors, and controllers. Butter exposed edges with approved mastic coating. Extend insulation to cover pipe return bends for air terminal unit reheat coils.
- E. Application - Type IV Insulation:
 - 1. Insulation shall be cut slightly longer than perimeter of duct to insure full thickness of corners. All insulation shall be applied with edges tightly fastened with staples. Tape the stitched seam with three inch (3") wide pressure sensitive tape. The insulation shall be additionally secured to the bottom of all square ducts eighteen inches (18") or wider by means of welded pins and speed clips. The protruding ends of the pins shall be cut off flush after the speed clips have been applied. The vapor barrier facing shall be thoroughly sealed where the pins have pierced through with a tape of the same material by applying a vapor barrier adhesive to both surfaces as recommended by the manufacturer.

2. All joints and penetrations of the vapor barrier shall be sealed with three inch (3") pressure sensitive tape. All cuts or tears shall be sealed with strips of the aluminum foil tape.

END OF SECTION 230700

SECTION 233300 - DUCTWORK AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections apply to this section.

1.2 SUMMARY

- A. This section includes the air distribution system including those devices distributing the air to the spaces, and those items which collect, filter, control, and convey air.
- B. Except for duct pressure tests, all testing and balancing of the air distribution system shall be performed under Section 230593 of the Specifications.

1.3 COMMISSIONING

- A. Division 23 will be responsible to carry out the commissioning requirements specified in Section 230010.

1.4 SUBMITTALS

- A. Submit shop drawings for all materials specified in this section in accordance with Section 230050.
 - 1. Include construction details, materials description, dimensions of individual components and finishes for the product.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories. Include mounting or attachment details.
 - 3. Include details of equipment assemblies. Indicate dimensions, weight, loads, required clearances, method of field assembly, components, and location and size of each filed connection.
 - 4. Include diagrams for power, signal, and control wiring.

PART 2 - PRODUCTS

2.1 AIR DEVICES

- A. Provide air devices of minimum sizes and quantities indicated and of the types specified. Contractor shall carefully study the drawings and the field conditions to ascertain the air device requirements as to suitability, location, air capacity, required accessories and finish. Devices shall be selected to provide draft-free air distribution over entire area served and sound rating shall not exceed scheduled NC level. Shop drawings shall indicate NC values.
- B. Provide Titus, Krueger, Nailor, Anemostat, or Price air devices in accordance with the enclosed schedule.
- C. Size of grilles and registers indicated on the drawings for installation in acoustical tile grid systems are nominal size. Devices shall be selected to fit standard ceiling tile space within the suspended grid.

- D. Margins and frames shall be as indicated or directed to suit field conditions. Devices shall have plaster frames when installed in plaster or drywall construction.
- E. Finishes shall be as specified herein. Devices installed in acoustical tile ceilings shall be white baked enamel finish.
- F. Finish (off-white) of T-bar diffusers shall match specified ceiling grid system. Perimeter T-bars adjacent to Type "A" diffusers shall be provided by the ceiling contractor. All center T-bars shall be supplied with air device.
- G. All devices located in toilet rooms, locker areas, and kitchens shall be of aluminum construction, unless otherwise specified herein.
- H. Paint ductwork behind grilles and registers with flat black enamel so that bright surface of metal cannot be seen. Properly prime galvanized surface prior to painting.
- I. For air devices furnished with internally lined plenums, provide 1 1/2 lb. density closed cell foam fiber free type.
- J. Provide air devices in accordance with the schedule shown on the contract drawings. Model numbers are those of Titus, unless otherwise indicated.

2.2 FIRE DAMPERS

- A. Fire dampers shall be Ruskin, Air Balance, National Controlled Air, Greenheck, Pottorff, United Enertech or approved equal U.L. labeled dynamic dampers. Damper shall match the wall, floor or ceiling rating in which it is installed, except no damper shall have less than 1-1/2 hour rating. Dampers shall be all welded construction and shall be fitted with integral galvanized sleeves. Dampers shall be Type "B" for low pressure rectangular ducts and Type "C" for circular or rectangular as required for medium pressure ducts. Dampers behind grilles and registers shall be Type "A".
- B. Fire damper assembly shall include fire damper and damper enclosure wall sleeve complete with duct attachment flanges, in accordance with all code requirements. Provide an access door (minimum 12" x 12") at each fire damper located so as to permit easy maintenance of damper and fusible link. Provide 165°F fusible link. All fire dampers shall be installed in accordance with NFPA requirements.
- C. Submit shop drawings indicating installation details, samples upon request, and manufacturer's installation drawings for approval to the Architect of all fire damper assemblies for low pressure and medium pressure duct systems. Dampers shall not be installed prior to receiving written approval of submitted samples.

2.3 COMBINATION FIRE SMOKE DAMPERS

- A. Combination fire smoke dampers shall be 1-1/2 hour rated under UL Standard 555, and shall further be classified by Underwriters Laboratories as a Leakage Rated Damper for use in smoke control systems under the latest version of UL555S, and bear a UL label attesting to same. The leakage rating under UL555S for medium pressure duct applications shall be no higher than leakage class I (4 cfm/SF at 1" w.g. and 8 cfm/SF at 4" w.g.). The leakage rating under UL555S for low pressure duct applications shall be no higher than leakage class II (10 cfm/SF at 1" w.g.). Elevated temperature rating shall be 250° F.
- B. Include on submittal data information for evaluation of damper flow characteristics, certified leakage rates and electrical load information (current at specified voltage).

- C. Damper frames shall be constructed of minimum 16 gage galvanized steel channel. Blades for medium pressure duct applications shall be airfoil shaped double skin construction. Blade edge seals shall be silicone rubber designed for smoke seal to 450 degree F. Jamb seal shall be flexible metal compression type. Bearings shall be stainless steel sleeves, pressed into frame. Damper materials shall be consistent with requirements of installed duct systems. Damper sleeve gage shall be in accordance with UL555 and NFPA 90A.
- D. Actuators shall be installed by the damper manufacturer at time of damper fabrication. Actuator shall be normally closed, 120 volt AC, two position type. Damper and actuator shall be supplied as a single entity which meets all applicable UL555 and UL555S qualifications for both dampers and actuators. Qualified actuators (supplied by damper manufacturer or ATC contractor) shipped loose for field mounting, must bear a U.L. label affixed by the damper manufacturer.
- E. Provide damper test switch and two position blade indicator switch. Provide factory mounted end switch Ruskin Model SP-100 for all dampers.
- F. Combination fire smoke dampers shall be equipped with a fusible link which shall melt at 165° degree F causing damper to close and lock in a closed position.
- G. Combination fire smoke dampers for medium pressure duct applications shall be Ruskin Model FSD-60 or approved equal by Greenheck, Air Balance, NCA, Pottorff or United Enertech. Combination fire smoke dampers for low pressure duct applications shall be Ruskin Model FSD-36 or approved equal.

2.4 SMOKE DAMPERS

- A. Smoke dampers shall be classified by Underwriters Laboratories as a Leakage Rated Damper for use in smoke control systems under the latest version of UL555S, and bear a UL label attesting to same. The leakage rating under UL555S for medium pressure duct applications shall be no higher than leakage class I (4 cfm/SF at 1" w.g. and 8 cfm/SF at 4" w.g. The leakage rating under UL555S for low pressure duct applications shall be no higher than leakage class II (10 cfm/SF at 1" w.g.). Elevated temperature rating shall be 250°F.
- B. Include on submittal data information for evaluation of damper flow characteristics, certified leakage rates and electrical load information (current at specified voltage).
- C. Damper frames shall be constructed of minimum 16 gage galvanized steel channel. Blades for medium pressure duct applications shall be airfoil shaped double skin construction. Blade edge seals shall be silicone rubber designed for smoke seal to 450 degree F. Jamb seal shall be flexible metal compression type. Bearings shall be stainless steel sleeves, pressed into frame. Damper materials shall be consistent with requirements of installed duct systems. Damper sleeve gage shall be in accordance with UL555 and NFPA 90A.
- D. Actuators shall be installed by the damper manufacturer at time of damper fabrication. Actuator shall be normally closed, 120 volt AC, two position type. Damper and actuator shall be supplied as a single entity which meets all applicable UL555 and UL555S qualifications for both dampers and actuators. Qualified actuators (supplied by damper manufacturer or ATC contractor) shipped loose for field mounting, must bear a U.L. label affixed by the damper manufacturer.
- E. Provide damper test switch and two position blade indicator switch. Provide factory mounted end switch Ruskin Model SP-100 for all dampers.
- F. Smoke dampers for medium pressure duct applications shall be Ruskin Model SD-60 or approved equal by Greenheck, Air Balance, NCA, Pottorff or United Enertech. Smoke dampers for low pressure duct applications shall be Ruskin Model SD-36 or approved equal.

2.5 DUCT LINING

- A. Duct lining shall be provided as indicated for return ductwork, and elsewhere as indicated on the drawings and as herein specified. Duct lining shall be Armacell, AP Armaflex SA duct liner, or approved equal 1" thickness for low pressure systems, or as noted on plans.
- B. Adhere liner, with mat side toward air stream, to all interior sides of duct with 100% coverage. Where duct width exceeds 12" or height exceeds 16", further secure the liner to these surfaces with welding pin type mechanical fastener as shown in the SMACNA Duct Manual.
- C. Provide leading edge protection as indicated in SMACNA Duct Manual at beginning of each section of lined duct. Take every precaution to protect surface of liner as damaged liner will be rejected. Submit samples for approval of liner for each of the following: low and medium pressure installations and leading edge protection for each pressure classification. Liner installed without approval of samples and shop drawings shall be subject to removal as directed by the Architect and replacement shall be at no cost to the Owner.
- D. Duct sizes indicated on the drawings are air side sizes. Increase sheet metal sizes accordingly to compensate for thickness of lining.

2.6 DUCTWORK

A. General

- 1. The Duct Manual as herein referenced shall mean the SMACNA manual as published by the Sheet Metal and Air Conditioning Contractors National Association, Inc.
- 2. Unless noted otherwise, ductwork shall be constructed of prime, first quality galvanized steel of gauges as called for in the Duct Manual. Reinforce all ducts to prevent buckling, breathing, vibrations, or unnecessary noise. Such reinforcing shall be as recommended in Duct Manual, plus any additional reinforcing as required to meet job conditions. Longitudinal and cross joints, elbows, transitions, etc, shall be furnished as specified in Duct Manual, including recommended duct supports to suit job conditions.
- 3. All uninsulated rectangular ductwork shall be crossbroken on all four sides of each panel section. All vertical and horizontal sheet metal barriers, duct offsets and elbows, as well as the panels of straight sections of ducts, shall be crossbroken. Crossbreaking shall be applied between the standing seams or reinforcing angles. The center of the crossbreak shall be of the required height to assure each panel section being rigid, to prevent vibrations and "breathing."
- 4. Prior to fabrication of any ductwork, Contractor shall submit to the Architect for approval shop drawings and data for each duct system which shall describe for each duct, the size, gauge, material, joint type, seam type, and reinforcement to be provided. All construction shall be in accordance with the requirements hereinafter specified. No ductwork shall be fabricated or installed until the details of construction are submitted and approved. Ductwork installed at variance to these conditions shall be subject to removal and replacement at no cost to the Owner.
- 5. Provide 22 gauge galvanized sleeve around ducts passing through drywall construction.
- 6. Provide 22 gauge aluminum flanged trim collar and sleeve around exposed ducts through walls, floor or ceilings in finished areas to provide finished appearance.

B. Low Pressure Ductwork-Less Than 2" Pressure Class

- 1. Ductwork shall conform with requirements and details, unless specified or indicated otherwise in the Duct Manual, "HVAC Duct Construction Standards, Metal and Flexible," 2005 with all addenda. A copy of the Duct Manual shall be secured by the Contractor and shall be kept at the project for convenient reference.

2. Flexible duct connections at air handling unit connections, where indicated or required to eliminate duct vibration shall be "Ventglass" duct fabric as manufactured by Ventfabrics, Inc., or approved equal.
3. Except as noted herein under "Medium Pressure Ductwork," all ductwork including supply air, outside air, return air, and exhaust air provided on the project shall be low pressure construction. Rectangular low pressure ductwork construction shall conform to the following SMACNA Standards:
 1. Material gauges Refer to the "Duct Construction Schedule" on the drawings.
 2. Longitudinal Seams Fig. 2-2, Types L-1, L-2 & L-4
 3. Corner Closures Fig. 2-14, 2-15, 2-17 & 2-18
 4. Hangers Fig. 5-1, 5-2, & 5-5 & Tables 5-1 & 5-2
 5. Rectangular Elbows Fig. 4-2, Types RE-1 & RE-2
 6. Vaned Elbows (Applies to RE-2 type) Fig. 4-3 & 4-4, Runner Type 1 to have a vane at each tab
 7. Offsets & Transitions Fig. 4-7
 8. Branch Connections Fig. 4-6, 45° or conical only
 9. Volume dampers (up to and including 12" deep) Fig. 7-4, Figs. A&B w/locking quadrant
 10. Volume dampers (over 12" deep) Fig. 7-5 w/locking quadrant
 11. Access doors Minimum 12"x12" unless otherwise noted. Provide Ventlock w/#140 latch, insulated or approved equal
4. Duct sizes indicated on the drawings are air side sizes. Where duct lining is indicated, increase sheet metal sizes accordingly to compensate for thickness of lining. Duct lining shall conform to paragraph 2.5 of this section.
5. Seal all traverse joints and fittings in all low pressure supply, return, and exhaust ductwork and reheat coil connections to supply air terminal units with United Duct Sealer. At contractor's option, mineral impregnated woven fiber tape as manufactured by Hardcast, Inc. shall be considered equal.
6. Provide Elgen Model E115, E116, or E117 low leakage or approved equal quadrant on all volume dampers.
7. Provide stand-offs, on volume dampers installed in all insulated ductwork. Depths of stand-offs shall exceed thickness of specified insulation to provide sufficient operating clearances.
8. Flexible ductwork shall be Hart & Cooley Type F-116 or approved equal. Flexible duct shall comply with NFPA Bulletin 90A and shall be U.L. listed as Class 1 Air Duct & Connector, Standard 181. Flexible duct shall be approved and suitable for installation in ceiling return air plenums.
9. Provide Conical Fittings with integral volume damper, at flexible duct connections to sheet metal duct. Seal all fittings to sheet metal duct with United Duct Sealer.

10. Support all ducts in accordance with Duct Manual, Tables 5-1 & 5-2 and as hereinbefore specified and as indicated and noted on the drawings.

C. Medium and High Pressure Ductwork-Greater Than 2" Pressure Class

1. Medium and high pressure ductwork shall be rated as indicated on the "Duct Construction Schedule" on the drawings.
2. Medium and high pressure ductwork shall consist of rectangular, and circular types as indicated on the drawings. At contractor's option, rectangular ductwork may be substituted for circular type. Equivalent circular sizes to rectangular sizes shall be maintained. Submit rectangular duct sizes for approval.
3. Ductwork, other than medium or high pressure type specified herein, including supply, return, relief, outdoor air, and exhaust shall be low pressure ductwork.
4. All medium and high pressure duct systems shall be leak tested in strict conformance with SMACNA standards. Tests shall be witnessed by the balance subcontractor as hereinafter specified.
5. Rectangular medium or high pressure ductwork, unless otherwise specified herein, shall conform with the requirements and details contained in the Duct Manual, "HVAC Duct Construction Standards, Metal and Flexible," 2005 with all addenda hereinafter referred to as "Duct Manual." A copy of the Duct Manual shall be secured by the Contractor and shall be kept at the project for convenient reference. Construction shall conform to the following:

- | | | |
|-----|-------------------------|---|
| 1. | Reinforcement & Gauges | Refer to the "Duct Construction Schedule" on the drawings. |
| 2. | Traverse Joints | Table 2-32, Figs. T-22, 2-2, T-24 & T-24a |
| 3. | Longitudinal Joints | Figs. #2-2, L-1 and L-3 |
| 4. | Vaness and Vane Runners | Fig. #4-3 & 4-4 Runner Type-1 to have a vane at each tab |
| 5. | Branch Connections | Fig. #4-6 45° only |
| 6. | Offsets & Transitions | Fig. #4-7 |
| 7. | Supporting Systems | Fig. #5-5 Trapeze type only, Tables 5-1 & 5-2 |
| 8. | Riser Supports | Fig. #5-8 Fig B |
| 9. | Volume Dampers | Ruskin CD-60 Airfoil |
| 10. | Duct Sealants | See Pages 1-11 through 1-13. Use 3M EC-750 or approved equal, on seams & joints |
| 11. | Access Doors | Ruskin or approved equal minimum 12" x 12", with cam lock latches, insulated |
| 12. | Welded galvanized | Coated with minimum two coats of |

corrosion resistant aluminum paint

D. Circular Medium Pressure Ductwork:

1. Circular medium pressure ductwork shall be manufactured by McGill AirFlow, Semco, Lindab Safe, Sheet Metal Connectors, Inc., TNT Manufacturing, Inc., MKT Metals, or Eastern Sheet Metal and shall consist of spiral pipe and welded fittings that shall be factory painted. Circular duct shall have locked seams so made as to eliminate any leakage under the pressures for which the system has been designed. Longitudinal seam duct shall have fusion welded butt seam. All welded seams shall be factory painted. Circular duct shall be manufactured of galvanized steel meeting ASTM A-527-80 by the spiral lockseam method and in the minimum gauges listed:

a. For systems operating at 2.0" W.G. or less positive pressure the minimum gauges shall be as follows:

<u>Diameter Seam</u>	<u>Spiral Seam</u>	<u>Longitudinal</u>
- 8"	28	26
- 14"	28	26
- 26"	26	24
- 36"	24	22
- 50"	22	20
- 60"	20	18
- 84"	N.A.	16

b. For systems operating at up to 10.0" W.G. or less positive pressure the minimum gauges shall be as follows:

<u>Diameter Seam</u>	<u>Spiral Seam</u>	<u>Longitudinal</u>
- 8"	26	24
- 14"	26	24
- 26"	24	22
- 36"	22	20
- 50"	20	20
- 60"	18	18
- 84"	N.A.	16

c. For systems operating between 0.0" and 2.0" W.G. negative the minimum gauges shall be as follows:

<u>Diameter Seam</u>	<u>Spiral Seam</u>	<u>Longitudinal</u>
- 8"	28	24
- 14"	26	24
- 26"	24	22
- 36"	22	20
- 50"	20	18
- 60"	18	16
- 84"	N.A.	14

2. All fittings are to have continuous welds along all seams. All welded seams shall be factory painted. All divided flow fittings are to be manufactured as separate fittings, not as tap collars welded into spiral duct sections. Fittings and couplings shall be of the following minimum gauges:

<u>Diameter</u>	<u>Minimum Gauge</u>
Through 14"	24
Through 26"	22
Through 50"	20
Through 60"	18
Through 84"	16

3. All 90 degree tees and 45 degree laterals, either full size or reducing shall be conical pattern produced by machine or press forming. The entrance shall be free of weld build-up, burrs, or irregularities. Provide tangential tees where indicated and as required to suit the installation.
4. Elbow diameters 3" through 8" shall be two section die-stamped elbows. All other elbows shall be gored construction with all seams continuous-welded and painted. Elbows shall be fabricated in a centerline radius of 1.5 times the cross section diameter. All elbows not die-stamped shall be fabricated according to the following schedule:

<u>Elbow Angle</u>	<u>No. of Gores</u>
Less than 30°	2
30° through 60°	3
Over 60°	5

5. The reduction of divided flow fittings shall be conical spun section in the thirty-six reductions in sizes 4" through 22".
6. Offset fitting shall be constructed so that length is not less than 2 duct diameters.
7. Galvanized areas that have been damaged by welding shall be coated with corrosion resistant aluminum paint, minimum 2 coats.
8. Supports, sealants and testing shall conform with applicable portions of the Duct Manual and as hereinbefore specified.
9. Flexible ductwork in medium pressure duct systems shall be Hart & Cooley Genflex Type SLR-25VM or approved equal.
10. Dampers in circular M.P. duct systems shall be Ruskin Model CDR 92 or approved equal with locking type quadrant.
11. Seal all transverse joints, longitudinal seams and duct wall penetrations in medium and high pressure ductwork in accordance with duct sealing requirements of the "Duct Construction Manual".

PART 3 - EXECUTION

3.1 AIR DEVICES

- A. Install air devices in accordance with the manufacturer's latest published installation instructions to insure against incorrect air pattern, drafts, and dirt smudging.

- B. Construct, and install sheet metal duct or plenum connections to air devices in accordance with manufacturer's recommendations.
- C. Make modifications of duct systems required to accommodate actual sizes of air devices furnished, e.g. transformations and collar sizes, without additional cost.

Coordinate installation of air devices with architectural reflected ceiling plan. Unless otherwise indicated on the RCP install air devices in the center of ceiling tiles.

3.2 FIRE DAMPERS, SMOKE DAMPERS, AND COMBINATION FIRE/SMOKE DAMPERS

- A. All fire dampers, smoke dampers, and combination fire/smoke dampers shall be tested upon installation, and at a period of one year after project completion. Contractor shall inspect, test and provide a written report documenting the testing procedure prior to the expiration date of the one year warranty. Any dampers failing inspection shall be repaired/replaced at no additional cost to the owner.
- B. The dampers shall be tested in accordance with NFPA 80 and 105, and Joint Commission Standard EC.02.03.05 EP18. Per NFPA 80, dampers shall be tested and operation documented after installation. Each damper must be numbered and tested. The installing or testing contractor shall request a test sheet with available device numbers from the Facilities Department. Each electrical or pneumatic device shall be operated through the fire alarm system and closure verified. The printed report from the fire alarm system shall be provided to indicate the operation of the initiating device. Each gravity fire alarm system shall be provided to indicate the operation of the initiating device. Each gravity fire link shall be released and damper closure verified. The device shall be logged on the test sheet with the initials of the tester, type of device, location, and date of test. All testing shall be in the presence of a witness from the Facilities Department.

3.3 DUCTWORK

- A. Install hangers, supports, and their attachments, generally, in conformance with SMACNA standards referred to in this section of the specifications.
- B. Furnish hangers capable of withstanding 5 times the weight of the load imposed on them without Damage to duct or any adjacent construction.
- C. Neatly erect ducts and plenums of sizes and arrangements shown and detailed and as required to carry out intent of specifications and drawings. Work must meet approval of the Architect in all its parts and details.
- D. Sizes shown are air side sizes. Where ducts are indicated as lined, dimensions shall be increased to reflect the thickness of the lining.
- E. Install ductwork in such a manner as to meet recommendations of NFPA Standard 90A.
- F. Contractor shall review and coordinate the installation of the ductwork. No ductwork shall be fabricated prior to the contractor obtaining exact field dimensions of the building structure, including new and existing ceiling space conditions, architectural, mechanical, electrical, and structural obstructions, etc, which may affect the installation of the air distribution system. Notify the Architect immediately upon any discrepancies.
- G. Because of the small scale of the drawings, it is not possible to indicate all duct offsets, rises, drops, fittings and accessories which may be required. Carefully investigate in the field the architectural, mechanical, electrical, and structural conditions affecting the work, and arrange

such work accordingly, providing such fittings, and accessories as may be required to meet such conditions.

- H. Provide each air outlet with a collar adequately stiffened, fastened, and made suitable for securing air device thereto. Make field changes in ductwork, such as those required to accommodate the sizes of factory fabricated equipment actually furnished, i.e., VAV terminal units, coils, fans, filter housings, and similar items, without additional cost. Provide duct flanges to match those of connecting factory fabricated equipment. When necessary, relocate and modify ductwork to avoid obstructions such as structural members, piping and conduit, in a manner acceptable to the Architect.
- I. Construct and install all ductwork in accordance with the SMACNA Standard specified.
- J. Leak Testing of Ductwork:
 - 1. Low Pressure System: Test all low pressure ductwork (pressure class less than 2" w.g.), scheduled for Seal Class A or B. Leakage testing shall be performed on 100% of the installed ductwork except for downstream of terminal units. **Random testing of low pressure ductwork, downstream of all terminal units shall be required if duct sealing appears inadequate.** Testing methodology shall be in accordance with SMACNA's "HVAC Air Duct Leakage Test Manual". Refer to the duct construction schedule on the drawings for additional information.

Allowable Leakage shall be determined by the following formula:

$$F = C_L \times P^{0.65}$$

- F = Leakage (CFM/100 ft² of duct surface)
- C_L = 12 (rectangular ductwork)
- C_L = 6 (round ductwork)
- C_L = 4 (all ductwork located outdoors)
- P = Duct Leakage Test Pressure (in. w.g.)

Keep ducts free of audible leaks which are detectable in all finished spaces. Notify testing and balancing contractor who shall witness tests, at least 48 hours in advance of tests.

- 2. Medium Pressure System: Test all ductwork with a pressure class of 2" w.g. or greater. Leakage testing shall be performed on 100% of the installed ductwork. Testing methodology shall be in accordance with SMACNA's "HVAC Air Duct Leakage Test Manual." Refer to the duct construction schedule on the drawings for additional information.

Allowable Leakage shall be determined by the following formula:

$$F = C_L \times P^{0.65}$$

- F = Leakage (CFM/100 ft² of duct surface)
- C_L = 12 (rectangular ductwork)
- C_L = 6 (round ductwork)
- C_L = 4 (all ductwork located outdoors)
- P = Duct Leakage Test Pressure (in. w.g.)

Keep ducts free of audible leaks which are detectable in all finished spaces. Notify testing and balancing contractor who shall witness tests, at least 48 hours in advance of tests.

K. Cleaning:

1. Clean the inside of ductwork and casing of debris, dirt, and other foreign matter before any system's fans and filters are operated for any reason. After the equipment has been used temporarily for any purpose, i.e., adjusting, testing and ventilating, clean or renew (depending on type) filter media and clean ducts down stream from the filters which have handled unfiltered air. Additionally, clean exhaust and return ducts, which in the opinion of the Architect, have been handling excessive dirty air prior to acceptance of the system.
2. Keep main duct risers capped with plastic or poly after duct testing to help maintain clean risers. Provide roll filter media at each open end duct to help maintain clean risers until project balancing begins.

END OF SECTION 233300

SECTION 233600 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes specifications for the following equipment:

- 1. Air Terminal Units

1.3 COMMISSIONING

- A. Division 23 will be responsible to carry out the commissioning requirements specified in Section 230010.

1.4 SUBMITTALS

- A. Submit shop drawings for all materials specified in this section in accordance with section 230050.
 - 1. Include construction details, material descriptions, dimensions of individual components and finishes for the product.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, methods of field assembly, components, and location and size of each field connection.
 - 4. Include diagrams of power, signal and control wiring.
 - 5. Operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 VARIABLE AIR VOLUME CONTROL UNITS

- A. Provide low pressure variable air volume control units as indicated on the plans.
- B. Type "VSD" Unit (Digital)
 - 1. Units shall be Titus, Enviro Tec, Krueger, Nailor, or Price, equal to Titus Model DESV, suitable for single duct variable air volume installation. Capacities shall be as scheduled on the drawings.
 - 2. The unit casing shall be minimum 22 gauge galvanized steel with a steel bladed damper. All seams shall be factory sealed to prevent leakage.
 - 3. The terminals shall have an approved non-porous EPFI sealed liner. The liner and insulation must meet the requirements of U.L. 181 and NFPA 90A. The liner must meet bacteriological standards of ASTM C665. Liners made of Tedlar, Mylar, Silane or Alpha-Temp are not acceptable. Insulation shall be 1.5 pound density, 3/8 inch thick with a thermal conductivity of 0.25 BTU-in/hr-ft². The lining shall be the Titus EPFI sealed Fibre Free lining system or approved equal.

4. The unit inlet shall be equipped with a cross-shaped flow sensor with amplifying pick-up points connected to central averaging chambers. The sensor shall maintain control accuracy with the inlet duct in any configuration. All pneumatic tubing shall be UL listed, fire retardant (FR) type.
5. Sound ratings shall be tested as power levels to 10-12 watts and shall not exceed values scheduled. The manufacturer shall furnish certified sound power levels for both discharge sound and casing radiated sound, tested in accordance with ASHRAE Standard 37-72. Sound data based on prior ASHRAE Standards will not be acceptable. The tests shall be conducted in an ARI-ADC approved sound facility. The data shall include the second through sixth octave bands for all unit sizes with multiple inlet static pressures. All attenuation factors shall be clearly defined. Provide additional approved attenuation as required to achieve the scheduled values. Sound power levels shall be submitted for each unit at its scheduled maximum air volume and inlet pressure of 1" w.g.
6. The direct digital controls (DDC) shall be provided by the automatic temperature control contractor. Controller shall be shipped to terminal unit manufacturer for factory mounting. The terminal unit manufacturer shall mount the electronic damper actuator and velocity flow sensor. The damper actuator shall apply at least 40 in-lbs of torque to the damper shaft. Electronic actuators shall be provided by the automatic temperature control contractor.
7. Electric Heating Coils (SCR)
 - a. Proportional, modulating electric coils shall be supplied and installed on the terminal by the terminal manufacturer. Coils shall be ETL listed. Coils shall be housed in an attenuator section integral with the terminal with element grid recessed from unit discharge a minimum of 5 inches to prevent damage to elements during shipping and installation. Elements shall be 80/20 nickel chrome, supported by ceramic isolators a maximum of 3½ inches apart, staggered for maximum thermal transfer and element life, and balanced to ensure equal output per step. The integral control panel shall be housed in a NEMA 1 enclosure with hinged access door for access to all controls and safety devices.
 - b. Electric coils shall contain a primary automatic reset thermal cutout, a secondary manual reset thermal cutout, proportional electronic airflow sensor for proof of flow, and line terminal block. The proportional electronic airflow sensor shall be totally independent of the duct static pressure and shall adjust the heater capacity according to the available airflow. The heaters shall deliver maximum heating when needed with normal minimum airflow, reduce heating with lower than minimum airflow and stop heating with no airflow. Unit shall include an integral door interlock type disconnect switch, which will not allow the access door to be opened while power is on. Non-interlocking type disconnects are not acceptable. All individual components shall be UL listed or recognized.
 - c. Heaters shall be equipped with a proportional SCR controller to modulate the heater load according to the temperature control signal. The electronic controller shall be compatible with the following input signals:
 - 1) Variable voltage signal 0-10VDC
 - 2) Pulse width modulation AC or DC
 - d. A downstream air temperature limit and control shall be automatically invoked by adding a downstream air temperature sensor. When invoked, the downstream air from the heater shall not exceed an adjustable maximum temperature set point. When the ATC's call for heat is less than 100%, the heater shall control the downstream air temperature to a point in proportion to the span between the heater's probable entering air temperature and the maximum air temperature set point.
8. Device shall be provided with a 120V to 24VAC Class 2 transformer and NEMA-1 disconnect factory mounted in NEMA-1 steel enclosure and shall be certified to UL873 Temperature and Regulating Equipment.

2.2 FAN POWERED VARIABLE AIR VOLUME CONTROL UNITS

- A. Provide low pressure fan powered units as indicated on the plans.
- B. Type "SFPTS" unit (Series)
 - 1. Units shall be Titus, Enviro Tec, Krueger, Nailor, or Price equal to Titus model DTFS-F (Quiet Performance), series flow fan powered terminal unit. Capacities shall be as scheduled on the drawings. The entire terminal shall be constructed as a single unit containing the primary air damper, fan, motor assembly, gasketed backdraft damper and all associated specified controls. Space limitations shall be reviewed carefully to ensure that all terminals will fit the available space.
 - 2. Terminals should be certified under the ARI Standard 880 Certification Program and carry the ARI Seal. Non-certified terminals may be submitted after testing at an independent testing laboratory under conditions selected by the engineer in full compliance with ARI Standard 880. These tests must be witnessed by the engineering consultant with all costs to be borne by the terminal manufacturer. Testing does not ensure acceptance.
 - 3. The terminal shall be designed, built, and tested as a single unit including motor and fan assembly, primary air damper assembly, water or electric heating coils, and accessories as shipped. Unit shall ship as a complete assembly requiring no field assembly (including accessories). All electrical components shall be UL listed and installed in accordance with the UL Standard 1995. Electrical connection shall be single point. All electrical components, including low voltage controls, shall be mounted in sheet metal control enclosures. The entire terminal shall be ETL listed as a complete assembly.
 - 4. The terminal casing shall be minimum 20-gauge galvanized steel, internally lined with engineered polymer foam insulation, which complies to UL181 and NFPA 90A. Insulation shall be 1½ pound density, closed cell foam. Exposed fiberglass is not acceptable. The insulation shall be mechanically fastened to the unit casing. The casing shall be designed for hanging by sheet metal brackets.
 - 5. The terminal casing shall have top and bottom access panels, which allows removal of fan assembly and servicing of terminal without disturbing duct connections.
 - 6. Fan motor assembly shall be forward curved centrifugal fan with a direct drive motor. Motors shall be General Electric ECM variable-speed dc brushless motors specifically designed for use with single phase, 277 volt, 60 hertz electrical input. Motor shall be complete and operated by a single phase integrated controller/inverter that operates the wound stator and senses rotor position to electronically commutate the stator. All motors shall be designed for synchronous rotation. Rotor shall be permanent magnet type with near zero rotor losses. Motor shall have built-in soft start and soft speed change ramps. Motor shall be able to be mounted with shaft in horizontal or vertical orientation. Motor shall be permanently lubricated with ball bearings. Motor shall be directly coupled to the blower. Motor shall maintain a minimum of 70 percent efficiency over its entire operating range. Provide a motor that is designed to overcome reverse rotation and not affect life expectancy.
 - 7. The terminal unit manufacturer shall provide a factory installed PWM controller for either manual or DDC controlled fan cfm adjustment. The manual PWM controller shall be field adjustable with a standard screwdriver. The remote PWM controller shall be capable of receiving a 0-10 Vdc signal from the DDC controller (provided by the controls contractor) to control the fan cfm. When the manual PWM controller is used, the factory shall preset the fan cfm as shown on the schedule.
 - 8. The primary air damper assembly shall be heavy gauge steel with shaft rotating in Delrin self-lubricating bearings. Nylon bearings are not acceptable. Shaft shall be clearly marked on the end to indicate damper position. Stickers or other removable markings are not acceptable. The damper shall incorporate a mechanical stop to prevent overstroking,

and a synthetic seal to limit close-off leakage to the maximum values shown in the following table. Provide an AeroCross™ four point, center-averaging differential pressure airflow sensor. A sensor that delivers the differential pressure signal from one end of the sensor is not acceptable. Balancing taps and airflow calibration charts shall be provided for field airflow measurements.

9. Sound ratings for the terminals shall not exceed scheduled NC at schedule inlet static pressure and discharge static pressure. Sound performance shall be ARI certified. The radiated and discharge path attenuation function for the specified NC shall be based upon factors found in ARI Standard 885-98 and in the following tables. No additional attenuation factors shall be deducted from the sound power.
10. Electric Heating Coils (SCR)
 - a. Proportional electric coils shall be supplied and installed on the terminal by the terminal manufacturer. Coils shall be ETL listed. Coils shall be housed in an attenuator section integral with the terminal with element grid recessed from unit discharge a minimum of 5 inches to prevent damage to elements during shipping and installation. Elements shall be 80/20 nickel chrome, supported by ceramic isolators a maximum of 3½ inches apart, staggered for maximum thermal transfer and element life, and balanced to ensure equal output per step. The integral control panel shall be housed in a NEMA 1 enclosure with hinged access door for access to all controls and safety devices.
 - b. Electric coils shall contain a primary automatic reset thermal cutout, a secondary replaceable heat limiter per element, differential pressure airflow switch for proof of flow, and line terminal block. Coil shall include an integral door interlock type disconnect switch, which will not allow the access door to be opened while power is on. Non-interlocking type disconnects are not acceptable. All individual components shall be UL listed or recognized.
 - c. Heaters shall be equipped with an integral controller to control heater coil firing. The control panel shall include an interface to control heater coil firing in proportion to the ATC signal. The ATC signal shall connect to low voltage universal signal interface circuitry supplied and installed by the terminal manufacturer. The universal interface shall allow at least the following seven interface options without additional interface circuitry. ATC equipment providers with 0-20mA or 4-20mA signals shall supply and install a suitable dropping resistor to convert the current signal to a 0-10VDC signal or 2-10VDC signals:
 - 1) PWM heat
 - 2) 2 stage heat
 - 3) 0-10V / 0-20mA
 - 4) 2-10V /4-20mA
 - 5) Incremental T-stat
 - 6) Binary
 - 7) 3 point floating
 - d. A downstream air temperature limit and control shall be automatically invoked by adding a downstream air temperature sensor. When invoked, the downstream air from the heater shall not exceed an adjustable maximum temperature set point. When the ATC's call for heat is less than 100%, the heater shall control the downstream air temperature to a point in proportion to the span between the heater's probable entering air temperature and the maximum air temperature set point.

PART 3 - EXECUTION

3.1 INSTALLATION

A. VAV Terminal Units

1. Install terminal units in accordance with details shown on the drawings. Provide all necessary supports as indicated and required. Locate units to provide full accessibility to all damper operators, controllers and accessories.

3.2 START-UP/COMMISSIONING

- A. Start-up shall include verifying proper installation, testing all valves & set points
- B. TAB (Test and Balance) contractor shall be responsible for final verification of airflow measurement.

END OF SECTION 233600

SECTION 260010 – ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1. Related Documents:

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

1.2. Scope:

- A. This section describes the general provisions for the electrical work included in Division 16. This section applies to all sections of Division 16.

1.3. Responsibility:

- A. The General Contractor shall be responsible for all work included in the Electrical Division and the delegation of work to Subcontractors shall not relieve him of this responsibility. Subcontractors who perform work under these sections shall be responsible to the General Contractor. The term "Contractor" is used throughout this Division and shall mean the General Contractor, although the actual performance of the work may be by a Subcontractor.

1.4. References and Definitions:

- A. Following are definitions of terms and expressions used in Electrical Sections:

Owner:	UPMC Western Maryland
Architects:	Lakeside Architecture Inc.
Engineers:	WSP USA Inc. (Formerly Leach Wallace Associates, Inc.)
Provide -	"Furnish and install"
Directed -	"directed by the Architect"
Indicated -	"indicated in the Contract Documents"
Concealed -	"hidden from normal sight"; includes items in shafts, pipe and duct spaces, and above ceilings
Exposed -	"not concealed"; Work within Equipment Rooms and all visible (normal sight) work shall be considered "exposed"

1.5. Standard Specifications:

- A. See General Requirements of the contract.
- B. References to catalogs, standards, codes, specifications, and regulations are latest edition in effect at date of invitation to bid.

1.6. Codes, Regulations and Permits:

- A. Give all necessary notices and obtain all required permits. Pay all fees and other costs, including utility connections or extensions in connection with the work. File all necessary plans, prepare all documents and obtain all necessary approvals of all governmental agencies having jurisdiction. Obtain all required certifications of inspection and deliver same to the Architect before request for acceptance and final

payment for the work.

- B. All materials furnished and all work installed shall comply with the latest issue of the codes, rules, regulations, and recommendations of the following bodies, unless otherwise noted:

ALLEGANY COUNTY

American National Standards Institute (ANSI)

American Society of Testing and Materials (ASTM)

International Building Code (IBC)

Illuminating Engineering Society (IES)

Insulating Cable Engineer Association (ICEA)

Institute of Electrical and Electronic Engineers (IEEE)

National Electrical Code (NEC)

National Electrical Manufacturers Association (NEMA)

National Fire Protection Association (NFPA)

Occupational Safety and Health Agency (OSHA)

Maryland Occupational Safety and Health (MOSH)

Underwriters Laboratories, Inc. (UL)

Allegheny Power

Verizon

Fire Prevention Bureaus of Allegany County and the State of Maryland

- C. The electrical installation shall be inspected and approved by the inspection department of the governmental agency having jurisdiction, and certificates documenting approval shall be furnished to the Architect before requests for final payment. The Contractor shall allow inspections at any time and shall not impede or interfere with inspections.

1.7. Materials List and Shop Drawings:

- A. See General Requirements.
- B. Within 15 working days after award of the contract, the Contractor shall submit to the Architect for approval a list of manufacturers' names of all material and equipment he proposes to provide. In the event any item of material or equipment contained in the list fails to comply with the specification requirements, such item will be rejected. If, prior to the expiration of the fifteen (15) day period of any duly authorized extension thereof, the Contractor fails to submit a schedule of acceptable material or equipment covering the items, the Architect will select the items and such selection shall be final and binding upon the Contractor as a condition of the contract. Rejected items shall be resubmitted within 15 days of receipt of notice of rejection. The Architect will select materials and equipment not submitted in such time.

- C. After receiving approval of equipment manufacturers and prior to delivery of any material to job site, submit for approval copies of detailed dimensioned shop drawings, together and descriptive specifications and engineering data sheets and catalog cuts showing construction size, arrangement, operating clearances, performance characteristics and capacity of all electrical materials, equipment and systems. Each item of equipment proposed shall be a standard catalog product of the approved manufacturer.
- D. Shop drawings, specifications, catalogs, etc., submitted for approval shall be properly labeled indicating specific service for which material or equipment is to be used, section and article number of specifications governing, and Contractor's name, name of job, and date.
- E. Shop drawings, catalogs, pamphlets or other documents submitted to describe items on which approval is being requested shall contain detailed and specific information which will demonstrate fully that the material, equipment, or system will conform to the contract documents. Each shop drawing, catalog pamphlet, etc. shall be clearly marked in ink to identify the item submitted. Data of a general nature will not be accepted. Any deviations or exceptions taken in the specification by the Contractor shall be noted.
- F. If material or equipment is installed prior to receipt by the Contractor of pertinent shop drawings marked "No Exceptions Taken" or "Comments Noted," the Contractor shall be liable for its removal and replacement at no extra charge to the Owner.
- G. The acceptance of shop drawings shall not relieve the Contractor from his responsibility to furnish material, equipment, and systems and to perform work required by the contract documents. Neither the Owner nor the Architect will be responsible for errors or omissions on shop drawings furnished by the Contractor even though such shop drawings containing errors or omissions are inadvertently accepted.
- H. The Contractor is further advised that the Architect will not act as coordinator between suppliers and subcontractors. All required coordination shall be the responsibility of the Contractor. Refer to other sections of these specifications for additional detailed requirements for wiring diagrams, schematic diagrams, interconnection diagrams and similar shop drawings for systems and equipment such as:

- Fire Detection and Alarm Systems

1.8. Contractor's Use of CAD Files:

- A. At the Contractor's written request, copies of the Engineer's CAD / Revit files may be made available for Contractor use in connection with the project, subject to the following conditions:
 - 1. Submit written request to the Architect listing the specific drawings the Contractor intends to use. Provide a specific list of submittals that the files will be used in preparing, and the list of names of subcontractors or suppliers.
 - 2. The Contractor shall request in writing the electronic transfer agreement. Prior to transfer of files, the Contractor shall prepare a separate electronic transfer agreement for each subcontractor or supplier who will be using the electronic files.
 - 3. Data contained on the electronic files is part of Leach Wallace Associates (LWA) instruments of service and shall not be used for any purpose other than as a convenience in the preparation of shop drawings for the referenced project. Any other use or reuse will be at the contractor's sole risk and without liability or legal exposure to LWA.
 - 4. The electronic files are not contract documents. Significant differences may exist between the electronic files and corresponding hard copy contract documents. Because of the possibility the information and data delivered in machine readable form may be altered, whether inadvertently or otherwise. LWA reserves the right to retain hard copy originals of the electronic documentation

delivered to the contractor, in machine readable form, which the original shall be referred to and shall govern in the event of any inconsistency between the two.

5. The use of the electronic files, does not relieve the contractor of their duty to fully comply with the contract documents, including and without limitation, the need to check confirm and coordinate all dimensions and details, take field measurements, verify field conditions and coordinate work with that of other contactors for the project.
6. All "internal" calculations integral to / performed by the Revit model shall not be utilized for any purpose by the contractor. This includes, but shall not be limited to, voltage drop calculations, duct static pressure calculations, air system airflow summary calculations, piping system pressure drop calculations, etc.
7. All Revit "families" are the property of LWA and shall not be re-used on any other project for any purpose by the contractor.

1.9. Operating and Maintenance Manuals:

- A. The Contractor shall assemble four (4) sets of Operating and Maintenance Manuals for all electrical systems and equipment to be delivered to the Architect upon completion of the work and prior to occupancy by the Owner.
- B. Each copy of the Operating and Maintenance Manuals shall be bound in a durable, hardback binder, with data sheets individually punched or perforated and entered. Data sheets shall be grouped and separated by dividers. At the Contractor's option, the manual may contain heavy manila tie-flap envelopes, punched and bound with data sheets inserted in the envelopes, and with a typed label on each envelope to identify its contents. The manual shall have an identifying label on the front cover and shall include at least the following:
 - Index
 - One copy of the approved materials list.
 - One copy of each approved shop drawing and associated data.
 - One copy of the nameplate data for each motor and overload protection device.
 - One copy of each system or equipment manufacturer's recommended preventive maintenance, if any.
 - One copy of each panelboard directory typed on a separate sheet.
 - One copy of each system or component operating instruction (where applicable).
 - One copy of each performance test.
 - One copy of all permits obtained and subsequent records of inspections.
- C. Instructions shall include the name or label, location, and a general description of each system together with specific instructions describing operating modes and routine or emergency procedures required of the building personnel for operating and maintaining each system. A listing of names, addresses, and phone numbers of the service organizations for each item of equipment and a typewritten maintenance schedule for each item of equipment shall be included.

1.10. Guarantee:

- A. Unless otherwise indicated in Division 1 or elsewhere herein, all material and equipment provided under this division shall be free from defects in workmanship and materials for a period of one year after date of certification of completion and acceptance of work. All defects in workmanship, materials or performance which appear within the guarantee period shall be corrected by the Contractor on notice from the Architect, without cost to the Owner. In default thereof, Owner may have such work done and charge the cost of same to the Contractor. On phased projects, warrantee shall begin on accepted areas based on a mutually agreed upon acceptance date.

1.11. Site Visit:

- A. Prior to preparing the bid, the mechanical and electrical subcontractors shall visit the site and familiarize themselves with all existing conditions. Make all necessary investigations as to locations of existing equipment, ductwork, piping, utilities, work to be removed, etc., and all other matters which can affect the work under the Contract. No additional compensation will be paid to the Contractor as result of his failure to completely familiarize himself with the existing conditions under which the work must be performed.
- B. See Instructions to Bidders

1.12. Drawings:

- A. The drawings are diagrammatic and are intended to indicate the general arrangements and work included in the Contract. They are not intended to show all details of construction or exact location of the work. Consult the architectural and structural drawings and details for exact location of structure and equipment; where same are not definitely located, obtain this information from the Architect.
- B. The Contractor shall obtain approval of the Architect for the final locations of all outlets, including lighting fixtures. The contractor shall make minor adjustments to the locations at no extra cost to the Owner.
- C. The Contractor shall carefully examine all contract documents and shall be responsible for the proper fitting of all materials and equipment as indicated.
- D. Although the location of materials and equipment may be shown on the drawings in a certain place, the construction may develop conditions that render this location inaccessible or impractical. In such cases, before fabricating and installing the work, the Contractor shall call the condition to the attention of the Architect for his direction. When requested by the Architect a detailed drawing of the proposed departure due to field conditions, or their causes, shall be submitted by the Contractor for approval. The Architect shall make all final written decisions as to the conditions which require the changing of any work.
- E. Check Drawings of other trades to verify spaces in which work will be installed and field inspect existing conditions.
- F. Maintain maximum headroom at all locations.

1.13. Record Drawings:

- A. The Contractor shall keep accurate records of all deviations in work as actually installed from work indicated. One complete set of contract documents shall be available at the construction site for indicating said deviations. The Contractor shall bring the drawings to each construction progress meeting for review.
- B. When the work is complete, make one (1) complete "As-Built" set of marked-up prints, certifying the accuracy of each print by endorsement and signature thereon and deliver to the Architect who will, after approval, make one complete set of reproducible "as-built" drawings and deliver to the Owner.
- C. See General and Supplementary Conditions.

PART 2 - PRODUCTS

2.1. Materials:

- A. All electrical materials and equipment shall be new, shall carry the label indicating product approval or listing of a Nationally Recognized Testing Laboratory (NRTL) label when such material, equipment and/or system are of a type or class listed by a NRTL, and shall be suitable for the conditions and duties imposed on them at the building. Listing and labeling shall indicate compliance with all applicable United States product standards. Approved NRTL's shall be recognized by OSHA in accordance with Title 29

CFR 1910.7.

1. If a NRTL label is not available from the manufacturer, when requested or required by the local authority having jurisdiction, the equipment shall be tested by an approved electrical testing company in accordance with NEC at no additional cost to the Owner. Submit data indicating compliance with standards prior to installation. The description, characteristics, and requirements of materials to be used shall be in accordance with qualifying conditions established in the following sections.
- B. See Division 1 - General Requirements.
- C. All component parts of each item of equipment or device shall bear the manufacturers' name plate, giving name of manufacturer, description, size, type, serial or model number, electrical characteristics, etc., in order to facilitate the maintenance or replacement. The name plate of a subcontractor or distributor will not be acceptable.
- D. In specifying materials, four general procedures are used. The four classifications are as follows:
 1. GROUP 1: When the material or equipment is specified by name or other identifying information and one name brand only is used, it is considered that the use of that particular item is essential to the project, and the Contractor shall base his proposal on the cost of that item.
 2. GROUP 2: When the material or equipment is specified by brand name and other identifying information and two or more brand names are given, it is considered that any one of the brands so named will perform as desired, and the Contractor shall base his proposal on one of the named brands.
 3. GROUP 3: When the material or equipment is specified with the phrase "...or approved equivalent..." after a brand name and other identifying information, it is intended that the brand name used is for the purpose of establishing a minimum acceptable standard of quality and performance and the Contractor may base his bid proposal on any item which is in all respects equal to that specified and presents essentially the same appearance, size, operation, and performance.
 4. GROUP 4: When material is specified as complying with the requirements of published "Standard Specification" of trade associations, American Society for Testing of Material, government specifications, etc., the Contractor shall base his proposal on any item which can be shown to comply in all respects with the referred "Standard Specification."
- E. It is distinctly understood: (1) that the Architect will use his own judgment in determining whether or not any materials, equipment or methods offered in substitution are equal to those specified and will fit within the space available; (2) that the decision of the Architect on all such questions of equality is final; and (3) that all substitutions will be made at no increases in cost to the Owner.
- F. Upon receipt of written approval from Architect, Contractor may proceed with a substitution providing the Contractor assumes full responsibility for and makes, at his expense, any change or adjustment in construction or connection with any work that may be required by the substitution of such materials, equipment or methods. In the event of any adverse decisions by the Architect, no claim of any sort shall be made or allowed against the Owner.

PART 3 - EXECUTION

3.1. Workmanship:

- A. Each subcontractor shall furnish the services of an experienced superintendent who shall be constantly in charge of the installation of the work.
- B. Install all electrical equipment in accordance with the requirements of the NEC, the National Electrical

Contractor's Association (NECA) "Standard Practice of Good Workmanship in Electrical Construction" and the manufacturer's recommendations.

- C. The quality of the workmanship required for each trade in the execution of its work shall be the finest and highest obtainable in that trade working with the materials specified. Workmanship shall be satisfactory to the Architect and his decision as to acceptable quality if final.

3.2. Equipment Connections:

- A. All equipment requiring electrical service shall be installed and connected in accordance with the best engineering practice and in accordance with the manufacturer's recommendations.
- B. Equipment connections indicated on drawings shall be considered diagrammatic. The actual connections shall be made to best suit the requirements of each case and to minimize the space used.
- C. All conduit, outlets, wiring and all necessary fittings or accessories for connections to all electrical equipment shall be provided. All equipment ratings shown on the drawings are for the specified equipment. Should equipment of different ratings be furnished, all circuit components shall be adjusted accordingly, at the Contractor's expense, after approval by the Architect. The contractor shall be responsible for confirming the proper size and location of each equipment connection before fabrication and installation of the work.
- D. The contractor shall review lugs and terminal configuration of all equipment, existing and new, for coordination with installed conductor sizes. Where equipment has lugs that do not permit installation of the conductor size indicated on the drawings, the contractor shall provide adapters, or alternately, provide a pullbox in the entering raceway. Within the pullbox, provide reducing lugs and smaller size conductors with ampacity equal to or greater than the overcurrent protective device, in accordance with NEC 240.
- E. Aluminum conductors shall not be utilized where prohibited by local codes, or equipment manufacturer's installation instructions.
- F. The Contractor shall reach an agreement as to the limits of responsibility of the various trades when connecting to outlets provided by others, and when providing outlets to receive connections by others, so that all work and equipment will be provided with the proper services connected and ready to use.

3.3. Cutting and Patching:

- A. Cutting and patching associated with the work in the existing structure shall be performed in a neat and workmanlike manner. Existing surfaces which are damaged by the Contractor shall be repaired or provided with new materials and methods similar to existing adjacent work, subject to approval of the Architect. Structural members shall not be cut or penetrated unless otherwise indicated on the drawings. Verify in the field with the Architect. Holes cut through concrete and/or masonry to accommodate new work shall be cut by reciprocating or rotary non-percussive methods. Existing masonry block walls shall be patched with new masonry or gypsum board attached and sealed to both block faces.
- B. Where existing conduits to be removed penetrate masonry walls or floor slabs, the contractor shall cut the conduits off flush with or below the concrete surface, and patch with non-shrink grout, smooth and level, ready for final finishing. Any patches which are discernable through finishes shall be removed and reapplied. Conduits encased in concrete slabs and walls may be abandoned in place after removal of conductors.
- C. See General Conditions.

3.4. Work in Existing Areas:

- A. Portions of the existing building may be occupied by the Owner during construction, and the electrical systems associated with these portions of the building shall be kept in operation as much as possible.

The duration of outages shall be kept to a minimum and they shall be scheduled and approved in advance by the Owner. Where necessary, provide temporary connections as required to maintain service.

- B. In areas to be renovated, remove the entire electrical installation except those portions indicated to be reused. All unused raceways and wiring exposed after demolition shall be removed back to the nearest point of concealment. Unused wiring shall be removed back to the source of voltage for the unused segment. All electrical equipment removed under this contract and not reused shall be disposed of as directed by the Owner.
- C. Where existing electrical systems pass through renovated areas to serve other portions of the building, they shall be suitably relocated or modified to avoid conflict with new work. Existing outlet, junction and pull boxes, etc. and equipment in areas to be renovated and requiring access for service, operation, etc. shall remain "readily accessible" as required by the NEC.
- D. Information describing existing circuits, systems, devices and equipment is based on the best available information. The existing branch circuit numbers indicated may not agree with the actual space or pole number of the device used to protect the branch circuit, but they shall be made to match by the Contractor who shall rearrange the connections in the panelboard or shall (as part of the Record Drawing documentation) renumber the circuits to match actual conditions. Panelboard directories shall be revised and updated to incorporate all changes in branch circuit numbers.
- E. The Contractor shall verify the exact location and rating of all existing system components in the field before starting any work.

3.5. Tests:

- A. Upon completion of the work, the Contractor shall, in the presence of the Architect, operate, test, adjust, and retest if necessary, the complete electrical system. The system shall function fully and completely as designed.
- B. The Contractor shall furnish all labor, material, supplies, equipment, instruments and power necessary for testing. The tests shall demonstrate the following to the Architect:
 - 1. That all lighting, power and control circuits are continuous and free from short circuits.
 - 2. That all circuits are free from unspecified grounds.
 - 3. That all circuits and equipment are properly connected in accordance with the applicable wiring diagrams, and are operable by demonstrating the functioning of each control device not less than ten (10) times and by continuous operation of each circuit for not less than one-half (1/2) hour.
 - 4. Voltage and Impedance testing shall be performed from an approved reference point as defined by NFPA 99.
 - a. Voltage measurements shall be taken between the reference point and exposed fixed electrical equipment with conductive surfaces in a patient care vicinity. Voltage shall not exceed 20mV.
 - b. Impedance measurements shall be made between the reference point and the grounding contact of 10% of all the receptacles in a patient care vicinity. Impedance measurements shall not exceed 0.2 ohms for a quiet ground systems and 0.1 ohms for all others.
 - 5. All receptacles in patient care areas shall meet the requirements in NFPA 99.
 - a. Physical integrity of each receptacle shall be confirmed by visual inspection.
 - b. Continuity of the grounding circuit in each electrical receptacle shall be verified.

- c. Correct polarity of the hot and neutral conductors shall be confirmed.
 - d. The retention force of the grounding blade of each electrical receptacle (except locking-type) shall be not less than 4oz.
 - C. All defects shall be repaired at once and the tests reconducted at the Contractor's expense.
 - D. For the purpose of these tests, normal and emergency conditions may be simulated during these tests if approved by the Architect. The services of the manufacturer's factory-trained service engineer shall be provided to inspect the installation of all systems and equipment furnished under this division to assure that it is installed in accordance with the manufacturer's instructions, assist with start-up and instruct operating personnel in the operation and maintenance of the equipment.
 - E. Also, the following testing procedure shall be made on all equipment operating on 480 volts and below:
 - 1. Measure the insulation resistance of all transformer windings, busses, etc. These measurements shall be made before the external connections are completed to the high and low voltage bushings of each transformer.
 - 2. Receptacle circuit voltage drop testing: Contractor shall determine the (4) branch circuits from each receptacle/small power panelboard that represent the longest installed circuit lengths. Using an approved circuit analyzer or dummy load, the contractor shall measure the voltage drop for the furthest receptacle of each circuit under test.
 - 3. Receptacle testing: Contractor shall test and verify the correct polarity and grounding of each receptacle, and correct trip and timing of each GFI receptacle.
 - 4. Make voltage build-up tests on all equipment and wiring with a voltage sufficient to determine that no short circuits exist.
 - 5. Make tests of phase demand load current on each panelboard serving single-phase loads, at least 30 days but not more than 90 days after project occupancy or closeout. Adjust panelboard branch circuit connections as required until all phase currents are balanced within 10%. Where one or more large single phase branch circuits has load current too great to be balanced by the remaining loads, the contractor shall balance as much as possible and document the condition.
 - 6. All outages for performing tests and adjustments shall be scheduled and coordinated in advance with the Owner.
 - F. Results of the above tests shall show the equipment and wiring meets the requirements of this specification before being accepted by the Architect. Should any of the above tests indicate defects in materials or workmanship, the faulty installation shall be repaired or replaced at once and the tests reconducted at the Contractor's expense. Test results shall be documented and included in the Operating and Maintenance Manual.
- 3.6. Handling and Storage of Materials:
 - A. Proper and suitable tools, equipment and appliances for the safe and convenient handling and placing of all materials and equipment shall be used. During loading, unloading, and placing, care shall be taken in handling the equipment and materials so that no equipment or materials, including Owner furnished, are damaged. Refer to the General and Supplementary Conditions of the specifications.
- 3.7. Cooperation with Other Trades:
 - A. The Contractor shall have a competent foreman on the premises at all times to check, layout, and

coordinate the installation of the work shown on the drawings and described in the following specifications. He shall provide information regarding locations and sizes of chases and openings and be responsible for the accuracy of such information. The foreman shall lay out and coordinate the installation of all hangers, inserts, sleeves and other work in masonry and concrete in advance of and during construction, giving consideration to the work of other trades to prevent interference in the location of other equipment.

- B. Exact locations of electrical equipment, outlets, conduits, etc. shall be coordinated with all other trades so that there will be no interference between mechanical equipment, piping, ducts, etc. Where conflicts between the trades result, they shall be resolved by the Contractor to the Architect's satisfaction and at no expense to the Owner.

3.8. Cleaning and Painting:

- A. Thoroughly clean all exposed surfaces of equipment and material and leave in a neat, clean condition ready for painting. Restore and touch-up factory finishes which have been damaged during construction. Finished painting will be performed under another Division.

3.9. Accessibility:

- A. Locate all equipment which must be serviced, operated or maintained, in fully accessible positions. Equipment shall include, but not be limited to, switches, controllers, circuit breakers, and wiring splices. Where required and where directed, provide 14 gauge steel access panels, Milcor or equal, to suit material in which installed. Doors installed in fire rated walls or shafts shall be labeled and shall match rating of the construction. Door shall be sufficient size to allow access to all components, except minimum size shall be 12" x 12". Doors in kitchen areas and toilet rooms shall be stainless steel or have chrome plated finish.
- B. Equipment deemed inaccessible by the Architect shall be reworked by the Contractor at no expense to the Owner. All doors shall have cylinder locks operable from same key. Submit shop drawings for approval.

3.10. Equipment Bases and Supports:

- A. The Contractor shall provide all supports, foundations and stands required for the electrical equipment and shall provide and set all necessary anchor bolts.
- B. Where equipment is indicated or specified to be hung from ceiling or roof construction, the Contractor shall provide all necessary hanger rods of size and number required by the equipment and all necessary supplemental structural steel sections, securely fastened to the building construction.
- C. Where equipment is indicated or specified to be wall-mounted, the Contractor shall provide all necessary brackets, constructed of structural steel shapes suitable for the application, securely anchored to the building construction.
- D. Where equipment/devices are indicated to be mounted to fire-proofed structure, the contractor shall provide necessary extensions so that devices are not mounted recessed within fireproofing.

END OF SECTION

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
- B. Related Requirements:
 - 1. Section 271500 "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Alpha Wire.
 - 2. AFC Cable Systems.
 - 3. Encore Wire Corporation.
 - 4. Cerro Wire.
 - 5. Okonite Company, The.
 - 6. General Cable Technologies Corporation.
 - 7. Southwire Incorporated.
- B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2.
- D. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type XHHW-2.
- E. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658/ UL 1569 for metal-clad cable, Type MC with insulated ground wire and #10 AWG bare aluminum bonding conductor, steel interlocking armor with green stripe.

- F. Multiconductor Luminaire Cable: Comply with NEMA WC 70/ICEA S-95-658//UL 1569 for metal-clad cable, Type MC with insulated ground wire and #10 AWG bare aluminum bonding conductor, two #16 insulated for 0-10V dimming signal, steel interlocking armor with green stripe.

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Gardner Bender.
 - 3. Hubbell Power Systems, Inc.
 - 4. Ideal Industries, Inc.
 - 5. Ilscq; a branch of Bardes Corporation.
 - 6. NSi Industries LLC.
 - 7. O-Z/Gedney; a brand of the EGS Electrical Group.
 - 8. 3M; Electrical Markets Division.
 - 9. TE Connectivity.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway.
- B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace (General): Type THHN-2-THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace (Normal Power Circuits only, 30 amperes or less): Armored cable, Type MC.
- D. Exposed Branch Circuits: Type THHN-2-THWN-2, single conductors in raceway.

- E. Branch Circuits Concealed in Ceilings, Walls, and Partitions (General): Type THHN-2-THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions (Normal Power Circuits only, 30 amperes or less): Armored cable, Type MC.
- G. Branch Circuit Luminaire Whips, 0-10V dimming (non-patient care areas): Metal-clad luminaire cable, Type MC with signal conductors.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls and ceilings, unless otherwise indicated. Cables shall not be installed encased in concrete floor slabs, or below slabs on grade, except where specifically indicated on drawings.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. 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.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."
- G. Wiring shall only be provided as single or combined wiring groups as follows:
 - 1. Multiwire branch circuits are not permitted; when multiple circuits in a single raceway or cable assembly are installed, a separate phase and grounded (neutral) circuit conductor shall be routed from the respective indicated space or pole numbers in the schedule for the panelboard, to the associated utilization point, device, or outlet.
 - 2. Wiring shall only be provided as single or combined wiring groups as follows:
 - a. Multiwire branch circuits are not permitted; when multiple circuits in a single raceway or cable assembly are installed, a separate phase and grounded (neutral) circuit conductor shall be routed from the respective indicated space or pole numbers in the schedule for the panelboard, to the associated utilization point, device, or outlet.
 - 3. Where multiple branch circuits are routed in a single raceway or cable assembly, a shared equipment grounding conductor shall be permitted, except for circuits serving isolated ground receptacles or unless otherwise indicated.
 - 4. The contractor shall review each utilization device or equipment for connection requirements and provide neutral conductor if required.
 - 5. One section of conduit (raceway) shall not enclose more than three single-phase branch circuits, one three-phase branch circuit, or one feeder (three phase or single phase), unless otherwise indicated.

6. Wiring size shall be #12 AWG minimum for a typical 20 ampere, 120 volt or 277 volt lighting or receptacle branch circuit with a maximum total length of 90 feet and 225 feet, respectively. When circuit total lengths exceed those limits (measured horizontally and vertically along the path from the Panelboard to the load) wiring size (including phase, neutral, and equipment grounding conductors) shall be increased from the sizes indicated in the panel schedules as follows:

120V to Ground		277V to Ground	
Size	Max. Total Length	Size	Max. Total Length
#12	90'	#12	225'
#10	150'	#10	375'
#8	over 150'	#8	over 375'

- H. Emergency power branch circuits/feeders shall not be routed in the same raceway system as normal power branch circuits/feeders. Additionally, branch circuits/feeders originating from critical and life safety branch panelboards shall not be routed in raceway systems originating from other panelboards, whether of the same branch or not.
- I. Wiring exposed to temperatures higher than 30°C (Celsius) shall have insulation properly rated for the temperatures it must withstand (i.e., wiring in lighting fixtures or electric heating equipment unless provided by the fixture or equipment manufacturer shall be type THHN, AVB, or other as needed).
- J. "Green Wire" grounding and neutral wires shall be color coded throughout their entire length. Phase wires may be color coded throughout their entire length or may be color coded by applied sleeves or tape at each splice and termination and at a maximum interval of 3' for any accessible segment. Color coding shall be as follows:

	<u>208Y/120V</u>	<u>480Y/277V</u>
PHASE A	BLACK	BROWN
PHASE B	RED	ORANGE
PHASE C	BLUE	YELLOW
NEUTRAL	WHITE	GRAY
GROUNDING	GREEN	GREEN

- K. Green colored insulated equipment grounding conductors shall be provided for all feeders and for all branch circuits. Provide a "Green Wire" grounding conductor in addition to grounding provided by the raceway system enclosing the branch circuit or circuits. The size of the "Green Wire" grounding conductor shall be as indicated on the drawings, and shall interconnect the grounding terminal of each receptacle, lighting fixture or equipment enclosure containing the circuit and the grounding bus or terminal at the point of origin or the respective circuit. The "Green Wire" grounding conductor shall be run with each respective feeder or branch circuit conductor group. At each receptacle location, connect the "Green Wire" system to the receptacle enclosure using a separate pigtail.
- L. All wiring whose voltage exceeds 100 volts with respect to ground shall be protected by enclosing it in a raceway. All low voltage wiring not protected by raceway shall be rated for the application (e.g. plenum rated cable, etc.).
- M. Communications, signaling, fire alarm, Class 2 cabling, etc. shall not be installed in the same raceways as line voltage power circuits.

3.4 CONNECTIONS

- A. 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.
- B. Screw-on "Wirenut" type fittings shall not be used for connecting stranded wiring unless the strands are twisted for each conductor before installing the "wirenut". Aluminum fittings shall not be used for wire splices, termination or any wire connections. When stranded wires are to be terminated in a screw pressure connection, carefully selected fittings and installation methods shall be used to avoid the problem of separating strands.
- C. No splices or joints shall be permitted in either feeders or branches except at outlets or accessible junction boxes. Joints in branch circuits shall be mechanically and electrically secured with solderless connectors as listed by Underwriters' Laboratories, Inc., as pressure cable type, 600-volt rating, compression or indent type. Connectors shall be insulated by integral or separate cover, or by means of taping with approved plastic or rubber friction tapes to provide insulating value equal to that of the conductors being joined. In the making of a splice, connectors shall be brought up securely upon the conductor in a workmanlike manner in such a way that all conductors are equally engaged, the insulation is not ruptured, no bare wires are exposed or have "back-off" due to the application of pressure, and the connector will not loosen due to cycling or vibration. The number, size and combinations of conductors permitted by the Underwriters' Laboratories, Inc., as listed on manufacturers' packaging of the connector shall be strictly complied with. Wires, No. 8 AWG and smaller, shall be twisted together with a minimum of one turn of the stripped conductors before insertion into connectors. Splice connectors shall be of a type and be so installed that the conductor insulation will not be reduced when the conductor is positioned in its final operating position. Tools used to compress these fittings shall be the type that requires proper compression before the tool can be released.
- D. All insulating materials for splices, connections, etc. such as rubber, friction, glass and synthetic tapes, putties, resins, splice cases, compositions, and similar materials shall be of the type approved for the particular use, location, voltage, and similar applicable requirements and shall be applied and installed in an approved manner, all in accordance with the manufacturer's recommendations.
- E. Make splices, terminations, and taps that are compatible with conductor material.
- F. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test feeder conductors for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- B. Test and Inspection Reports: Prepare a written report to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.

1.6 QUALITY ASSURANCE

- A. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation; Kindorf.
 - f. Unistrut.
 - g. Wesanco, Inc.
 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 3. 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. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. 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.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) 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. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 APPLICATION

- A. 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.
- B. 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 (6 mm) in diameter.
- C. 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 50 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with single-bolt conduit clamps.

3.2 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.
- C. 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.
- D. 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.

- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Boxes, enclosures, and cabinets.

- B. Related Requirements:

1. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For raceways, fittings, and enclosures.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. AFC Cable Systems, Inc.
 2. Allied Tube & Conduit.
 3. Anamet Electrical, Inc.
 4. Electri-Flex Company.
 5. O-Z/Gedney; a brand of EGS Electrical Group.
 6. Picoma Industries, a subsidiary of Mueller Water Products, Inc.
 7. Republic Conduit.

8. Southwire Company.
 9. Thomas & Betts Corporation.
 10. Western Tube and Conduit Corporation.
 11. Wheatland Tube Company; a division of John Maneely Company.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. EMT: Comply with ANSI C80.3 and UL 797. Raceways with integral "quick fit" couplings are not permitted.
- D. FMC: Comply with UL 1; zinc-coated steel; aluminum for use with ARC and EMTA raceway systems.
- E. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B. Match raceway material.
1. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Setscrew.
 2. Expansion Fittings: steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

2.2 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Adalet.
 2. Cooper Technologies Company; Cooper Crouse-Hinds.
 3. EGS/Appleton Electric.
 4. Erickson Electrical Equipment Company.
 5. FSR Inc.
 6. Hoffman; a Pentair company.
 7. Hubbell Incorporated; Killark Division.
 8. Kraloy.
 9. Milbank Manufacturing Co.
 10. Mono-Systems, Inc.
 11. O-Z/Gedney; a brand of EGS Electrical Group.
 12. RACO; a Hubbell Company.
 13. Spring City Electrical Manufacturing Company.
 14. Thomas & Betts Corporation.
 15. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb . Outlet boxes designed for attachment of luminaires weighing more than 50 lb. shall be listed and marked for the maximum allowable weight.

- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- G. Device Box Dimensions: Minimum 4" square.
- H. Gangable boxes are prohibited.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Indoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed, Not Subject to Physical Damage: EMT.
 - 2. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 - 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 - 4. Boxes and Enclosures: NEMA 250, Type 1.
- B. Minimum Raceway Size: 3/4-inch (21-mm) trade size.
- C. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. EMT: Use setscrew, steel fittings. Comply with NEMA FB 2.10.
 - 2. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- D. Install surface raceways only where indicated on Drawings.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

- G. Support conduit within 12 inches of enclosures to which attached.
- H. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- J. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- K. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- L. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- M. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- N. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- O. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations subject to severe physical damage.
- P. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- Q. 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.
- R. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- S. Locate boxes so that cover or plate will not span different building finishes.
- T. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- U. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.4 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

END OF SECTION 260533

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

- B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

- C. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:

- a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
- b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Advance Products & Systems, Inc.
 - b. CALPICO, Inc.
 - c. Metraflex Company (The).
 - d. Pipeline Seal and Insulator, Inc.
 - e. Proco Products, Inc.
 2. Sealing Elements: Nitrile (Buna N) rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 3. Pressure Plates: Carbon steel.
 4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Presealed Systems.

2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi , 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
 - 2. Sealant shall have VOC content of <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4 inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Sleeves shall be flush with finished floors, and extended 2" above finished floor level in kitchens, equipment rooms, and wet floor areas. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Warning labels and signs.
 - 5. Equipment identification labels.
 - 6. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

- A. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.

- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage.
- C. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Colors for Cables Carrying Circuits at 600 V and Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage.
- C. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- C. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3 mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

- B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3 mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.
- C. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around conductor it identifies. Full shrink recovery at a maximum of 200 deg F (93 deg C). Comply with UL 224.
- D. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.5 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Warning label and sign shall include, but are not limited to, the following legends:
Arc Flash Hazard signs: "WARNING – ARC FLASH AND SHOCK HAZARD PRESENT – APPROPRIATE PPE REQUIRED".

2.6 EQUIPMENT IDENTIFICATION LABELS

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

2.7 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F , According to ASTM D 638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F .
 - 4. Color: Black except where used for color-coding.
- B. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F , According to ASTM D 638: 7000 psi .
 - 3. UL 94 Flame Rating: 94V-0.
 - 4. Temperature Range: Minus 50 to plus 284 deg F .
 - 5. Color: Black.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.
- G. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 - 1. In Spaces Handling Environmental Air: Plenum rated.
- H. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 10-foot (3-m) maximum intervals.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. Emergency Power.
 - 2. Power.
- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded feeder and branch-circuit conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- E. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive vinyl labels with the conductor or cable designation, origin, and destination.
- F. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive vinyl labels with the conductor designation.
- G. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
 1. Comply with 29 CFR 1910.145.
 2. Identify system voltage with black letters on an orange background.
 3. Apply to exterior of door, cover, or other access.
- J. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power,

lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

- a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
- b. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
- c. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
- d. Label legend shall include: equipment designation, branch of power (normal, emergency, emergency critical branch, emergency life safety branch, emergency equipment branch, UPS, standby, etc.) in corresponding facility standard color code, voltage/phase, and the panel/circuit number of the source feeding the equipment.

2. Equipment to Be Labeled:

- a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
- b. Enclosures and electrical cabinets.
- c. Access doors and panels for concealed electrical items.
- d. Enclosed switches.

END OF SECTION 260553

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Indoor occupancy sensors.
 - 2. Dimmer Switches.
- B. Related Requirements:
 - 1. Section 262726 "Wiring Devices" for manual light switches.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 - 1. Interconnection diagrams showing field-installed wiring.
 - 2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR ALL DEVICES

- A. Provide all components necessary for a complete functioning system, including power packs, room controllers, control wiring, programming, etc. Install, connect, and program devices as recommended by manufacturer.

- B. Verify compatibility between individual control devices and compatibility of the dimming system with each lighting fixture type.

2.2 INDOOR OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:

- 1. Lithonia Lighting; Acuity Lighting Group, Inc nLight.

- B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.

- 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
- 3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
- 4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
- 5. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
- 6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
- 7. Bypass Switch: Override the "on" function in case of sensor failure.
- 8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux); turn lights off when selected lighting level is present.

- C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

- 1. Sensitivity Adjustment: Separate for each sensing technology.
- 2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
- 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

2.3 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:

- 1. Lithonia Lighting; Acuity Lighting Group, Inc nLight.

- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).
 - 3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.

- C. Wall-Switch Sensor Tag O:
 - 1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft. (84 sq. m).
 - 2. Sensing Technology: Dual technology - PIR and ultrasonic.
 - 3. Switch Type: SP, manual "on," automatic "off."
 - 4. Voltage: Dual voltage, 120 and 277 V; dual-technology type.
 - 5. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
 - 6. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
 - 7. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

2.4 DIMMER SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Lithonia Lighting; Acuity Lighting Group, Inc nLight.

- B. Wall-Switch Dimmer Tag D:
 - 1. Provide 0-10V dimming signal.
 - 2. Verify capability of dimming range matches the range for each lighting fixture (For example 5% to 100%).
 - 3. Provide with On/Off/Raise/Lower buttons with appropriate labels.

- C. Wall-Switch Occupancy Sensor Dimmer Tag OD:
 - 1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft. (84 sq. m).
 - 2. Sensing Technology: Dual technology - PIR and ultrasonic.
 - 3. Switch Type: SP, manual "on," automatic "off."
 - 4. Voltage: 0-10V Dimming signal.
 - 5. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
 - 6. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
 - 7. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
 - 8. Provide with On/Off/Raise/Lower buttons with appropriate labels.

2.5 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors, with minimum sizes as recommended by controls manufacturer. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors, with minimum sizes as recommended by controls manufacturer. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."
 - 1. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Lighting control devices will be considered defective if they do not pass tests and inspections.

- C. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
 - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. SPD: Surge Protective Device.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 6. Include wiring diagrams for power, signal, and control wiring.
 - 7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

1.5 INFORMATIONAL SUBMITTALS

- A. Field Quality-Control Reports:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

- B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Keys: Two spares for each type of panelboard cabinet lock.

1.8 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer. (Exception: Fused panelboards and fuses may be obtained from a different manufacturer than circuit breaker panelboards.)
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NECA 407.

1.10 PROJECT CONDITIONS

- A. Environmental Limitations:
 - 1. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

- a. Ambient Temperature: Not exceeding 23°F to plus 104°F.
 - b. Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
1. Ambient temperatures within limits specified.
 2. Altitude not exceeding 6600 feet.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
1. Notify Owner no fewer than ten days in advance of proposed interruption of electric service. Submit outage request forms and other documentation as required by the Owner.
 2. Do not proceed with interruption of electric service without Owner's written permission.
 3. Comply with NFPA 70E.

1.11 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.12 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures: Flush- and surface-mounted cabinets.
1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1
 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 3. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
 4. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 5. Finishes:

- a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel, or same finish as panels and trim where required for environmental conditions.
6. Directory Card: Inside panelboard door, mounted in transparent card holder.
- B. Incoming Mains Location: Top or bottom, contractor to coordinate with drawings and installation requirements.
- C. Phase, Neutral, and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- D. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Tin-plated aluminum.
 2. Main and Neutral Lugs: Mechanical type.
 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 4. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- E. Future Devices (Spaces, provisions for future): Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- F. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Branch Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers, replaceable without disturbing adjacent units. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents. Devices and assemblies shall be fully rated; series rating is not permitted.

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 225 A and larger.
2. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
3. Molded-Case Circuit-Breaker (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. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NECA 407.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NECA 407.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- C. Mount top of trim 72 inches above finished floor unless otherwise indicated, or as required for taller equipment. In all cases, center of top-most circuit breaker or switch handle in the energized position shall not exceed 79 inches above finished floor or grade.
- D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- E. Install overcurrent protective devices and controllers not already factory installed.
 1. Set field-adjustable, circuit-breaker trip ranges.
- F. Install filler plates in unused spaces.
- G. Stub four empty 1-inch 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 below slab not on grade.

- H. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- I. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Where required by applicable codes, breakers for fire alarm, fire protection equipment, and similar shall be identified with a red handle and/or red nameplate.
- E. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

- B. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
1. Measure as directed during period of normal system loading.
 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Hospital-grade receptacles.
 - 3. Tamper-resistant receptacles.
 - 4. Snap switches.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. UTP: Unshielded twisted pair.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.6 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand (Pass & Seymour).

- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

- A. Hospital-Grade, 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.
 1. Products: Subject to compliance with requirements, provide the following:
 - a. Cooper; 8310 (single), 8300 (duplex).
 - b. Hubbell; HBL8310 (single), HBL8300 (duplex).
 - c. Leviton; 8310 (single), 8300 (duplex).
 - d. Pass & Seymour; 8301 (single), 8300H (duplex).
 2. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
- B. Hospital-Grade, Tamper-Resistant 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.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; TR8300.
 - b. Hubbell; HBL8300SGA.
 - c. Leviton; 8300-SGG.
 - d. Pass & Seymour; TR63H.
2. Description: Labeled shall comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

2.4 GFCI RECEPTACLES

A. General Description:

1. Straight blade, feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Hospital-Grade, Duplex GFCI 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.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Cooper; VGFH20.
- b. Hubbell; HFR8300HL.
- c. Leviton; 7899-HG.
- d. Pass & Seymour; 2095HG.

C. Tamper- and Hospital-Grade, Duplex GFCI 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.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Cooper; TRVGFH20.
- b. Hubbell; GFR8300TR.
- c. Leviton; T7899-HGR.
- d. Pass & Seymour; 2095HGTR.
- e.

D. Double-duplex, or "Quad" receptacles: Provide two duplex receptacles in a common outlet. Double-duplex GFCI shall consist of two duplex GFCI receptacles.

2.5 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896. Nylon body and toggle, heavy duty, chemical resistant.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Single Pole:

- 1) Cooper; AH1221.
- 2) Hubbell; HBL1221.
- 3) Leviton; 1221-2.

2.6 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished and Unfinished Spaces, recessed mount: 0.035-inch- thick, satin-finished, Type 302 stainless steel.

2.7 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: **Ivory** unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red for Receptacles, Ivory for Switches.

PART 3 - EXECUTION

3.1 INSTALLATION

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.
- c. Pigtailling existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 GFCI RECEPTACLES

- A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use silk screened or engraved machine printing, with black filled lettering on face of plate, red for emergency circuits, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
 2. Test Instruments: Use instruments that comply with UL 1436.
 3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- B. Tests for Convenience Receptacles:
1. Line Voltage: Acceptable range is 105 to 132 V.
 2. Percent Voltage Drop under a 80%: A value of 6 percent or higher is unacceptable.
 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 4. Polarity: Verify correct polarity of all receptacle phase and neutral conductors is maintained.
 5. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 6. Using the test plug, verify that the device and its outlet box are securely mounted.
 7. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- C. Test straight-blade receptacles in patient care areas for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz.
- D. Voltage and Impedance testing shall be performed from an approved reference point as defined by NFPA 99.
1. Voltage measurements shall be taken between the receptacle ground pin and exposed fixed electrical equipment with conductive surfaces in a patient care vicinity. Voltage shall not exceed 20mV.
 2. Impedance measurements shall be made between the reference point and the grounding contact of 10% of all the receptacles in a patient care vicinity. Impedance measurements shall not exceed 0.1 ohms.
- E. Wiring device will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Nonfusible switches.
 - 2. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet.
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without Owner's written permission.
 - 4. Comply with NFPA 70E.

1.9 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 600V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Lugs: Mechanical or compression type, suitable for number, size, and conductor material.

2.2 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- C. Tests and Inspections:
 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262816

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Interior lighting fixtures.
2. Exit signs.
3. Lighting fixture supports.

- B. Related Sections:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section 262726 "Wiring Devices" for manual wall-box dimmers for LED sources.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color-rendering index.
- C. LER: Luminaire efficacy rating.
- D. Lumen: Measured output of luminaire.
- E. Luminaire: Complete lighting fixture, including driver housing if provided.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
 1. Physical description of lighting fixture including dimensions.
 2. Energy-efficiency data.
 3. Life, output (lumens, CCT, and CRI), and energy-efficiency data for LEDs.
 4. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for accessories identical to those indicated for the lighting fixture as applied in this Project.

- a. **Manufacturer Certified Data:** Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - B. **Shop Drawings:** For nonstandard or custom lighting fixtures. Include plans, elevations, sections, details, and attachments to other work.
 - 1. **Detail equipment assemblies** and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. **Wiring Diagrams:** For power, signal, and control wiring.
 - C. **Installation instructions.**
- 1.5 **CLOSEOUT SUBMITTALS**
- A. **Operation and Maintenance Data:** For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
- 1.6 **QUALITY ASSURANCE**
- A. **Luminaire Photometric Data Testing Laboratory Qualifications:** Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - B. **Electrical Components, Devices, and Accessories:** Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - C. **Comply with NFPA 70.**
- 1.7 **COORDINATION**
- A. **Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.**

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. **Products:** Subject to compliance with requirements provide one of the products indicated on Drawings. **Lighting fixtures not included in the schedule are not acceptable and should not be submitted as substitutions, unless submitted and approved prior to bidding.**

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

- A. **Recessed Fixtures:** Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. **Metal Parts:** Free of burrs and sharp corners and edges.

- C. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
- D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during replacement of LED sources and components and when secured in operating position.
- E. Diffusers and Globes:
 - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
 - b. UV stabilized.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.
- F. Factory-Applied Labels: Comply with UL 1598. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following luminaire characteristics:
 - a. Rated delivered lumens.
 - b. CCT and CRI for all luminaires.

2.3 LED SOURCES

- A. Minimum lumen output, as indicated in the lighting fixture schedule on the drawings, shall be initial lumens exiting the luminaire in the 0-90 degree zone, as measured by an accredited laboratory, per IESNA Standard LM-79-08.
 - 1. Fixtures lumens shall match lumen output indicated on lighting fixture schedule +10% / -5%.
- B. Lumen output shall not decrease more than 20% over an operational life of at least 50,000 hours.
- C. Individual LED's shall be connected such that failure of one LED will not result in loss of light from the entire luminaire.
- D. LED boards shall be suitable for field maintenance or service above or below the ceiling, using plug-in connectors. LED boards shall be upgradable.
- E. Color rendering index (CRI) shall be 80 or greater. Color shift shall be <0.007 over 6000 hours.
- F. LED lighting fixtures shall be designed as an integrated assembly, with the LED sources, driver(s), housing, and optics all designed to function optimally as a complete assembly. Retrofits or adaptations of fixture primarily intended for incandescent, HID, or fluorescent sources will not be permitted.

- G. Indoor LED fixtures shall be thermally stable over the life of the fixture, in an operating temperature range of 0 to 25 degrees Celsius. Thermal management shall be passive in design, without use of cooling fans.

2.4 LED DRIVERS

- A. LED dimming shall be equal in range, quality, and character to that achieved by specification-grade, architectural wall box dimming controls applied to incandescent sources.
- B. Rated design life shall be 50,000 hours, and drivers shall carry a five-year replacement warranty or warranty as indicated on drawings, whichever is greater.
- C. Input voltage shall be universal type, allowable range 108 to 305 V (120-277 +/- 10%) AC.
- D. Quality of dimming shall be defined by dimming range, lack of perceptible flicker or stroboscopic effect, smooth and continuous linear changes in level without steps, natural square law response to control input, stability throughout rated voltage range, consistent color appearance over dimming range, and symmetrical response to raise / lower control inputs.
- E. Demonstration of compliance shall be required where requested by the Architect. Drivers which are not acceptable to the Architect, shall be replaced at no cost to the Owner.
- F. Operating temperature range shall be -30 to 50 degrees Celsius.
- G. Flicker index shall be less than 1% at all frequencies less than 1000Hz.
- H. Control input shall be 4-wire 0-10VDC voltage controlled, capable of sinking 0.6mA per driver at a low end of 0.3V.
- I. Total harmonic distortion (THD) shall not exceed 10%, minimum power factor shall be 90%. Drivers shall conform to the electro-magnetic interference (EMI) limits established by the Federal Communications Commission (FCC), part 18, for industrial (Class A) applications.
- J. Drivers shall include listing as a UL-Recognized component.
- K. Manufacturers shall be CREE, Philips Xitanium, Sylvania Optotronic, Acuity Accudrive, EldoLED, GE Lighting, or approved equivalent.

2.5 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 - 1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.

2.6 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Section 260529 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.
- F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lighting fixtures:
 - 1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
- B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, and reinstall.
- C. Remote Mounting of Drivers and Power Supplies: Distance between the driver or power supply and fixture shall not exceed that recommended by the manufacturer. Verify, with manufacturers, maximum distance between driver or power supply and luminaire. Where remote driver or power supply locations are not indicated on plan, coordinate location with Owner and Architect in field.
- D. Lay-in Ceiling Lighting Fixtures Supports: Do not use grid as a support element.
 - 1. Install at least two independent support rods or wires from structure to a tabs on opposite corners of lighting fixture. Wires or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- E. Suspended Lighting Fixture Support:
 - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
 - 4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.
- F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 IDENTIFICATION

- A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

- A. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 265100

SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 1. System smoke detectors.
 2. Notification appliances.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. NICET: National Institute for Certification in Engineering Technologies.

1.4 SYSTEM DESCRIPTION

- A. Noncoded, UL-certified addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
 1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
 2. Include voltage drop calculations for notification appliance circuits.
 3. Include battery-size calculations.
 4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
 6. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

C. General Submittal Requirements:

1. Submittals shall be approved as necessary by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. Licensed or certified as necessary by authorities having jurisdiction.

D. Delegated-Design Submittal: For smoke and heat detectors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Drawings showing the location of each smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the detector.

1.6 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Software and Firmware Operational Documentation:
 1. Device address list.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.9 PROJECT CONDITIONS

- A. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
1. Notify Owner no fewer than two days in advance of proposed interruption of fire-alarm service.
 2. Do not proceed with interruption of fire-alarm service without Owner's written permission.

1.10 SEQUENCING AND SCHEDULING

- A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.
- B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. SimplexGrinnell LP; a Tyco International company, to match existing system in building.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Provide new devices as indicated on plans to be fully compatible with existing system. All devices shall be programmed to match existing functionality of similar devices throughout the building.

2.3 FIRE-ALARM CONTROL UNIT

- A. Modify/Upgrade and provide all necessary programming for existing system to accommodate new devices.

2.4 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
 - 1. Comply with UL 268; operating at 24-V dc, nominal.
 - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
 - 3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
 - 4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 - 5. Integral Visual-Indicating Light: LED type indicating detector has operated.
 - 6. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
 - a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.
 - b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.

- c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).
3. Each sensor shall have multiple levels of detection sensitivity.
4. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
5. Test Station: Remote key test switch station with LED alarm light. Operation of the key switch shall place the detector into alarm condition, as well as changing the state of the relay contacts and actuating any control function associated with duct detector.

2.5 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.
1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.
- B. Horns: Match existing building standard. Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.
- C. Visible Notification Appliances: Match existing building standard. Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.
1. Rated Light Output:

- a. 15/30/75/110 cd, selectable in the field.
2. Mounting: Wall mounted unless otherwise indicated.
3. Flashing shall be in a temporal pattern, synchronized with other units.
4. Strobe Leads: Factory connected to screw terminals.
5. Mounting Faceplate: Factory finished, white.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Install wall-mounted equipment, with tops of cabinets not more than 72 inches above the finished floor.
- C. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
 1. Connect new equipment to existing control panel in existing part of the building.
 2. Expand, modify, and supplement existing equipment as necessary to extend existing functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.
- D. Smoke- or Heat-Detector Spacing:
 1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
 2. Smooth ceiling spacing shall not exceed 30 feet.
 3. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A in NFPA 72.
 4. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.
 5. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.
- E. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
- F. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- G. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling.
- H. Provide system wiring to devices in Metal-Clad FPLP plenum rated fire alarm cable, Red Alert by Southwire, or approved equal.

3.2 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
 - 1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.
- B. Provide system equipment upgrades and programming to existing Fire Alarm system as necessary to accommodate the new devices.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
 - 2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 - 3. Test audible appliances for the private operating mode according to manufacturer's written instructions.
 - 4. Test visible appliances for the public operating mode according to manufacturer's written instructions.
- C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- D. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 283111