TREANORHL

Project Manual
ISSUE FOR CONSTRUCTION
Volume 2 of 2

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Gibson Library Renovation – Level 3 Provost Suite
University of North Texas Health Science Center
Fort Worth, Texas

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Architectural
Mechanical, Plumbing, and Fire Protection
Electrical
Communications

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SECTION 21 0010 - BASIC FIRE PROTECTION REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS AND SUPPLEMENTAL GENERAL PROVISIONS

A. The General Conditions and Supplementary Conditions are by reference made a part of this section and shall apply to each and every heading as though included herein.

B. In the event of conflict, the requirements of the General Conditions and Supplementary Conditions will take precedence over these General Requirements .

1.2 GENERAL

A. The Contractor shall provide all plans, labor, equipment, appliances and materials, and shall perform all operations in connection with the installation of the fire protection work in accordance with the Specifications, applicable drawings, and the conditions specified above.

B. Contractor shall provide all equipment required and usually furnished in connection with such work and systems whether or not specifically mentioned or specifically indicated on the drawings.

1.3 INSPECTION OF THE SITE

A. The Contractor shall visit the site, verifying all existing items indicated on drawings and/or specified, and become familiar with the existing work conditions, hazards, grades, actual formations, soil conditions, and local requirements. The submission of bids shall be deemed evidence of such visits.

B. All proposals shall take these existing conditions into consideration, and the lack of specific information on the drawings shall not relieve the Contractor of any responsibility.

C. The trade furnishing the equipment shall be responsible for notifying the Contractor prior to ordering it, in the event that equipment specified and/or reviewed is incompatible with this requirement.

1.4 PERMITS, UTILITY CONNECTIONS, AND INSPECTIONS

A. Refer to other sections of the specifications for construction phasing and time increments.

B. The Contractor shall obtain and pay for all required utility connections, impact fees, utility extensions and/or relocations and shall pay all costs and inspection fees for all work included herein.

1.5 APPLICABLE CODES AND STANDARDS

A. The installation shall meet the minimum standards prescribed in the latest editions of the following listed codes and standards, which are made a part of the Specifications, except as may be hereinafter modified in these Specifications and associated drawings.

B. Latest edition of the National Fire Protection Association Standards (NFPA):

1. NFPA No. 13 Installation of Sprinkler Systems

2. NFPA No. 14 Installation of Standpipes and Hose Systems

3. NFPA No. 70 National Electrical Code

4. NFPA No. 90A Installation of Air Conditioning and Ventilating systems

5. NFPA No. 91 Exhaust systems of Air Conveying of Gases, etc.

6. NFPA No. 101 Safety to Life from Fire in Buildings and Structures

7. NFPA No. 255 Test of Surface Burning Characteristics of Building Materials

C. United States of America Standards Institute (ASA) Standards:

1. A40.8 National Plumbing Code

2. B31.1 B31.1a Code for Pressure Piping

D. American Society of Mechanical Engineers (ASME): Boiler and Pressure Vessel Codes.

E. Air Conditioning and Refrigeration Institute Standards (ARI): All standards related to refrigeration and air conditioning equipment and piping furnished under these Specifications.

F. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) 1985: All applicable manuals and standards.

G. American Society of Testing and Material (ASTM): All applicable manuals and standards.

H. American Water Works Association (AWWA): All applicable manuals and standards.

I. National Electrical Manufacturer's Association (NEMA): All applicable manuals and standards.

J. City Fire Department as applicable to construction of this site.

K. City and State Building Codes.

L. State of Texas Occupational Safety Act: Applicable safety standards.

M. Refer to Specifications sections hereinafter bound for additional codes and standards.

N. All materials and workmanship shall comply with all applicable state and national codes, specifications, and industry standards. All material shall be listed by the Underwriter's Laboratories, Inc., as conforming to its standards and so labeled in every case where such a standard has been established for the particular type of material in question.

O. The Contract Documents are intended to comply with the aforementioned rules and regulations; however, some discrepancies may occur. Where such discrepancies occur, the Contractor shall immediately apply for an interpretation. Should the discovery and notification occur after the execution of a contract, any additional work required for compliance with said regulations shall be paid for as covered by other specifications of the Contract Documents, providing no work or fabrication of materials has been accomplished in a manner of non-compliance. Should the Contractor fabricate and/or install materials and/or workmanship in such a manner that does not comply with the applicable codes, rules and regulations, the Contractor who performed such work shall bear all costs arising in correcting these deficiencies to comply with said rules and regulations.

1.6 CONTRACT DOCUMENTS

A. These specifications are accompanied by drawings of the building and details of the installations indicating the locations of equipment, piping, ductwork, outlets, switch controls, circuits, lines, etc. The drawings and these specifications are complementary to each other, and what is required by one shall be as binding as if required by both.

B. If the Contractor deems any departures from the drawings necessary, details of such departures and the reasons therefore shall be submitted to the Architect for review. No departures shall be made without prior written acceptance.

C. There are intricacies of construction that are impractical to specify or indicate in detail; however, in such cases the current rules of good practice and applicable specifications shall govern.

D. It is the Contractor's responsibility to properly use all information found on the Civil, Architectural, Structural, Mechanical and Electrical drawings where such information affects their work.

E. All dimensional information related to new structures should be taken from the appropriate drawings. All dimensional information related to existing facilities shall be taken from actual measurements made by the Contractor on the site.

F. The interrelation of the specifications, the drawings, and the schedules is as follows: The specifications determine the nature and setting of the several materials, the drawings establish the quantities, dimensions and details, and the schedules give the performance characteristics.

G. Should the drawings or specifications disagree within themselves, or with each other, the better quality of greater quantity of work or materials shall be estimated upon, and unless otherwise directed by the Architect in writing, shall be performed or furnished. Figures indicated on drawings govern scale measurements and large-scale details govern small-scale drawings.

1.7 SPACE AND EQUIPMENT ARRANGEMENT

A. The size of fire protection, plumbing, mechanical, and electrical equipment indicated on the drawings is based on the dimensions of a particular manufacturer. While other manufacturers may be acceptable, it is the responsibility of the Contractor to determine if the equipment he proposes to furnish will fit in the space. Shop drawings shall be prepared to indicate a suitable arrangement.

B. All equipment shall be installed in a manner to permit access to all surfaces. All valves, motors, drives, filters, and other accessory items shall be installed in a position to allow removal for service without disassembly of another part.

C. Maintain all Code required clearances for equipment access.

1.8 FABRICATION DRAWINGS

A. Each contractor shall submit shop drawings whenever (1) equipment proposed varies in physical size and arrangement from that indicated on the drawings, thus causing rearrangement of equipment space, (2) where tight spaces require extreme coordination between ductwork, piping, conduit and other equipment, and (3) where called for elsewhere in the specifications.

B. All required shop drawings, except as hereinafter specified, shall be prepared at a scale of not less than 1/8 inch equal to 1 foot..

1.9 SUPERVISION

A. Each contractor shall keep a competent superintendent or foreman on the job at all times necessary for the timely and proper completion of the work.

B. It shall be the responsibility of each superintendent to study all drawings and become familiar with the work to be done by other trades. The Contractor shall coordinate this work with other trades, and before material is fabricated or installed, make sure that the work will not cause an interference that cannot be resolved without major changes to the drawings. If a conflict between trades arises that cannot be resolved at the jobsite, the matter shall be referred to the Architect for their ruling.

1.10 EXISTING FACILITIES

A. The Contractor shall be responsible for loss or damage to the existing facilities caused by themselves and their workers, and shall be responsible for repairing or replacing such loss or damage. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection and in-service maintenance of all plumbing, heating, air conditioning, and ventilating services for the new and existing facilities. The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, and remove all such temporary protection upon completion of the work. All barricades and safety devices shall be in compliance with OSHA.

B. The Contractor shall provide temporary or new services to all existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.

C. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air conditioning ductwork and equipment, etc., to provide this access and shall reinstall same upon completion of work in the areas affected.

D. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed, all Contractors shall remove and reinstall, in locations approved by the Architect, all devices required for the operation of the various systems installed in the existing construction. This is to include, but is not limited to, temperature control system devices, electrical switches, relays, fixtures, piping, conduit, etc.

E. Outages of services, as required by the new installation, will be permitted only at a time approved by the Architect.

1.11 DEMOLITION AND RELOCATION

A. The Contractor shall modify, remove and/or relocate all materials and items so indicated on the drawings or required by the installation of new facilities. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition.

B. All items that are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean and repair and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.

C. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed and sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Architect. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas of facilities, which must remain in operation during the construction period, shall not be interrupted without prior specific approval of the Architect as hereinbefore specified.

D. All equipment and materials indicated to be removed and not be re-used shall be disposed of by the Contractor. Coordinate with Owner where materials are to be stored.

1.12 OPERATING AND MAINTENANCE INSTRUCTIONS

A. The Contractor shall prepare, in triplicate for the Owner's Manual, complete sets of operating and maintenance instructions, system piping, valving, control and interlock diagrams, manuals, parts lists, etc., for each item of equipment. Include copies of all equipment warranties.

B. In addition, the Contractor shall provide the services of a competent engineer or a technician acceptable to the Architect to instruct a representative of the Owner in the complete and detailed operation of all equipment and systems. These instructions shall be provided for a period of not less than 8 hours to fully accomplish the desired results. Upon completion of these instructions, a letter of release will be required, stating the dates of instruction and the personnel to whom instructions were given. The Contractor shall be responsible for proper maintenance until the instructions have been given to the Owner's maintenance personnel.

1.13 GUARANTEE

A. All work and equipment shall be guaranteed for a period of one year from the date of substantial completion.

B. Guarantee shall be for all labor and materials.

C. Certain items for equipment shall have additional or extended warranties when so specified.

1.14 MATERIALS AND WORKMANSHIP

A. All materials, unless otherwise specified, shall be of current U.S. manufacture, new, free from all defects, and of the best quality of their respective kinds. Materials and equipment shall be installed in accordance with the manufacturer's recommendations and the best standard practice for the type of work involved. All work shall be executed by mechanics skilled in their respective trades, and the installations shall present a neat, workmanlike appearance. Materials, and/or equipment damaged in shipment, or otherwise damaged prior to installation, shall not be repaired at the job site, but shall be replaced with new materials and/or equipment.

B. The responsibility for furnishing the proper equipment and/or material, and to see that it is installed as intended by the manufacturer rests entirely upon the Contractor, who shall request advice and supervisory assistance from the representative of specific manufacturers during the installation.

1.15 FLAME SPREAD PROPERTIES OF MATERIALS

A. Materials and adhesives incorporated in this project shall conform to NFPA 255, latest edition. The classification shall not exceed No. 2, with the range of indices between 0 to 25 for these Classifications as listed in the Federal Specifications. Modifications shall be made to insulating materials, etc., as required to comply with the Federal Specification.

1.16 LARGE APPARATUS

A. Any large piece of apparatus which is to be installed in any space in the building, and which is too large to permit access through stairways, doorways, or shafts shall be brought to the job and placed in the space before the enclosing structure is completed. Following placement in the space, such apparatus shall be thoroughly, completely protected from damage as hereinafter specified.

1.17 SLEEVES, INSERTS AND FASTENINGS

A. Proper openings through floors, walls, roofs, etc., for the passage of piping, ductwork, etc., shall be provided. All penetrations must pass through sleeves except soil pipe installed under concrete slabs on fill. Sleeves shall be set in new construction before concrete is poured, as cutting holes through any part of the concrete will not be permitted unless acceptable to the Architect.

B. Pipes passing through concrete or cinder walls and floor or other corrosive material shall be protected by a protective sheathing or wrapping or by sleeves, as required to meet the local code. Annular spaces between sleeves and pipes shall be filled or tightly caulked in an approved manner. Annular spaces between sleeves and pipes in fire-resistance-rated assemblies shall be filled or tightly caulked in accordance with the local code.

C. The minimum clearance between horizontal penetrations including insulation where applicable, and sleeves shall be 1/4 in., except that the minimum clearance shall be 2 in. where piping contacts the ground. Sleeves through walls and partitions shall be installed flush with exposed surfaces. Sleeves through floors shall be extended 2 in. above finished floor.

D. Above grade and dry location sleeves shall be constructed from 20 to 22 gauge galvanized steel. Sleeves passing through walls or floors on or below grade and/or moist areas such as mechanical rooms shall be constructed of galvanized steel Schedule 40 pipe and shall be designed with suitable flange in the center of the floor or wall to form a waterproof passage. After the pipes have been installed in the sleeves, void space around the pipe shall be sealed with Link-Seal modular wall and casing seals as manufactured by Thunderline Corporation.

E. Suitable concrete inserts for pipe and equipment hangers shall be set and properly located for all pipe and equipment to be suspended from concrete construction.

F. Fastening of pipes, conduits, etc., in the building shall be as follows: To wood members - by wood screws; to masonry - by threaded metal inserts, metal expansion screws, or toggle bolts, whichever is appropriate for the particular type of masonry; to steel - machine screws or welding (when specifically permitted or directed), or bolts, and to concrete by suitable inserts anchored to reinforcing steel, and poured in place unless other means are acceptable for general use, and will only be permitted where specifically acceptable to the Architect.

G. Under no circumstances will the use of plastic anchors or plastic expansion shields be permitted for any purpose whatsoever.

H. Vermin Proofing: The open space around all ductwork, piping, etc., passing through the ground floor and/or exterior walls shall be sealed with a continuous bead of sealant.

I. The space around piping, ductwork, etc., penetrating walls, ceilings and floors that define air plenums shall be sealed airtight in an acceptable manner. Ceiling plenums used for return air are considered air plenums.

1.18 ACCESS DOORS

A. This Contractor shall provide wall or ceiling access doors for unrestricted access to all concealed shutoff, service or drain valves, and other items of concealed fire protection equipment. All access door locations are not shown on the drawings. It is the Contractor's responsibility to provide access doors at all locations required.

B. Access doors mounted in painted surfaces shall be equal to Milcor (Inland-Ryerson Construction Products Company) manufacture, Style K for plastered surfaces and Style M or DW for non-plastered surfaces. The Style K doors shall be set so that the finished surface of the door is even with the finished surfaces of the adjacent finishes. Access doors mounted on tile surfaces shall be stainless steel materials. Access doors shall be minimum of 18 in. x 18 in. in size.

1.19 CONSTRUCTION REQUIREMENTS

A. The Civil, Architectural, Structural, Mechanical, Plumbing, and Electrical plans and specifications including the General Provisions, Supplemental General Provisions, and other pertinent documents issued by the Architect, are a part of these specifications and the accompanying fire protection drawings, and shall be complied with in every respect. All the above is included in the Contract Documents, and shall be examined by all bidders. Failure to comply shall not relieve the Contractor of responsibility or be used as a basis for additional compensation due to omission of architectural, structural and electrical details from the fire protection drawings.

B. It is the intent of the Contract Documents to provide an installation complete in every respect. In the event that additional details or special construction may be required for work indicated or specified in this section or work specified in other sections, it shall be the responsibility of the Contractor to provide same as well as to provide material and equipment usually furnished with such systems or required to complete the installation, whether mentioned or not.

C. The Contractor shall be responsible for fitting their material and apparatus into the building and shall carefully lay out their work at the site to conform to the structural conditions, to avoid all obstructions, to conform to the details of the installation supplied by the manufacturer of the equipment to be installed and thereby to provide an integrated satisfactory operating installation.

D. The fire protection and associated drawings are necessarily diagrammatic in character and cannot show every connection in detail or every pipe or equipment in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members; therefore, inserts to accommodate pipe hangers shall be set before concrete is poured, and proper openings through floor, walls, beams, etc., shall be provided as hereinafter specified or as otherwise indicated or required. All work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.

E. When the drawings do not give exact details as to the elevation of pipe, ducts, etc., physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Piping and duct systems are generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner, and the plans do not show all required offsets, control lines, pilot lines and other location details. Work shall be concealed in all finished areas. Piping specified to be insulated shall be supported in a manner that will allow the insulation to be installed without gaps. Insulated piping in concealed areas shall be offset with fittings as necessary to permit installation of insulation. Bending of pipes or installing pipes in a strain in order to insulate will not be permitted.

F. All oiling devices and all parts of equipment requiring adjustment shall be easily accessible. Equipment shall be so located and installed as to permit convenient and safe maintenance and future replacement. Piping, ductwork, valve stems, etc., shall not block service space.

1.20 FIRE PROTECTION SUBMITTALS

A. Refer to the Conditions of the Contract (General and Supplementary) and Division 01 Section: SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES for submittal definitions, requirements, and procedures.

B. Submittal of Shop Drawings and product data will be accepted only when submitted by The Contractor. Data submitted from Subcontractors and material suppliers directly to the Architect will not be processed.

C. Submit Shop Drawings and product data on items indicated in the individual sections.

D. Shop Drawings and submittal data shall not be used as requests or proposals for alternate equipment or materials. Refer to Item Product Options and Substitutions elsewhere in this section.

E. THIRD PARTY CERTIFICATION: All Packaged equipment shall be independently Third Party labeled as a system for its intended use by a Nationally Recognized Testing Laboratory (NRTL) in accordance with OSHA Federal Regulations 29CFR1910.303 and .399, as well as NFPA Pamphlet 70, National Electric Code (NEC), Article 90-7.

1.21 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Refer to the Instructions to Bidders and the Division 01 Section SUBSTITUTION PROCEDURES for requirements in selecting products and requesting substitutions.

B. Standards for Materials:

1. These specifications indicate a standard for all materials incorporated into the work, with manufacturer's names and catalog numbers used to establish a grade and quality of materials and equipment. The manufacturer listed on the equipment schedules, or named first in the specifications, is the one on whose equipment the layout is based. Other named manufacturers must meet the indicated performance and space requirements.

2. The approved equal clause used in these specifications is to permit the proposal of unnamed manufacturer's products for the work, and the Architect/Engineer's decision concerning equal products is final.

3. Considerations as to determination of equal products include, but are not limited to, the following:

Materials	Physical Size
Workmanship	Weight
Gauges of Materials	Appearance
Available Local Service Personnel	Performance
Previous successful installations	Capacity
Delivery Schedules	Required Equipment Clearances

C. Requests for substitutions for equipment, materials and apparatus listed in Division 21 Sections must be submitted in writing a **O** prior to the scheduled bid date. Such requests must be accompanied by complete data to permit proper evaluation.

D. BIDS SHALL NOT BE BASED ON UN-APPROVED MATERIALS, EQUIPMENT, OR APPARATUS. UNAPPROVED MATERIAL, EQUIPMENT OR APPARATUS WILL NOT BE ACCEPTED.

E. Should electrical, water, drain, natural gas, structural support, or other similar requirements for alternate equipment, whether named in the specifications or approved as a substitution, be different from requirements for the products used in laying out the project, such changes shall be the responsibility of the Contractor, and shall not result in extra charges to the Owner or Architect/Engineer.

1.22 RECORD DOCUMENTS

A. Refer to the Division 01 Section: CLOSEOUT SUBMITTALS for requirements. The following paragraphs supplement the requirements of Division 01.

B. Mark Drawings to indicate revisions to piping and ductwork, size and location both exterior and interior; including locations of coils, dampers and other control devices, filters, boxes, and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned for column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.); Change Orders; concealed control system devices.

C. Mark Specifications to indicate approved substitutions; Change Orders; actual equipment and materials used.

1.23 PAINTING

A. Field painting of fire protection equipment, piping systems, etc., shall be accomplished under Division 09 of these specifications.

B. Protection of Factory-applied Finishes:

1. Factory-applied finishes on equipment and apparatus installed on the project shall be carefully protected.

2. At the conclusion of the work, and prior to final acceptance of the project, equipment and apparatus shall be thoroughly cleaned of all construction dirt, oil and grease smears, temporary labels, debris, paint droppings, etc.

3. Damaged factory finishes shall be restored to their original condition using procedures, materials and application techniques as set forth in Division 09 found elsewhere in these specifications.

1.24 CLEANING

A. Refer to the Division 01 Section: CLOSEOUT SUBMITTALS for general requirements for final cleaning.

B. Name Plates:

1. All nameplates shall be protected from damage during the construction process.

2. At the conclusion of the work, the nameplates shall be carefully cleaned and left in a fully legible condition.

C. Removal of Rubbish: Each Contractor is responsible for the timely removal of rubbish and trash generated by their work, such as empty cartons, containers, materials crates, etc. Particular attention is called to residue that may present a potential tripping or injury hazard.

1.25 MOTORS AND DRIVES

A. Motors:

1. General: Motors shall be U/L-approved, with copper windings, and with a minimum Service Factor of 1.15. The nominal capacity shall exceed the brake horse-power requirements at duty schedules.

2. Motors 1/2 HP and smaller shall be 120-volt, single-phase with internal overload protection.

3. Motors 3/4 HP and larger shall be 208/230 or 460 -volt, 3-phase, unless scheduled or noted otherwise, and shall have thermal over-load cutouts in each phase as recommended by the motor manufacturer.

4. Motors shall be as manufactured by Century, General Electric, US Motors, Wagner, Westinghouse, or approved equal.

B. Specific requirements:

1. Provide high-efficiency motors for the following:

a. Air-Handling Units, as scheduled.

b. Ventilating Fans, as scheduled.

2. Efficiency ranges shall be as follows:

Nominal HP	Minimum Efficiency	Premium Efficiency
3	86.5	89.5
5	87.5	89.5
7.5	88.5	91.7
10	89.5	91.7
15	91.0	92.4
20	91.0	93.0
25	91.7	93.6
30	92.4	93.6
40	93.0	94.1
50, 60, 75	93.0, 93.6, 94.1	94.5, 95.0, 95.4
100	94.1	95.4

3. Motor efficiency certification shall be included with Product Submittal Data in accordance with Division 01 of these specifications.

4. Variable Speed (Frequency) AC Drives:

a. Where scheduled on the plans, provide and install variable speed (frequency) AC drives for motors.

b. Variable speed (frequency) AC drives shall be as described in Section 23 8965 - MOTOR CONTROLLERS - of these Specifications.

5. Motor Starters and Controllers:

   a. Motor starters and controllers for fans, pumps, air-handling units, compressors, etc., which are not provided as an integral part of a factory-assembled package, shall be provided under Division 23 of the specifications. Refer to Section 23 8965 MOTOR CONTROLLERS.

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS

A. The manufacturer's published instructions shall be followed for preparing, assembling, installing, erecting, and cleaning manufacturer's materials or equipment, unless otherwise indicated. The Contractor shall promptly notify the Architect in writing of any conflict between the requirements of the Contract Documents and the manufacturer's directions and shall obtain the Architect's instructions before proceeding with the work. Should the Contractor perform any such work that does not comply with the manufacturer's directions or such instructions from the Architect, he shall bear all costs arising in connection with the deficiencies.

B. The Contractor shall not receive material or equipment at the jobsite until there is suitable space provided to properly protect equipment from rust, drip, humidity, and dust damage.

C. Capacities shall be not less than those indicated but shall be such that no component or system becomes inoperative or is damaged because of start-up or other overload conditions.

D. Where materials or equipment are specified to be approved, listed, tested, or labeled by the Underwriter's Laboratories, Inc., or constructed and/or tested in accordance with the standards of the American Society of Mechanical Engineers, the Contractor shall submit proof that the items furnished under these sections of the specifications conform to such requirements. The ASME stamp will be acceptable as sufficient evidence that the items conform to the respective requirements.

E. Each major component of equipment shall have the manufacturer's name, address, and catalog number on a plate securely attached to the item of equipment. All data on nameplates shall be legible at the time of Final Observation.

F. Standard factory finish will be acceptable on equipment specified by model number; otherwise surfaces of ferrous metal shall be given a rust-inhibiting coating. The treatment shall withstand 200 hours in salt-spray fog test, in accordance with Method 6061 of Federal Standard No. 141. Immediately after completion of the test, the specimen shall show no signs of wrinkling or cracking, and no signs of rust creepage beyond 1/8 in. on either side of the scratch mark. Where rust-inhibitor coating is specified hereinafter, any treatment that will pass the above test is acceptable, unless a specific coating is specified, except that coal tar or asphalt type coatings will not be acceptable, unless so stated for a specific item. Where steel is specified to be hot-dip galvanized, mill-galvanized sheet steel may be used provided all raw edges are painted with a zinc-pigmented paint conforming to Military Specification MIL-P-6215.

G. Belts, pulleys, chains, gears, couplings, projecting setscrews, keys and other rotating parts located so that any person can come in close proximity thereto, shall be fully enclosed or properly guarded.

H. The Contractor shall be responsible for the coordination and proper relation of their work to the building structure and to the work of all trades. The Contractor shall visit the premises and become familar with all details of the work and working conditions, to verify all dimensions in the field, and to advise the Architect of any discrepancy before performing any work. Adjustments to the work required, in order to facilitate a coordinated installation, shall be made at no additional cost to the Owner.

2.2 PROTECTION

A. The Contractor shall at all times take such precautions as may be necessary to properly protect all materials and equipment from damage from the time of delivery until the completion of the work. This shall include the erection of all required temporary shelters and supports to adequately protect any items stored in the open on the site from the weather, the ground and surrounding work; the cribbing of any items above the floor of the construction; and the covering of items in the incomplete building with tarpaulins or other protective covering. Failure on the part of the Contractor to comply with the above will be sufficient cause for the rejection of the items in question.

B. Take particular care not to damage the building structure in performing work. All finished floors, steel treads, and workmen or their tools and equipment shall cover finished surfaces to prevent any damage during the construction of the building.

C. Equipment and materials shall be protected from rust both before and after installation. Any equipment or materials found in a rusty condition at the time of final observation must be cleaned of rust and repainted as specified elsewhere in these specifications.

2.3 COOPERATION BETWEEN TRADES AND WITH OTHER CONTRACTORS

A. Each trade, subcontractor and/or contractor must work in harmony with the various other trades, subcontractors, and/or contractors on the job as may be required to facilitate the progress to the best advantage of the job as a whole. Each trade, subcontractor, and/or contractor must pursue the work promptly and carefully as not to delay the general progress of the job. This Contractor shall work in harmony with contractors working under other contracts on the premises.

2.4 PRECEDENCE OF MATERIALS

A. These specifications and the accompanying drawings are intended to cover systems which will not interfere with the structural design of the building, which will fit into the available space, and which will insure complete and satisfactory systems. Each Contractor shall be responsible for the proper fitting of their own material and apparatus into the building.

B. Each Contractor shall so harmonize their work with that of the other trades so that it may be installed in the most direct and workmanlike manner without hindering or handicapping the other trades. Piping interferences shall be handled by giving precedence to pipelines that require a stated grade for proper operation. Where space requirements conflict, the following order of precedence shall, in general, be observed:

1. Building lines

2. Structural members

3. Drain piping

4. Vent piping
5. Steam piping
6. Condensate piping
7. Refrigerant piping
8. Electrical bus duct
9. Supply ductwork
10. Return ductwork
11. Exhaust ductwork
12. Chilled water and heating water piping
13. Automatic Fire Protection Sprinkler Piping
14. Natural gas piping
15. Domestic hot and cold water piping
16. Electrical conduit

2.5 LOCATION OF OUTLETS IN ROOMS

A. All fire protection, plumbing, acoustical tile, diffusers, grilles, registers, and other devices shall be referenced to coordinated, established data points and shall be located to present symmetrical arrangements with these points and to facilitate the proper arrangements of acoustical tile panels and other similar panels with respect to the mechanical and electrical outlets and devices. Those mechanical and electrical outlets shall be referenced to such features as wall and ceiling furrings, balanced border widths, masonry joints, etc. Outlets in acoustical tile shall occur symmetrically in tile joints or in the center of whole tiles. When locations of mechanical and electrical devices shown on the Architect's reflected ceiling plans need to be modified, the final determination of the exact location of each outlet and the arrangement to be followed shall be acceptable to the Architect.

B. The drawings show diagrammatically the location of the various outlets and apparatus. Exact locations of these outlets and apparatus shall be determined by reference to the general plans and to all detail drawings, equipment drawings, roughing-in drawings, etc., by measurements at the building, and in cooperation with the other trades. The Architect reserves the right to make any reasonable change in location of any outlet or apparatus before installation, without additional cost to the Owner.

C. The Contractor, by submitting a bid on this work, sets forth that they have the necessary technical training and ability, and that they will install their work in a satisfactory and workmanlike manner which is up to the best standards of the trade, complete, and in good working order. If any of the requirements of the drawings and specifications are impossible of performance, or if the installation, when made in accordance with such requirements, will not perform satisfactorily, the Contractor shall report it to the Architect for correction promptly after discovery of the discrepancy.

PART 3 - INSTALLATION

3.1 INSTALLATION METHODS

A. All pipes shall be concealed in pipe chases, walls, furred spaces, or above the building, unless otherwise indicated.

B. Piping may be run exposed in mechanical rooms, janitors' closets, or storage spaces, but only where necessary. All exposed piping shall be run in the neatest, most inconspicuous manner, and parallel or perpendicular to the building lines.

C. All piping shall be adequately and properly supported from the building structure by means of hanger rods or clamps to walls as herein specified.

D. Where limited space is available above the ceilings and below concrete beams or other deep projections, pipe and conduit shall be sleeved through the projection where it crosses, in a manner to provide maximum above-floor clearance. Sleeves shall be as specified or as required.

E. All pipe, conduits, etc., shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing. All ducts, pipes and conduits run, exposed in machinery and equipment rooms, shall be installed parallel to the building plans, except as otherwise shown. Conduits in furred ceilings and in other concealed spaces may be run at angles to the construction but shall be neatly grouped and racked indicating good workmanship. All conduit and pipe openings shall be kept closed until the systems are closed with final connections.

F. There shall be no pipe joints nearer than 12 in. to a wall, ceiling, or floor penetration, unless pipe joint is the welded type joint.

G. The Contractor shall study all construction documents and carefully lay out all work in advance of fabrication and erection in order to meet the requirements of the extremely limited spaces. Where conflicts occur, the Contractor shall meet with all involved trades and the Architect and resolve the conflict, prior to erection of any work, in the area involved.

3.2 CUTTING AND PATCHING

A. Cut and patch openings through walls, floors, etc., resulting from work in existing construction or by failure to provide proper openings or recesses in new construction.

B. Openings cut through concrete and masonry shall be made with masonry saws and/or core drills at locations acceptable to the Architect. Impact-type equipment will not be used, except where specifically acceptable to the Architect. Openings in Precast concrete slabs for pipes, conduits, outlet boxes, etc., shall be core drilled or cast to exact size.

C. All openings shall be restored to as-new condition under the appropriate Specification Section for the materials involved, and shall match remaining surrounding materials and/or finishes.

D. Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry. Adequate supports shall be provided during the cutting operation to prevent any damage to the masonry occasioned by the operation. All structural members, supports, etc., shall be of the proper size and shape, and shall be installed in a manner acceptable to the Architect.

E. All fire protection work in areas containing plaster shall be completed prior to the application of the finish plaster coat. Cutting of finish plaster coat will not be permitted.

F. No cutting, boring, or excavating, which will weaken the structure, shall be undertaken. NO STRUCTURAL MEMBER MAY BE CUT WITHOUT THE WRITTEN APPROVAL OF THE ARCHITECT.

3.3 FABRICATION OF PIPE

A. All the various piping systems shall be made up straight and true and run at proper grades to permit proper flow of the contained material. Lines shall also be graded for proper drainage.

B. Piping shall follow as closely as possible the routes shown on plans, but shall take into consideration conditions to be met at the site.

C. Should any unforeseen conditions arise, lines shall be changed or rerouted as required after approval has been obtained.

D. All piping shall be installed with due regard to expansion and contraction and so as to prevent excessive strain and stress in the piping, in connections, and in equipment to which lines are connected.

E. All piping shall be clean when it is installed. Before installation it shall be checked, upended, swabbed, if necessary, and all rust or dirt from storage shall be removed. Pipe shall not be permitted to lie on the ground during storage. Pipe ends shall be sealed during storage.

3.4 IDENTIFICATION AND LABELING

A. The Contractor shall make it possible for the personnel operating and maintaining the equipment and systems in this project to readily identify the various pieces of equipment, valves, piping, etc., by marking them.

B. The Contractor shall install identification tags to be affixed to those valves that have functions that are not obvious. For example, it would not be expected that valves at a pressure reducing station in a machine room would be tagged. The valve identification tags shall be brass discs, 2 in. in diameter. Each tag shall be attached to its valve with copper clad annealed iron wire or other approved material.

3.5 TESTS AND INSPECTIONS

A. The Contractor shall, during the progress of the work and upon its completion, test their work and make all tests as required by the specifications, state, municipal and other authorities having jurisdiction of the work. Piping pressure tests shall be made before pipe is concealed or covered. Tests shall be made in the presence of authorities requiring tests. The Contractor shall pay all costs, inspection charges and fees required for the tests of their work.

B. The Contractor shall provide all apparatus, temporary piping connection, etc., required for tests. The Contractor shall take all due precautions to prevent damage to the building or its contents incurred by such tests. The Contractor shall repair and make good at their own expense any damage caused by failures or leaks during the tests.

C. Leaks, defects or deficiencies shall be repaired and/or replaced, and tests shall be repeated until the test requirements are complied with fully.

D. All equipment shall be placed in operation and tested for proper automatic control before the final balancing of the system is started.

E. All tests shall have pertinent data logged by the Contractor at the time of testing. Data shall include date, time, personnel, description, and extent of system tested, test condition, test results, specified results, and any other pertinent data. Data shall be delivered to the Architect.

3.6 COOPERATION AND CLEANUP

A. It shall be the responsibility of each trade to cooperate fully with the other trades on the job to help keep the job site in a clean and safe condition. At the end of each day's work, each trade shall properly store all of their tools, equipment and materials and shall clean their debris from the job. Upon the completion of the job, each trade shall immediately remove all of their tools, equipment, any surplus materials and all debris caused by their portion of the work.

3.7 CLEANING AND PAINTING

A. All equipment, piping, ductwork, grills, insulation, etc., in finished areas furnished and installed by the Contractor shall be painted. Finished areas include mechanical rooms, boiler rooms, and outside the building as well as occupied areas inside the building. Final painting is to be done by the General Contractor. This Contractor shall thoroughly clean all part of materials and equipment of cement, plaster, and other materials, and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out. Exposed metal work shall be carefully brushed down with steel brushes to remove rust and other spots and left smooth and clean.

B. This Contractor shall thoroughly clean the finish on all parts of the materials and equipment with factory applied finishes. Exposed parts in equipment rooms, above crawl space slabs, and all other spaces except sealed chases and attics shall be thoroughly cleaned of cement, plaster and other materials, and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out. If the finish has been damaged, the Contractor shall re-paint to the satisfaction of the Architect.

C. No nameplates on equipment shall be painted, and suitable protection shall be afforded to the plates to prevent their being rendered illegible during painting operation.

3.8 ELECTRICAL PROVISIONS OF FIRE PROTECTION WORK

A. The extent of electrical provisions to be provided as fire protection work is indicated in other sections of the specifications, on the drawings and as further specified in this section.

B. Starters, Controllers: In general, fire protection work includes furnishing combination starters. Controllers are specifically included as electrical work when mounted in motor control centers. Electrical work includes installation, mounting and wiring of starters and controllers that are furnished as mechanical work. Free standing, large motor controllers shall be set in place, on pads, as fire protection work.

C. Wherever possible, match the elements of the electrical provisions of fire protection work with similar elements of the electrical work specified in electrical sections of the specifications.

D. Standards:

1. For electrical equipment and products, comply with applicable NEMA standards, and refer to NEMA standards to definitions of terminology herein.

2. Comply with National Electrical Code (NFPA No. 70) for installation requirements.

3. Comply with National Electrical Contractors Association (NECA) Standard of Installation .

3.9 TEMPORARY FACILITIES

A. Unless noted otherwise in the Supplementary General Conditions; provide temporary facilities.

3.10 EQUIPMENT INSTALLATION REQUIREMENTS

A. All fire protection equipment shall be furnished and installed complete and ready for use.

END OF SECTION 21 0010

SECTION 21 0506 - FIRE PROTECTION DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Demolition of:

1. Fire protection equipment and associated piping.

2. Hanger and support devices.

3. All other appliances or devices associated with equipment or devices to be removed.

1.2 QUALITY ASSURANCE

A. Perform all demolition and removal work necessary to arrive at the arrangement shown on the Contract Drawings.

B. Perform all operations in such a method to cause minimum damage to items to be relocated, salvaged, or to remain intact and in use.

1.3 JOB CONDITIONS

A. Perform site repair and removal of salvaged items at times approved by the Owner. Accomplish repair and removal of items in a continuous and diligent manner in order to limit interference with Owner's on-going operations.

B. Drawings may not indicate and specifications may not identify every item required to be moved or removed.

C. Before submitting bids, visit and examine the site of the work and become familiar with the scope of the work and the details of the demolition work to be accomplished.

D. Submittal of a bid will be evidence that such an examination has been made and the various details noted.

E. Claims for extra compensation because of additional labor, materials, or equipment required because of difficulties encountered, will not be recognized unless items were concealed at time of inspection of the Contract Documents. Bring all such items to the attention of the Owner's Representative and the Architect for their disposition before continuing with the work.

F. Execute demolition work in a manner to protect adjacent equipment and other existing items against damage.

G. Provide and erect lights, barricades, warning signs, and other items as required for protection of the Owner's employees, building occupants, and the public.

H. Maintain barricades in good condition throughout the project to substantial completion.

I. Control the dust resulting from demolition to prevent it from spreading the occupied areas of the building and to avoid creating a nuisance in the immediate surrounding area.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 PROTECTION

A. Provide protection for all building elements, all items which are to remain, all occupants and all workers at all times, and in accordance with all requirements of the Owner.

3.2 PROTECTION OF BUILDING FROM THE WEATHER

A. Maintain weather protection for the space(s) being worked in at all times, and in accordance with all requirements of the Owner.

3.3 DEMOLITION

A. Perform demolition in accordance with all requirements of the Owner.

3.4 DISPOSITION OF MATERIALS

A. Dispose of all demolition items and materials in a legal off-site location.

3.5 RELOCATION AND REUSE OF PLUMBING ITEMS

A. Relocate items indicated on the Contract Drawings as required to accommodate the new construction. Remove, relocate and reconnect equipment and accessories that are to be reused.

B. Coordinate the work with the Electrical Contractor. Determine which items and equipment are to remain, to be relocated or to be removed. Perform the work consistent with the scope of the project.

C. Transport and store materials removed and designated for relocation as directed by the Owner's Representative.

D. Remove all salvage items not be reused or delivered to the Owner, from the property at the end of each workday.

E. Maintain full water, drain, electrical service, etc., to all equipment and apparatus that remains in service in the building.

3.6 CLEANING

A. Section 21 0010 - BASIC FIRE PROTECTION REQUIREMENTS

3.7 REMOVAL OF WATER

A. Be responsible for the removal of water in areas in which scheduled work is to be performed.

1. Remove water by pumping, siphoning, absorbent mopping, or compressed air brooming.

2. Do not use any method of removal that will cause damage to new or reused adjacent equipment or materials.

3.8 SCHEDULING

A. Schedule demolition in strict compliance with the Owner's instructions.

3.9 DISCONNECTION AND RECONNECTION OF UTILITIES

A. Do not disconnect or reconnect any utilities until notifying the Owner's Representative.

B. Notify the Electrical Contractor when requiring Electrical Disconnect or Reconnect.

END OF SECTION 21 0506

SECTION 21 0512 - FIRE PROTECTION AND ELECTRICAL COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Refer to Section 260510 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.

B. Refer to Section 21 0010 - BASIC FIRE PROTECTION REQUIREMENTS.

C. Refer to Section 22 0010 - BASIC PLUMBING REQUIREMENTS.

D. Refer to Section 23 0010 - BASIC MECHANICAL REQUIREMENTS.

1.2 SUMMARY

A. This Section describes the coordination between the Fire Protection, Plumbing, Mechanical and Electrical portions of the work.

B. This Section is included under the Division 21 portion of the Specifications as Section 21 0512, under the Division 22 portion of the Specifications as Section 22 0512, under the Division 23 portion of the Specifications as Section 23 0512, and under the Division 26 portion of the Specifications as Section 260512.

1.3 WORK INCLUDED

A. Responsibility: Unless otherwise indicated, motors and controls shall be furnished, set in place and wired in accordance with the following schedule. **This schedule may include equipment and systems that are not required for this project. Only the equipment and systems that are required on the drawings and/or specified elsewhere will be required by this section:**

	ITEM	FURNISHED UNDER DIVISION	INSTALLED UNDER DIVISION	WIRED AND CONNECTED UNDER DIVISION
1.	Equipment Motors	21/22/23	21/22/23	26
2.	Magnetic Motor Starters			
	a. Automatically controlled, with or without HOA switches	21/22/23	26	Notes 1,3,5
	b. Automatically controlled, with or without HOA switches and furnished as part of factory wired equipment	21/22/23	22/23	Notes 1,3,5
	c. Manually controlled	21/22/23	26	Notes 1,3,5
	d. Manually controlled and furnished as part of factory wired equipment	21/22/23	26	Notes 1,3,5
	e. Furnished in Motor Control Centers	26	26	Notes 1,3,5
3.	Variable Speed (Frequency) AC Drives	22/23	26	Notes 1,4,5

	ITEM	FURNISHED UNDER DIVISION	INSTALLED UNDER DIVISION	WIRED AND CONNECTED UNDER DIVISION
4.	Line voltage thermostats, time clocks, etc., not connected to control panel systems	23	26	23
5.	Electric thermostats, time clocks, remote bulb thermostats, motorized valves, float controls, etc. which are an integral part or directly attached to ducts, pipes, etc.	22/23	22/23	22/23
6.	Temperature control panels and time switches mounted on temperature control panels	23	23	23
7.	Motorized valves, motorized dampers, solenoid valves, EP and PE switches, etc.	23	23	Note 1
8.	Alarm bells furnished with equipment installed by Division 22 or 23	22/23	22/23	22/23
9.	Wiring to obtain power for control circuits, including circuit breaker	21/22/23	21/22/23	21/22/23
10.	Low voltage controls	21/22/23	21/22/23	21/22/23
11.	Fire protection system (sprinkler) controls	21	21	Note 8
12.	Fire and smoke detectors installed on mechanical units and in ductwork	28	23	Note 8
13.	All relays required for fan shutdown, motorized dampers, smoke control devices, and other items integral with HVAC equipment to provide operation and control of HVAC equipment	23	23	Note 1
14.	Smoke dampers, and combination fire/smoke dampers	23	23	Note 7
15.	Boiler and water heater controls, boiler burner controls panels	22/23	22/23	22/23
16.	Pushbutton stations, pilot lights	22/23	22/23	22/23
17.	Heat Tape	21/22/23	21/22/23	26
18.	Disconnect switches, manual	21/22/23	21/22/23	Notes 1,5

	ITEM	FURNISHED UNDER DIVISION	INSTALLED UNDER DIVISION	WIRED AND CONNECTED UNDER DIVISION
	operating switches furnished as a part of the equipment			
19.	Disconnect switches, manual operating switches furnished separate from equipment	26	26	26
20.	Multispeed switches	23	23	26
21.	Thermal overloads	21/22/23	21/22/23	21/22/23
22.	Control relays, transformers	21/22/23	21/22/23	21/22/23
23.	Refrigeration cycle, cooling tower and controls	23	23	23
24.	Tamper switches for fire protection (sprinkler) system	21	21	28
25.	Flow and/or pressure switches for fire protection (sprinkler) system	21	21	28
26.	Fire and jockey pump controllers and automatic transfer switch	21	21	Note 6
27.	Alarm bells or horns for fire protection (sprinkler) system	21	21	28
28.	Generator (underground) fuel tank	22	22	--
29.	Generator fuel level indicator	22	22	26
30.	Generator fuel piping from tank to generator	22	22	--
31.	Underground fuel tank leak detection and monitoring system	22	22	22

NOTES:
(1) Power wiring as defined in Section 262913 of the specifications shall be provided under Division 26; control wiring as defined in Section 262913 of the specifications shall be provided under Division 21/22/23.
(2) Wiring from alarm contacts to alarm systems provided by Division 26, wiring from auxiliary contacts to air handling system controls provided by Division 23. Division 26 shall provide power to smoke detector. Smoke detectors required for all air handling systems 2000 CFM or greater. Refer to other Division 23 specifications, Division 26 and Drawings for more specific requirements.
(3) For requirements for Magnetic Motor Starters, refer to Section 23 8965 - MOTOR CONTROLLERS.
(4) For requirements for Variable Speed (Frequency) AC drives, refer to Section 23 8965 - MOTOR CONTROLLERS.

(5) Disconnect switches, operating switches, starters and other similar items that are factory-mounted, as a part of complete assembly, shall comply with applicable provisions of the National Electric Code. All such disconnect switches shall be fused.

(6) Power wiring from energy source to controllers and automatic transfer switch provide shall be provided under Division 26. Interconnection power and control wiring from controllers and automatic transfer switch to pumps shall be provided under Division 21, 22 or 23 and conforming to Division 26 specifications. Control wiring from automatic transfer switch to generator starter shall be provided under Division 26.

(7) Division 26 will provide power to all smoke and combination fire/smoke dampers, and Division 28 will provide control for all such dampers using area smoke detectors.

(8) Wiring for sprinkler system controls to be provided by Division 21. Wiring from devices to Fire Alarm System to be provided by Division 28.

B. CONNECTIONS: Make all connections to controls that are directly attached to ducts, piping and mechanical equipment with flexible connections.

C. PRECEDENCE

1. In general, piping systems that require a stated grade for proper operation shall have precedence over other systems.

2. Precedence for pipe, conduit and duct systems shall be as follows.

a. Building lines

b. Structural members

c. Soil and drain piping

d. Vent piping

e. Steam piping

f. Condensate piping

g. Refrigerant piping

h. Electrical bus duct

i. Supply ductwork

j. Return ductwork

k. Exhaust ductwork

l. Chilled water and heating water piping

m. Automatic Fire Protection Sprinkler Piping

n. Natural gas piping

o. Domestic hot and cold water piping

p. Electrical conduit

3. Lighting Fixtures shall have precedence over air grilles and diffusers.

D. FINAL INSPECTION AND REPORT

1. At the completion of the work, there shall be a meeting of the Fire Protection, Plumbing, Mechanical, Electrical Fire Alarm and Temperature Control Contractors, representatives of mechanical and electrical equipment manufactures whose equipment was actually installed on the project, and similarly-involved individuals, who shall thoroughly inspect all systems, and who shall mutually agree that all equipment has been properly wired and installed, and that all temperature and safety controls are properly functioning. A written report of this meeting, listing those in attendance, and the companies that they represent, shall be filed with the Owner and Architect or Engineer.

END OF SECTION 21 0512

SECTION 21 1313 - FIRE PROTECTION SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes labor and materials for the installation of a hydraulically calculated, automatic fire sprinkler system(s), complete in all respects and ready for operation.

1. Work includes the design of a hydraulically calculated, wet-pipe, automatic sprinkler system, designed for 100 coverage of the renovated project area.

2. Design and installation of the sprinkler system shall be such that no parts interfere with general construction, doors, windows, heating, plumbing, air conditioning systems or electrical equipment.

B. System components for each zone shall include, but not be limited to:

1. one control valve and test/drain assembly.

2. Drain valve.

3. Waterflow switches.

4. Valve supervisory switches.

5. Piping.

6. Sprinkler heads.

1.3 SYSTEM DESCRIPTION

A. The existing sprinkler system shall be modified so that the renovated project area is provided with an automatic fire sprinkler system supplied by a pressurized water supply (Municipal water main) to fusible sprinkler heads for the control of fire.

B. The sprinkler system shall be hydraulically designed to meet the more stringent of the requirements of the 2013 Edition of NFPA 13.

C. Work shall be installed in accordance with NFPA 13 and Owner’s direction. Devices and equipment shall be listed by Underwriters’ Laboratories, Inc. or Factory Mutual-approved, individually and as a system, as applicable.

D. Coordinate the location of sprinkler heads and piping such that it does not interfere with the installed ceiling configuration or other building construction and equipment. Locate heads in center of ceiling tiles and/or as directed by the owner or architect.

1.4 HYDRAULIC CALCULATIONS

A. Prepare hydraulic calculations in accordance with NFPA 13 and with the following exceptions:

1. Provide a minimum safety factor of 10 psi on all hydraulically calculated sprinkler systems.

B. Hydraulic calculations shall be performed by a State of Texas Licensed Responsible Managing Employee (RME) in the direct employ of the fire protection contractor, or by a Texas State Registered Professional Engineer (P.E.).

C. A recent fire flow test shall be the basis for the fire sprinkler design.

1.5 SUBMITTALS

A. Contractor's Qualification Data: Copies of fire sprinkler firm's TDI registration, RME-G License and TDI required liability insurance.

B. Product Data: For each type of product indicated

C. Shop Drawings: Submit 3 (three) full-size sets of shop drawings for review. Plans must include the following:

1. A "Wet" RME or Texas Professional Engineer's signature and stamp, is required on all plan drawings and calculations.

2. Plans shall be clear and legible and all sheets shall be in a common and appropriate scale;

3. The following information shall be provided on the plans:

a. Site plan showing location of the building, all fire hydrants, fire lanes, fire department connections and the fire service main location.

b. Scale.

c. Floor plan.

d. Square footage.

e. Location of doors.

f. Intended use of each room is identified.

g. North arrow provided.

h. Location of the Fire Department Connection (FDC).

i. Occupancy classification.

j. Scope of Work.

k. Equipment List.

l. Hydraulic calculations for each design area.

m. A complete full-height cross section of the building.

n. Area of coverage of each sprinkler head.

o. Total area protected by each system.

p. Hydraulic node symbols and schedule.

q. Indicate all Riser Nipples (RN) or Drop Nipples (DN).

r. Elevations of sprinkler lines and node points.

s. Hanger details.

t. Hanger locations.

u. Sprinkler riser diagram.

v. Inspectors test connection detail.

w. Auxiliary drain details.

x. Size and location of standpipe hose stations, if applicable.

y. Description of the design area.

z. Design density of each design area.

aa. Clearly indicate each remote area.

bb. Provide graphic representation of the waterflow analysis.

cc. Provide the water supply test information.

dd. Provide notes to indicate the following;

ee. Design code.

ff. Responsible party with regards to freeze protection. If to be provided by others, indicate and provide drawings to indicate the heaters with your submittal.

4. The title block shall contain the following;

a. Location of the installation.

b. Name and complete address of the business.

c. Name and complete address of the installing company.

d. Licensing information.

e. Date.

f. Drawn by.

5. A legend shall be provided to include:

a. Symbol, sprinkler description, manufacturer, model number, and quantity for each device.

b. Pipe and fittings type.

D. Submit 3 (three) copies of equipment specification booklets containing all materials, equipment and products that are being provided for installation.

1. Materials, equipment and products being used shall be identified in the specification booklets by an arrow or highlighter.

E. Field test reports and certifications for compliance with performance requirements shall be submitted to the owner. Include “Contractor’s Material and Test Certificate for Aboveground Piping”

F. All fire system submittals shall be provided to the UNTS Fire Marshal for review and approval prior to any work.

G. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction including hydraulic calculations

H. Welding certificates.

I. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13, Include Contractor's Material and Test Certificate for Aboveground Piping.

J. Field quality-control reports.

K. Operation and maintenance data.

L. Submit complete “As-Built” set of plans for each fire sprinkler and standpipe system.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Specialist Firm -- The installing contractor shall specialize in the design and installation of fire sprinkler systems and shall be registered as a fire sprinkler contractor by the Texas State Board of Insurance Underwriters (TDI) and shall have in its employ, a Responsible Managing Employee (RME), licensed by the Texas State Board of Insurance Underwriters (TDI). The contractor shall have a minimum of three years of verifiable installation experience with fire sprinkler systems.

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services where needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test performed within past 90 days or less of design.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

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. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with 2013 Edition of NFPA 13.

1.7 PIPING AND FITTINGS

A. Piping and fittings:

1. All exposed, aboveground piping shall be minimum schedule 40 steel pipe , no exception, conforming to ASTM A53 or ASTM A795, Type E, Grade A. Comply with applicable governing regulations and industry standards.

2. Piping and fittings for the fire main installed between the City’s water utility connection and the required backflow prevention device for the fire riser shall be ASTM approved materials for potable water systems.

B. Pipe and fittings shall be domestically manufactured by one of the manufacturers listed in the latest edition of the American Petroleum Institute (API) approved manufacturers listing.

C. Threaded Fittings: Class 150 malleable iron, ANSI B16.3, for pipe sizes 2-inch and less.

D. Malleable Iron Threaded Unions: ANSI B16.3, select for proper piping fabrication and service requirements including style, end connections, and metal-to-metal seats (iron, bronze, or brass), plain or galvanized as specified.

E. Threaded Pipe Plugs: ANSI B16.14.

F. Steel Flanges/Fittings: ANSI B16.5, including bolting, gasketing, and butt weld end connections. Fittings same thickness as pipe.

G. Forged Steel Socket-welding and Threaded Fittings: ANSI Bl6.11, rated to match schedule of connected pipe.

H. Wrought Steel Butt-welding Fittings: ANSI B16.9, except ANSI B16.28 for short radius elbows and returns; rated to match connected pipe.

I. Flanged Fittings: Comply with ANSI B16.5 for bolt-hole dimensioning, materials, and flange thickness.

J. Flange Bolts: Bolts shall be carbon steel ASTM A307 Grade A hexagon head bolts and hexagonal nuts. Where one or both flanges are cast iron, furnish Grade B bolts. Cap screws utilized with flanged butterfly valves shall be ASTM A307 Grade B with hexagon heads.

K. Flange Bolt Thread Lubricant: Lubricant shall be an anti-seize compound designed for temperatures up to 1000 F and shall be Crane Anti-Seize Thread Compound or approved equal.

L. Saddle tap fitting are not allowed.

1.8 MISCELLANIOUS PIPING MATERIALS/PRODUCTS

A. Welding Materials: Comply with ASME Boiler and Pressure Vessels Code, Section 11, Part C, for welding materials.

1. Brazing Materials: American Welding Society, AWS A5.B, Classification B Cup-5.

B. Gaskets for Flanged Joints: 1/16 inch thick for pipe size 10 inches and smaller and 1/8 inch thick for all pipe size 12 inches and larger. Pingtype shall be used between raised face flanges and full face-type between flat face flanges with punched bolt holes and pipe opening. Gaskets shall be Garlock Style 3400 compressed non-asbestos or equal.

C. Dielectric Unions: Provide dielectric unions at all pipe connections between ferrous and nonferrous piping. Unions shall be Delvin as made by Pipeline Seal and Insulator Company or EPCO as made by Epco Sales, Inc. and shall have nylon insulation.

D. Mechanical couplings may only be used for pipe sizes over 2-inch, to engage and lock grooved or pipe ends and to allow for some angular deflection, contraction and expansion.

1. Couplings shall be positive lock type and shall consist of ASTM A536 ductile iron housing, c-shaped composition sealing gasket and carbon steel bolts conforming to ASTM A183.

2. Gasket Material for wet systems shall be EPDM.

3. All couplings shall be UL listed and approved.

4. Provide only full flow (no-fabricated) fittings. Snap joint couplings, outlet couplings, cut-in style couplings, reducing couplings, mechanical-T style couplings, pressfit couplings, and plain end type couplings are not allowed.

5. When mechanical couplings are used, ONLY grooved type fittings and pipe shall be used, no plain end fittings or pipe. Grooved couplings and fittings shall be manufactured by Victaulic, “Firelock” or approved equivalent.

E. Water Flow Switches: Viking or approved equal water flow switch with adjustable retard feature. Switch shall be double-pole double-throw type and shall be rated at least 7 amperes at 125/250 volts.

F. Valve Supervisory Switches:

1. Provide on each valve, controlling or shutting-off sprinkler system where shown on drawings or/and on all valves required by NFPA 13, or any portion thereof.

2. Provide UL listed unit, with either one single pole double throw switch or two single pole double throw switches as required. Switch shall be compatible with installed valve for standard mounting. Manufactured by Potter Roemer No. 6220, or approved equal.

G. Sight Flow Connection: Provide acrylic sight flow connection in all test lines, conforming to NFPA 13.

H. Pressure Gauges: Potter-Roemer No. 6240 or approved equal 3-1/2 inch diameter polished brass case, 1/4 inch NPT male connection, glass enclosed, 0-300 psi dial pressure gauges with isolation valves.

I. All hangers and supports shall comply with NFPA 13.

J. Fire Valve Cabinet (FVC): Where required, Potter-Roemer No. FRC1810 fire-rated, recessed fire valve cabinet consisting of 20 gauge steel cabinet with continuous hinge, re-coatable white polyester finish.

K. Fire Department Valve (FDV): Where required, provide Potter Roemer No. 4060-D, UL Listed and FM approved 2-1/2 cast-brass angle valve with iron hand-wheel, female inlet by 2-1/2 male NST hose thread outlet, 300 pound rating, with female NST hose thread cap with pin lugs and chain.

PART 2 - PRODUCTS

2.1 SPRINKLERS

A. Unless otherwise specified, sprinkler heads shall be a quick response type with standard (155 F) temperature rated glass-bulb, 1/2 inch orifice and a 5.6 K factor.

1. Heads located within the air streams of heat emitting equipment, elevator shafts, boiler rooms and similar areas shall have an intermediate (200 F) temperature rated glass-bulb.

2. Install corrosion-resistant sprinkler heads where they are exposed to weather, moisture, or corrosive vapors.

3. Heads installed where they might receive mechanical injury or are less than 7 feet above the floor level shall be protected with approved guards in accordance with NFPA 13.

4. Sprinklers in areas with suspended ceilings shall have pipe and fittings located above the suspended ceiling.

B. Sprinkler Heads

1. Suspend Ceiling Type:

a. Fully recessed pendent type with white cover plate.

b. In all electrical and mechanical rooms provide high temeperature rated at 200 F pendant type sprinkler heads with sprinkler head guards.

c. The use of o-ring sealed sprinkler heads is prohibited.

2. Hard Ceiling Type: Fully recessed pendent type with white cover plate.

3. Exposed Area Type: Standard upright types with chrome finish.

4. Glass-bulb: Temperature rated for specific area hazard.

5. Guards: Finish to match sprinkler head.

C. Sprinkler heads shall be UL Listed and approved:

1. TYCO

2. VIKING

3. RELIABLE

D. Provide metal cabinet containing a stock of spare sprinkler heads of all types and ratings installed per NFPA 13.

1. Locate cabinet where temperature will not exceed 100 F.

2. Location shall be approved by the Owner.

3. Number of spare sprinklers shall conform to NFPA 13.

4. Provide a sprinkler wrench in the cabinet, for each different type sprinkler head.

E. The use of extended coverage type heads must have prior approval.

F. The use of UL listed flexible type head assemblies are permitted. Any flexible head assemblies used shall be factory pre-assembled equal to Anvil FlexHead. Field assembled flexible head assemblies are not allowed.

2.2 VALVE SUPERVISORY SWITCHES

A. Contractor shall furnish and install supervisory switches. Coordinate wiring of switches with Electrical Contractor.

2.3 WATERFLOW SWITCHES

A. A.Provide Viking VSR-F or equivalent waterflow switches, with adjustable retard feature in the supply pipe to each zone for remote alarm. Switch shall be double-pole single-throw type and shall be rated at least 7 amperes at 125/250 volts.

B. B.Waterflow switches shall be furnished and installed by this Contractor and wired by Fire Alarm or Electrical Contractor. Coordinate wiring of flow switches with appropriate contractor.

2.4 BUILDING FIRE ALARM SYSTEM INTERFACE

A. Each zone control assembly shall provide an alarm signal output to the Building Fire Alarm System whenever there is waterflow in the zone. Coordinate with Fire Alarm Contractor.

B. Each valve which controls the flow of sprinkler system water shall be monitored by the Building Fire Alarm System. Coordinate with Fire Alarm Contractor.

2.5 SPRINKLER INSPECTOR'S TEST ASSEMBLY

A. Provide NFPA 13 compliant UL Listed and approved sprinkler system inspector's test assembly, consisting of sight glass, tamper resistant test orifice, test and drain ball valve, rated for 300 psi, manufactured by AGF Model 1000, or approved equal.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction.

B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

C. Piping and joints shall be full bore reamed, for all joint types.

D. Slag shall be removed and cleaned at all welded joints.

E. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

F. Install unions adjacent to each valve in pipes NPS 2" and smaller.

G. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

H. Install Inspector's Test Connections in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

I. Install sprinkler piping with drains for complete system drainage.

J. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

K. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

L. Install hangers and supports for sprinkler system piping according to NFPA13. Comply with requirements for hanger materials in NFPA 13.

M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

N. Fill sprinkler system piping completely with water.

3.2 PIPING INSTALLATION

A. Piping shall be concealed, except by prior approval of Owner. Install all piping parallel to or at right angles to the column lines of the building wherever possible.

B. Individual sprinkler head piping shall not connect to piping from the bottom of cross-main or branch lines.

C. In electrical rooms, only sprinkler piping which serves the sprinkler heads in that room are allowed.

D. Wet sprinklers shall not be located in rooms containing IT servers or elevator equipment rooms.

E. Grade piping to eliminate traps and pockets and for drainage per NFPA 13. Where air pockets or water traps cannot be avoided, provide gate valves with hose connections for drainage.

F. It shall be the responsibility of the Fire Protection Contractor to coordinate electrical equipment locations with the Electrical Contractor and design the fire protection piping system such that no piping is routed over electrical equipment, unless it serves that room.

G. Changes in direction, branches, offsets etc., shall be made with standard pipe fittings. Holes in the main for branches shall be made with a hole-cutting machine and a standard Weld-O-Let' or 'Thread-O-Let' fitting used. Burning holes in the fire protection System Piping will cause that section of the piping to be cut out and replaced at the Contractor's expense.

H. Pipe shall be reamed to full pipe diameter before joining:

1. Screwed joints shall be made with standard pipe thread and an approved compound applied to the male thread only.

2. Welded joints shall be made in accordance with the procedure outlined in the ANSI piping code.

3. Valves and specialties shall be screwed or flanged joints.

4. Grooved joints shall be made in accordance with manufacturers recommendations with UL listed and approved couplings or weld-o-let connections to pipe mains shall be full bore.

5. Slag, etc. shall be removed.

I. Install unions or flanges at equipment connections and as indicated on the Drawings.

J. Cold-springing piping will not be permitted. Install piping with adequate support to prevent strain on the equipment and to allow for piping system expansion and contraction.

K. Welded joints on pipe runs shall be made with continuous welds and with pipe ends beveled before fabrication. Piping shall be carefully aligned prior to welding and no metal shall project within the pipe.

L. Piping shall be sized as required by applicable codes and as indicated on the Drawings.

M. Provide all test and drain lines as required by NFPA 13.

1. Pressure gauges, signs, and other such standard appurtenances shall be furnished as required for a complete installation in accordance with NFPA 13.

2. Provide nameplate data sign at the zone controlling valve to identify the system as a hydraulically designed system indicating the location and basis for design in accordance with NFPA 13.

3. Install sprinkler piping so that it can be thoroughly drained, and where practicable shall be arranged to drain at the zone drain valve. The zone drain valve shall be capable of a full discharge test without allowing water to flow onto the floor. All drips and drains shall conform to NFPA 13.

4. Field changes in the piping layout or pipe sizes shall not be made without the prior approval of the Owner.

3.3 CUTTING AND PATCHING

A. General: Cut and patch walls, floors, etc., resulting from work or by failure to provide proper openings or recesses in new construction.

B. Methods of Cutting:

1. Openings cut through concrete and masonry shall be made with masonry saws and/or core drills and at such locations acceptable to the Owner.

2. Impact-type equipment shall not be used except where specifically acceptable to the Owner.

3. Openings in precast concrete slabs for pipes, conduits, outlet boxes, etc., shall be core drilled to exact size.

C. Fire Stopping:

1. Holes and penetrations through smoke barriers, fire barriers, fire walls or any other fire rated assembly shall be installed and sealed using an approved U.L. listed assembly. Materials used for fire sealing / draft stopping shall be compatible with the fire sprinkler piping material.A factory certified fire seal contractor shall install and seal these penetrations.

D. Restoration:

1. 1. All openings shall be restored to as-new condition for the materials involved, and shall match remaining surrounding materials and/or finishes.

E. Masonry:

1. Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry.

2. Adequate supports shall be provided during the cutting operation to prevent any damage to the masonry occasioned by the operation.

3. All structural members, supports, etc., shall be of the proper size and shape, and shall be installed in a manner acceptable to the Owner.

4. Special Note: No cutting, boring, or excavating which will weaken the structure shall be undertaken. A Texas Registered Professional Engineer shall be consulted in these cases. Necessary structural repairs shall be designed by a Texas Registered Professional Engineer.

3.4 TESTS AND INSPECTIONS

A. Inspections, examinations and tests required by the authorities or agencies specified shall be arranged and paid for by the Fire Protection Subcontractor, as necessary, to obtain complete and final acceptance of the system as installed. The certificates of inspection shall be in quadruplicate, and shall be delivered to the Owner.

B. Fire protection piping systems shall be hydrostatically tested by the Contractor upon completion of the installation as required by NFPA 13 in the presence of the Owners Representative.

1. The fire protection piping systems shall be hydrostatically tested per the requirements listed in NFPA 13.

2. When hydrostatic and alarm tests have been completed and all necessary corrections made, a material and test certification shall be provided in accordance with NFPA 13.

3. Final inspection shall include full flow testing through the inspectors test connection.

4. Actuation of the flow switch shall occur within one minute of opening of the inspector's test valve.

5. Final tests shall be witnessed by the Owner’s Representative.

C. Sprinkler system zone control assemblies shall be tested to demonstrate proper operation of the flow switch and valve supervisory switch.

D. Arrange and pay for all tests and inspections required by authorities having jurisdiction.

E. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.5 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2” and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2” and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads 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 compound to external pipe threads.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to Quality Assurance Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

I. Steel-Piping, Cut-Grooved Joints: Cut square-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 joints.

J. 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.

K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.6 PERIODIC INSPECTION SERVICE

A. After completion of the fire protection system installation and at the beginning of the guarantee period, the Automatic Sprinkler Subcontractor shall execute the National Automatic Sprinkler and Fire Control Association, Inc., Standard Form of Inspection Agreement , without change in the Contract amount, calling for four inspections of the fire protection system during the warranty period.

B. During the warranty period, inspections shall be in accordance with the Inspection Agreement, plus the following maintenance to be performed during the course of the fourth inspection:

1. Operation of all control valves.

2. Lubrication of operating stems of all interior valves.

3. Operation of all alarms, supervisory switches, air compressors, alarm trip switches, flow switches, and similar items.

4. Cleaning of alarm valves.

5. Lubrication of Fire Department valve hose connections.

6. The standard form of the National Automatic Sprinkler and Fire Control Association, Inc., Report of Inspection , shall be filled out in triplicate after each inspection and the copies sent to the Owner.

3.7 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install double check, fire service rated backflow preventer in connection to potable-water-supply sources.

D. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.

3.8 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

3.9 SPRINKLER AND COVER PLATE (RECESSED SPRINKLER HEADS) INSTALLATION

A. Sprinkler heads and recessed sprinkler cover plates shall be protected from damage, dirt and other deleterious materials during construction. Remove and replace any damaged sprinkler or sprinkler cover plate, or sprinklers or cover plates having any foreign material other than factory finish. Sprinkler heads and cover plates shall not be cleaned unless by a method approved by the manufacturer AND accepted by the Owner.

3.10 ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls, ceilings, and floors.

3.11 SLEEVE INSTALLATION

A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.

B. Sleeves are not required for core-drilled holes.

C. Permanent sleeves are not required for holes formed by removable PE sleeves

D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.

E. Install sleeves in new partitions, slabs, and walls as they are built.

F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint.

G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint.

H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals.

I. Seal space outside of sleeves in concrete slabs and walls with grout.

J. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.12 SLEEVE SEAL INSTALLATION

A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.

B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.13 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

3.14 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3. Flush, test, and inspect sprinkler systems according to NFPA 13, Systems Acceptance Chapter.

4. Energize circuits to electrical equipment and devices.

5. Start and run excess-pressure pumps.

6. Coordinate with fire-alarm tests. Operate as required.

7. Verify that equipment hose threads are NST.

8. Sprinkler system zone control assemblies shall be tested to demonstrate proper operation of the flow switch and valve supervisory switch.

9. Arrange pay for all tests and inspections required by authorities having jurisdiction.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.15 PERIODIC INSPECTION SERVICE

A. Provide periodic inspections service after completion and Owner acceptance.

B. This agreement shall be executed at no cost to the Owner and shall include four inspections of the entire sprinkler system during the warranty period, each with a NASFCA “Report of Inspection to the Owner”. The final inspection shall include operation and lubrication of all valves, cleaning of all alarm valves and operational testing of all system Electrical and alarm components.

3.16 TRAINING

A. The installation contractor shall provide a minimum of 4 hours of training for the Owner in operation and maintenance of the wet-pipe sprinkler system.

END OF SECTION 21 1313

SECTION 23 0010 - BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS AND SUPPLEMENTAL GENERAL PROVISIONS

A. The General Conditions and Supplementary Conditions are by reference made a part of this section and shall apply to each and every heading as though included herein.

B. In the event of conflict, the requirements of the General Conditions and Supplementary Conditions will take precedence over these General Requirements .

1.2 GENERAL

A. The Contractor shall provide all plans, labor, equipment, appliances and materials, and shall perform all operations in connection with the installation of the mechanical work in accordance with the Specifications, applicable drawings, and the conditions specified above.

B. Contractor shall provide all equipment required and usually furnished in connection with such work and systems whether or not specifically mentioned or specifically indicated on the drawings.

1.3 COMMISSIONING

A. The Contractor shall provide all system commissioning services as required by section C408 of the 2018 International Energy Conservation Code (IECC). Mechanical systems shall comply with IECC section C403.

B. Commissioning, as outlined in IECC section C408 shall include the following:

1. A commissioning plan.

2. Air systems balancing.

3. Hydronic systems balancing.

4. Functional performance testing for all mechanical equipment, controls and economizers.

5. A preliminary commissioning report.

6. Final documentation including drawings, O M manual(s), T B report, and final commissioning report.

1.4 INSPECTION OF THE SITE

A. The Contractor shall visit the site, verifying all existing items indicated on drawings and/or specified, and familiarize himself with the existing work conditions, hazards, grades, actual formations, soil conditions, and local requirements. The submission of bids shall be deemed evidence of such visits.

B. All proposals shall take these existing conditions into consideration, and the lack of specific information on the drawings shall not relieve the Contractor of any responsibility.

C. In the event that equipment specified and/or reviewed is not compatible with the existing conditions, the trade furnishing the equipment shall be responsible for notifying the Contractor prior to ordering it.

1.5 PERMITS, UTILITY CONNECTIONS, AND INSPECTIONS

A. Refer to other sections of the specifications for construction phasing and time increments.

B. The Contractor shall obtain and pay for all required utility connections, utility extensions and/or relocations and shall pay all costs and inspection fees for all work included herein.

1.6 APPLICABLE CODES AND STANDARDS

A. The installation shall meet the minimum standards prescribed in the latest editions of the following listed codes and standards, which are made a part of the Specifications, except as may be hereinafter modified in these Specifications and associated drawings.

B. Latest edition of the National Fire Protection Association Standards (NFPA):

1. NFPA No. 70 National Electrical Code

2. NFPA No. 90A Installation of Air Conditioning and Ventilating systems

3. NFPA No. 91 Exhaust systems of Air Conveying of Gases, etc.

4. NFPA No. 96 Ventilation control and Fire Protection of Commercial Cooking Operations

5. NFPA No. 101 Safety to Life from Fire in Buildings and Structures

6. NFPA No. 255 Test of Surface Burning Characteristics of Building Materials

C. United States of America Standards Institute (ASA) Standards:

1. A40.8 National Plumbing Code

2. B31.1 B31.1a Code for Pressure Piping

D. American Society of Mechanical Engineers (ASME): Boiler and Pressure Vessel Codes.

E. Air Conditioning and Refrigeration Institute Standards (ARI): All standards related to refrigeration and air conditioning equipment and piping furnished under these Specifications.

F. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) 1985: All applicable manuals and standards.

G. Air Moving and Conditioning Association (AMCA): All applicable manuals and standards.

H. American Society of Testing and Material (ASTM): All applicable manuals and standards.

I. American Water Works Association (AWWA): All applicable manuals and standards.

J. National Electrical Manufacturer's Association (NEMA): All applicable manuals and standards.

K. City Fire Department as applicable to construction of this site.

L. City and State Building Codes.

M. State of (Texas) Occupational Safety Act: Applicable safety standards.

N. Occupational Safety and Health Act (OSHA).

O. State of (Texas) Energy Conservation Construction Code.

P. All work shall be in accordance with all regulations and requirements of the State of Texas Architectural Barriers Act (TAS).

Q. Refer to Specifications sections hereinafter bound for additional codes and standards.

R. All materials and workmanship shall comply with all applicable state and national codes, specifications, and industry standards. All material shall be listed by the Underwriter's Laboratories, Inc., as conforming to its standards and so labeled in every case where such a standard has been established for the particular type of material in question.

S. All equipment provided and all installation methods shall meet all applicable requirements of the International Energy Conservation Code.

T. The Contract Documents are intended to comply with the aforementioned rules and regulations; however, some discrepancies may occur. Where such discrepancies occur, the Contractor shall immediately apply for an interpretation. Should the discovery and notification occur after the execution of a contract, any additional work required for compliance with said regulations shall be paid for as covered by other specifications of the Contract Documents, providing no work or fabrication of materials has been accomplished in a manner of non-compliance. Should the Contractor fabricate and/or install materials and/or workmanship in such a manner that does not comply with the applicable codes, rules and regulations, the Contractor who performed such work shall bear all costs arising in correcting these deficiencies to comply with said rules and regulations.

1.7 CONTRACT DOCUMENTS

A. These specifications are accompanied by drawings of the building and details of the installations indicating the locations of equipment, piping, ductwork, outlets, switch controls, circuits, lines, etc. The drawings and these specifications are complementary to each other, and what is required by one shall be as binding as if required by both.

B. If the Contractor deems any departures from the drawings necessary, details of such departures and the reasons therefore shall be submitted to the Architect for review. No departures shall be made without prior written acceptance.

C. There are intricacies of construction that are impractical to specify or indicate in detail; however, in such cases the current rules of good practice and applicable specifications shall govern.

D. It is the Contractor's responsibility to properly use all information found on the Civil, Architectural, Structural, Mechanical, Plumbing, Fire Protection, and Electrical drawings where such information affects his work.

E. All dimensional information related to new structures should be taken from the appropriate drawings. All dimensional information related to existing facilities shall be taken from actual measurements made by the Contractor on the site.

F. The interrelation of the specifications, the drawings, and the schedules is as follows: The specifications determine the nature and setting of the several materials, the drawings establish the quantities, dimensions and details, and the schedules give the performance characteristics.

G. Should the drawings or specifications disagree within themselves, or with each other, the better quality of greater quantity of work or materials shall be estimated upon, and unless otherwise directed by the Architect in writing, shall be performed or furnished. Figures indicated on drawings govern scale measurements and large-scale details govern small-scale drawings.

1.8 SPACE AND EQUIPMENT ARRANGEMENT

A. The size of fire protection, plumbing, mechanical, and electrical equipment indicated on the drawings is based on the dimensions of a particular manufacturer. While other manufacturers may be acceptable, it is the responsibility of the Contractor to determine if the equipment he proposes to furnish will fit in the space. Shop drawings shall be prepared to indicate a suitable arrangement.

B. All equipment shall be installed in a manner to permit access to all surfaces. All valves, motors, drives, filters, and other accessory items shall be installed in a position to allow removal for service without disassembly of another part.

C. Maintain all code required clearances for equipment access.

1.9 FABRICATION DRAWINGS

A. Contractor shall submit ductwork fabrication and hydronic piping shop drawings for review by the Architect. Fabrication drawings shall be fully coordinated with ALL other trades and with existing conditions.

B. All required shop drawings, except as hereinafter specified, shall be prepared at a scale of not less than 1/8 in. equal to 1 ft. for floor plans and 1/4 in. equal to 1 ft. for mechanical rooms.

1.10 SUPERVISION

A. Each contractor shall keep a competent superintendent or foreman on the job at all times necessary for the timely and proper completion of the work.

B. It shall be the responsibility of each superintendent to study all drawings and familiarize himself with the work to be done by other trades. He shall coordinate this work with other trades, and before material is fabricated or installed, make sure that his work will not cause an interference that cannot be resolved without major changes to the drawings. If a conflict between trades arises that cannot be resolved at the jobsite, the matter shall be referred to the Architect for his ruling.

1.11 EXISTING FACILITIES

A. The Contractor shall be responsible for loss or damage to the existing facilities caused by him and his workmen, and shall be responsible for repairing or replacing such loss or damage. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection and in-service maintenance of all plumbing, heating, air conditioning, and ventilating services for the new and existing facilities. The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, and remove all such temporary protection upon completion of the work. All barricades and safety devices shall be in compliance with OSHA.

B. The Contractor shall provide temporary or new services to all existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.

C. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air conditioning ductwork and equipment, etc., to provide this access and shall reinstall same upon completion of work in the areas affected.

D. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed, all Contractors shall remove and reinstall, in locations approved by the Architect, all devices required for the operation of the various systems installed in the existing construction. This is to include, but is not limited to, temperature control system devices, electrical switches, relays, fixtures, piping, conduit, etc.

E. Outages of services, as required by the new installation, will be permitted only at a time approved by the Architect.

1.12 DEMOLITION AND RELOCATION

A. The Contractor shall modify, remove and/or relocate all materials and items so indicated on the drawings or required by the installation of new facilities. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition.

B. All items that are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean and repair and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.

C. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed and sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Architect. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas of facilities, which must remain in operation during the construction period, shall not be interrupted without prior specific approval of the Architect as hereinbefore specified.

D. All equipment and materials indicated to be removed and not be re-used shall be disposed of by the Contractor. Coordinate with Owner where materials are to be stored.

1.13 OPERATING AND MAINTENANCE INSTRUCTIONS

A. The Contractor shall prepare, in triplicate for the Owner's Manual, complete sets of operating and maintenance instructions, system piping, valving, control and interlock diagrams, manuals, parts lists, etc., for each item of equipment. Include copies of all equipment warranties.

B. In addition, the Contractor shall provide the services of a competent engineer or a technician acceptable to the Architect to instruct a representative of the Owner in the complete and detailed operation of all equipment and systems. These instructions shall be provided for a period of not less than 4 hours to fully accomplish the desired results. Upon completion of these instructions, a letter of release will be required, stating the dates of instruction and the personnel to whom instructions were given. The Contractor shall be responsible for proper maintenance until the instructions have been given to the Owner's maintenance personnel.

1.14 GUARANTEE

A. All work and equipment shall be guaranteed for a period of one year from the date of substantial completion.

B. Guarantee shall be for all labor and materials.

C. Certain items for equipment shall have additional or extended warranties when so specified.

1.15 MATERIALS AND WORKMANSHIP

A. All materials, unless otherwise specified, shall be of current U.S. manufacture, new, free from all defects, and of the best quality of their respective kinds. Materials and equipment shall be installed in accordance with the manufacturer's recommendations and the best standard practice for the type of work involved. All work shall be executed by mechanics skilled in their respective trades, and the installations shall present a neat, workmanlike appearance. Materials, and/or equipment damaged in shipment, or otherwise damaged prior to installation, shall not be repaired at the job site, but shall be replaced with new materials and/or equipment.

B. The responsibility for furnishing the proper equipment and/or material, and to see that it is installed as intended by the manufacturer rests entirely upon the Contractor, who shall request advice and supervisory assistance from the representative of specific manufacturers during the installation.

1.16 FLAME SPREAD PROPERTIES OF MATERIALS

A. Materials and adhesives incorporated in this project shall conform to NFPA 255, latest edition. The classification shall not exceed No. 2, with the range of indices between 0 to 25 for these Classifications as listed in the Federal Specifications. Modifications shall be made to insulating materials, etc., as required to comply with the Federal Specification.

1.17 LARGE APPARATUS

A. Any large piece of apparatus which is to be installed in any space in the building, and which is too large to permit access through stairways, doorways, or shafts shall be brought to the job and placed in the space before the enclosing structure is completed. Following placement in the space, such apparatus shall be thoroughly, completely protected from damage as hereinafter specified.

1.18 FLOOR AND CEILING PLATES

A. Except as otherwise noted, provide chrome plated brass floor and ceiling plates around all pipes, conduits, ducts, etc., passing exposed through walls, floors, or ceilings, in any spaces, except under floor and attic spaces. Plates shall be sized to fit snugly against the outside of the pipe or against the insulation on lines that are insulated and positively secured to such pipe or insulation. Plates will not be required for piping where pipe sleeves extend 3/4 in. above finished floor. All equipment rooms are classified as finished areas. Round and rectangular ducts shall have plates made to fit accurately at all floor, wall and ceiling penetrations.

1.19 SLEEVES, INSERTS AND FASTENINGS

A. Proper openings through floors, walls, roofs, etc., for the passage of piping, ductwork, etc., shall be provided. All penetrations must pass through sleeves except soil pipe installed under concrete slabs on fill. Sleeves shall be set in new construction before concrete is poured, as cutting holes through any part of the concrete will not be permitted unless acceptable to the Architect.

B. Pipes passing through concrete or cinder walls and floor or other corrosive material shall be protected by a protective sheathing or wrapping or by sleeves, as required to meet the local code. Annular spaces between sleeves and pipes shall be filled or tightly caulked in an approved manner. Annular spaces between sleeves and pipes in fire-resistance-rated assemblies shall be filled or tightly caulked in accordance with the local code.

C. The minimum clearance between horizontal penetrations including insulation where applicable, and sleeves shall be 1/4 in., except that the minimum clearance shall be 2 in. where piping contacts the ground. Sleeves through walls and partitions shall be installed flush with exposed surfaces. Sleeves through floors shall be extended 2 in. above finished floor.

D. Above grade and dry location sleeves shall be constructed from 20 to 22 gauge galvanized steel. Sleeves passing through walls or floors on or below grade and/or moist areas such as mechanical rooms shall be constructed of galvanized steel Schedule 40 pipe and shall be designed with suitable flange in the center of the floor or wall to form a waterproof passage. After the pipes have been installed in the sleeves, void space around the pipe shall be sealed with Link-Seal modular wall and casing seals as manufactured by Thunderline Corporation.

E. Suitable concrete inserts for pipe and equipment hangers shall be set and properly located for all pipe and equipment to be suspended from concrete construction.

F. Fastening of pipes, conduits, etc., in the building shall be as follows: To wood members - by wood screws; to masonry - by threaded metal inserts, metal expansion screws, or toggle bolts, whichever is appropriate for the particular type of masonry; to steel - machine screws or welding (when specifically permitted or directed), or bolts, and to concrete by suitable inserts anchored to reinforcing steel, and poured in place unless other means are acceptable for general use, and will only be permitted where specifically acceptable to the Architect.

G. Under no circumstances will the use of plastic anchors or plastic expansion shields be permitted for any purpose whatsoever.

H. Vermin Proofing: The open space around all ductwork, piping, etc., passing through the ground floor and/or exterior walls shall be sealed with a continuous bead of sealant.

I. The space around piping, ductwork, etc., penetrating walls, ceilings and floors that define air plenums shall be sealed airtight in an acceptable manner. Ceiling plenums used for return air are considered air plenums.

1.20 ACCESS DOORS

A. This Contractor shall provide wall or ceiling access doors for unrestricted access to all concealed shutoff or service valves, strainer, unions, pressure reducing valves, trap primers, water hammer arrestors, heat trace cable junction boxes, and other items of concealed mechanical equipment. All access door locations are not shown on the drawings. It is the Contractor's responsibility to provide access doors at all locations required.

B. Access doors mounted in painted surfaces shall be equal to Milcor (Inland-Ryerson Construction Products Company) manufacture, Style K for plastered surfaces and Style M or DW for non-plastered surfaces. The Style K doors shall be set so that the finished surface of the door is even with the finished surfaces of the adjacent finishes. Access doors mounted on tile surfaces shall be stainless steel materials. Access doors shall be minimum of 18 in. x 18 in. in size.

1.21 CONSTRUCTION REQUIREMENTS

A. The Civil, Architectural, Structural, Fire Protection, Mechanical, Plumbing, and Electrical plans and specifications including the General Provisions, Supplemental General Provisions, and other pertinent documents issued by the Architect, are a part of these specifications and the accompanying mechanical drawings, and shall be complied with in every respect. All the above is included in the Contract Documents, and shall be examined by all bidders. Failure to comply shall not relieve the Contractor of responsibility or be used as a basis for additional compensation due to omission of architectural, structural and electrical details from the mechanical drawings.

B. It is the intent of the Contract Documents to provide an installation complete in every respect. In the event that additional details or special construction may be required for work indicated or specified in this section or work specified in other sections, it shall be the responsibility of the Contractor to provide same as well as to provide material and equipment usually furnished with such systems or required to complete the installation, whether mentioned or not.

C. The Contractor shall be responsible for fitting his material and apparatus into the building and shall carefully lay out his work at the site to conform to the structural conditions, to avoid all obstructions, to conform to the details of the installation supplied by the manufacturer of the equipment to be installed and thereby to provide an integrated satisfactory operating installation.

D. The mechanical and associated drawings are necessarily diagrammatic in character and cannot show every connection in detail or every pipe or equipment in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members; therefore, inserts to accommodate pipe hangers shall be set before concrete is poured, and proper openings through floor, walls, beams, etc., shall be provided as hereinafter specified or as otherwise indicated or required. All work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.

E. When the mechanical drawings do not give exact details as to the elevation of pipe, ducts, etc., physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Piping and duct systems are generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner, and the plans do not show all required offsets, control lines, pilot lines and other location details. Work shall be concealed in all finished areas. Piping specified to be insulated shall be supported in a manner that will allow the insulation to be installed without gaps. Insulated piping in concealed areas shall be offset with fittings as necessary to permit installation of insulation. Bending of pipes or installing pipes in a strain in order to insulate will not be permitted.

F. All oiling devices and all parts of equipment requiring adjustment shall be easily accessible. Equipment shall be so located and installed as to permit convenient and safe maintenance and future replacement. Piping, ductwork, valve stems, etc., shall not block service space.

1.22 MECHANICAL SUBMITTALS

A. Refer to the Conditions of the Contract (General and Supplementary) and Division 01 Section: SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES for submittal definitions, requirements, and procedures.

B. Submittal of Shop Drawings and product data will be accepted only when submitted by The Contractor. Data submitted from Subcontractors and material suppliers directly to the Architect will not be processed.

C. Submit Shop Drawings and product data on items indicated in the individual sections.

D. Shop Drawings and submittal data shall not be used as requests or proposals for alternate equipment or materials. Refer to Item Product Options and Substitutions elsewhere in this section.

E. THIRD PARTY CERTIFICATION: All Packaged equipment shall be independently Third Party labeled as a system for its intended use by a Nationally Recognized Testing Laboratory (NRTL) in accordance with OSHA Federal Regulations 29CFR1910.303 and .399, as well as NFPA Pamphlet 70, National Electric Code (NEC), Article 90-7.

1.23 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Refer to the Instructions to Bidders and the Division 01 Section PRODUCTS AND SUBSTITUTION for requirements in selecting products and requesting substitutions.

B. Standards for Materials:

1. These specifications indicate a standard for all materials incorporated into the work, with manufacturer's names and catalog numbers used to establish a grade and quality of materials and equipment. The manufacturer listed on the equipment schedules, or named first in the specifications, is the one on whose equipment the layout is based. Other named manufacturers must meet the indicated performance and space requirements.

2. The approved equal clause used in these specifications is to permit the proposal of unnamed manufacturer's products for the work, and the Architect decision concerning equal products is final.

3. Considerations as to determination of equal products include, but are not limited to, the following:

Materials	Physical size
Workmanship	Weight
Gauges of Materials	Appearance
Available Local Service Personnel	Performance
Previous successful installations	Capacity
Delivery Schedules	Required Equipment Clearances

C. Requests for substitutions for equipment, materials and apparatus listed in Division 23 Sections must be submitted in writing a **O** prior to the scheduled bid date. Such requests must be accompanied by complete data to permit proper evaluation.

D. BIDS SHALL NOT BE BASED ON UN-APPROVED MATERIALS, EQUIPMENT, OR APPARATUS. UNAPPROVED MATERIAL, EQUIPMENT OR APPARATUS WILL NOT BE ACCEPTED.

E. Should electrical, water, drain, natural gas, structural support, or other similar requirements for alternate equipment, whether named in the specifications or approved as a substitution, be different from requirements for the products used in laying out the project, such changes shall be the responsibility of the Contractor, and shall not result in extra charges to the Owner or Architect/Engineer.

1.24 RECORD DOCUMENTS

A. Refer to the Division 01 Section: CLOSEOUT PROCEDURES for requirements. The following paragraphs supplement the requirements of Division 01.

B. Mark Drawings to indicate revisions to piping and ductwork, size and location both exterior and interior; including locations of coils, dampers and other control devices, filters, boxes, and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned for column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.); Change Orders; concealed control system devices.

C. Mark Specifications to indicate approved substitutions; Change Orders; actual equipment and materials used.

1.25 PAINTING

A. Field painting of mechanical equipment, duct systems, piping systems, etc., shall be accomplished under Division 09 of these specifications.

B. Protection of Factory-applied Finishes:

1. Factory-applied finishes on equipment and apparatus installed on the project shall be carefully protected.

2. At the conclusion of the work, and prior to final acceptance of the project, equipment and apparatus shall be thoroughly cleaned of all construction dirt, oil and grease smears, temporary labels, debris, paint droppings, etc.

3. Damaged factory finishes shall be restored to their original condition using procedures, materials and application techniques as set forth in Division 09 found elsewhere in these specifications.

1.26 CLEANING

A. Refer to the Division 01 Section: CLOSEOUT PROCEDURES for general requirements for final cleaning.

B. Refer to Division 23 Section: TESTING, ADJUSTING, AND BALANCING for requirements for cleaning filters, strainers, and mechanical systems prior to final acceptance.

C. Name Plates:

1. All nameplates shall be protected from damage during the construction process.

2. At the conclusion of the work, the nameplates shall be carefully cleaned and left in a fully legible condition.

D. Removal of Rubbish: Each Contractor is responsible for the timely removal of rubbish and trash generated by his work, such as empty cartons, containers, materials crates, etc. Particular attention is called to residue that may present a potential tripping or injury hazard.

1.27 MOTORS AND DRIVES

A. Motors:

1. General: Motors shall be U/L-approved, with copper windings, and with a minimum Service Factor of 1.15. The nominal capacity shall exceed the brake horse-power requirements at duty schedules.

2. Motors 1/2 HP and smaller shall be 120-volt, single-phase with internal overload protection.

3. Motors 3/4 HP and larger shall be 208/230 or 460 -volt, 3-phase, unless scheduled or noted otherwise, and shall have thermal over-load cutouts in each phase as recommended by the motor manufacturer.

4. Motors shall be as manufactured by Century, General Electric, US Motors, Wagner, Westinghouse, or approved equal.

B. Drives:

1. Belts drives shall be rated for 150 of motor-rated horsepower.

2. Drive assemblies up to two (2) belts shall have adjustable motor sheaves with the mid-point of the adjustment range at the RPM required for the specified performance.

3. On drive assemblies with 3 or more belts, provide fixed motor sheaves for the specified RPM. Provide and install up to 2 pulley changes as necessary to achieve the required air quantities.

4. All multiple-belt drives shall be factory-marked-matched sets.

C. Specific requirements:

1. Provide high-efficiency motors for the following:

a. Air-Handling Units, as scheduled.

b. Ventilating Fans, as scheduled.

2. Efficiency ranges shall be as follows:

Nominal HP	Minimum Efficiency	Premium Efficiency
3	86.5	89.5
5	87.5	89.5
7.5	88.5	91.7
10	89.5	91.7
15	91.0	92.4
20	91.0	93.0
25	91.7	93.6
30	92.4	93.6
40	93.0	94.1
50, 60, 75	93.0, 93.6, 94.1	94.5, 95.0, 95.4
100	94.1	95.4

3. Motor efficiency certification shall be included with Product Submittal Data in accordance with Division 01 of these specifications.

4. Variable Speed (Frequency) AC Drives:

a. Where scheduled on the plans, provide and install variable speed (frequency) AC drives for motors.

b. Variable speed (frequency) AC drives shall be as described in Section 23 8965 - MOTOR CONTROLLERS - of these Specifications.

5. Motor Starters and Controllers:

a. Motor starters and controllers for fans, pumps, air-handling units, compressors, etc., which are not provided as an integral part of a factory-assembled package, shall be provided under Division 23 of the specifications. Refer to Section 23 8965 MOTOR CONTROLLERS.

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS

A. The manufacturer's published instructions shall be followed for preparing, assembling, installing, erecting, and cleaning manufacturer's materials or equipment, unless otherwise indicated. The Contractor shall promptly notify the Architect in writing of any conflict between the requirements of the Contract Documents and the manufacturer's directions and shall obtain the Architect instructions before proceeding with the work. Should the Contractor perform any such work that does not comply with the manufacturer's directions or such instructions from the Architect, he shall bear all costs arising in connection with the deficiencies.

B. The Contractor shall not receive material or equipment at the jobsite until there is suitable space provided to properly protect equipment from rust, drip, humidity, and dust damage.

C. Capacities shall be not less than those indicated but shall be such that no component or system becomes inoperative or is damaged because of start-up or other overload conditions.

D. Where materials or equipment are specified to be approved, listed, tested, or labeled by the Underwriter's Laboratories, Inc., or constructed and/or tested in accordance with the standards of the American Society of Mechanical Engineers or the Air Moving and Conditioning Association, the Contractor shall submit proof that the items furnished under these sections of the specifications conform to such requirements. The ASME stamp or the AMCA label will be acceptable as sufficient evidence that the items conform to the respective requirements.

E. Each major component of equipment shall have the manufacturer's name, address, and catalog number on a plate securely attached to the item of equipment. All data on nameplates shall be legible at the time of Final Observation.

F. Standard factory finish will be acceptable on equipment specified by model number; otherwise surfaces of ferrous metal shall be given a rust-inhibiting coating. The treatment shall withstand 200 hours in salt-spray fog test, in accordance with Method 6061 of Federal Standard No. 141. Immediately after completion of the test, the specimen shall show no signs of wrinkling or cracking, and no signs of rust creepage beyond 1/8 in. on either side of the scratch mark. Where rust-inhibitor coating is specified hereinafter, any treatment that will pass the above test is acceptable, unless a specific coating is specified, except that coal tar or asphalt type coatings will not be acceptable, unless so stated for a specific item. Where steel is specified to be hot-dip galvanized, mill-galvanized sheet steel may be used provided all raw edges are painted with a zinc-pigmented paint conforming to Military Specification MIL-P-6215.

G. Belts, pulleys, chains, gears, couplings, projecting setscrews, keys and other rotating parts located so that any person can come in close proximity thereto, shall be fully enclosed or properly guarded.

H. The Contractor shall be responsible for the coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with all details of the work and working conditions, to verify all dimensions in the field, and to advise the Architect of any discrepancy before performing any work. Adjustments to the work required, in order to facilitate a coordinated installation, shall be made at no additional cost to the Owner.

2.2 PROTECTION

A. The Contractor shall at all times take such precautions as may be necessary to properly protect all materials and equipment from damage from the time of delivery until the completion of the work. This shall include the erection of all required temporary shelters and supports to adequately protect any items stored in the open on the site from the weather, the ground and surrounding work; the cribbing of any items above the floor of the construction; and the covering of items in the incomplete building with tarpaulins or other protective covering. Failure on the part of the Contractor to comply with the above will be sufficient cause for the rejection of the items in question.

B. Take particular care not to damage the building structure in performing work. All finished floors, steel treads, and workmen or their tools and equipment shall cover finished surfaces to prevent any damage during the construction of the building.

C. Equipment and materials shall be protected from rust both before and after installation. Any equipment or materials found in a rusty condition at the time of final observation must be cleaned of rust and repainted as specified elsewhere in these specifications.

2.3 COOPERATION BETWEEN TRADES AND WITH OTHER CONTRACTORS

A. Each trade, subcontractor and/or contractor must work in harmony with the various other trades, subcontractors, and/or contractors on the job as may be required to facilitate the progress to the best advantage of the job as a whole. Each trade, subcontractor, and/or contractor must pursue his work promptly and carefully as not to delay the general progress of the job. This Contractor shall work in harmony with contractors working under other contracts on the premises.

2.4 PRECEDENCE OF MATERIALS

A. These specifications and the accompanying drawings are intended to cover systems which will not interfere with the structural design of the building, which will fit into the available space, and which will insure complete and satisfactory systems. Each Contractor shall be responsible for the proper fitting of his material and apparatus into the building.

B. Each Contractor shall so harmonize his work with that of the other trades so that it may be installed in the most direct and workmanlike manner without hindering or handicapping the other trades. Piping interferences shall be handled by giving precedence to pipelines that require a stated grade for proper operation. Where space requirements conflict, the following order of precedence shall, in general, be observed:

1. Building lines

2. Structural members

3. Soil and drain piping

4. Vent piping
5. Steam piping
6. Condensate piping
7. Refrigerant piping
8. Electrical bus duct
9. Supply ductwork
10. Return ductwork
11. Exhaust ductwork
12. Chilled water and heating water piping
13. Automatic Fire Protection Sprinkler Piping
14. Natural gas piping
15. Domestic hot and cold water piping
16. Electrical conduit

2.5 LOCATION OF OUTLETS IN ROOMS

A. All fire protection, plumbing, acoustical tile, diffusers, grilles, registers, and other devices shall be referenced to coordinated, established data points and shall be located to present symmetrical arrangements with these points and to facilitate the proper arrangements of acoustical tile panels and other similar panels with respect to the mechanical and electrical outlets and devices. Those mechanical and electrical outlets shall be referenced to such features as wall and ceiling furrings, balanced border widths, masonry joints, etc. Outlets in acoustical tile shall occur symmetrically in tile joints or in the center of whole tiles. When locations of mechanical and electrical devices shown on the Architect reflected ceiling plans need to be modified, the final determination of the exact location of each outlet and the arrangement to be followed shall be acceptable to the Architect.

B. The drawings show diagrammatically the location of the various outlets and apparatus. Exact locations of these outlets and apparatus shall be determined by reference to the general plans and to all detail drawings, equipment drawings, roughing-in drawings, etc., by measurements at the building, and in cooperation with the other trades. The Architect reserves the right to make any reasonable change in location of any outlet or apparatus before installation, without additional cost to the Owner.

C. The Contractor, by submitting a bid on this work, sets forth that he has the necessary technical training and ability, and that he will install his work in a satisfactory and workmanlike manner which is up to the best standards of the trade, complete, and in good working order. If any of the requirements of the drawings and specifications are impossible of performance, or if the installation, when made in accordance with such requirements, will not perform satisfactorily, he shall report it to the Architect for correction promptly after discovery of the discrepancy.

2.6 CONNECTIONS FOR OTHERS

A. This Contractor shall rough-in for and make all gas, water, steam, sewer, etc., connections to all fixtures, equipment, machinery, etc., provided by others in accordance with detailed roughing-in drawings provided by the equipment suppliers, along with actual measurements of the equipment connections, or as detailed.

B. After the equipment is set in place, this Contractor shall make all final connections and shall provide all required pipe, fittings, valves, traps, etc.

C. Provide all air gap fittings where required. In each water line serving an item of equipment or piece of machinery, provide a shut-off valve. On each drain not provided with a trap, provide a suitable trap.

D. All pipefittings, valves, traps, etc., exposed in finished areas and connected to chrome-plated lines provided by others shall be chrome plated to match.

E. Provide all sheet metal ductwork, transition pieces, etc., required for a complete installation of all mechanical systems, etc., provided by others.

2.7 SMOKE DETECTORS

A. The contractor shall for each air handling system with 2000 CFM (nominal 5 Tons) or greater airflow, install UL-listed ionized smoke detectors in the main supply air duct and main return air duct and/or where shown on the drawing. Smoke detectors furnished by Division 26. Refer to Section 23 0512. Connect the detectors into the control circuit to stop the fan in the event of the presence of smoke.

1. System airflow included the total airflow of all units serving any single space and all units connected to the same return air plenum.

PART 3 - INSTALLATION

3.1 INSTALLATION METHODS

A. All pipes shall be concealed in pipe chases, walls, furred spaces, or above the ceiling, unless otherwise indicated.

B. Piping may be run exposed in mechanical rooms, janitors' closets, or storage spaces, but only where necessary. All exposed piping shall be run in the neatest, most inconspicuous manner, and parallel or perpendicular to the building lines.

C. All piping shall be adequately and properly supported from the building structure by means of hanger rods or clamps to walls as herein specified.

D. Where limited space is available above the ceilings and below concrete beams or other deep projections, pipe and conduit shall be sleeved through the projection where it crosses, in a manner to provide maximum above-floor clearance. Sleeves shall be as specified or as required.

E. All pipe, conduits, etc., shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing. All ducts, pipes and conduits run, exposed in machinery and equipment rooms, shall be installed parallel to the building plans, except as otherwise shown. Conduits in furred ceilings and in other concealed spaces may be run at angles to the construction but shall be neatly grouped and racked indicating good workmanship. All conduit and pipe openings shall be kept closed until the systems are closed with final connections.

F. There shall be no pipe joints nearer than 12 in. to a wall, ceiling, or floor penetration, unless pipe joint is the welded type joint.

G. The Contractor shall study all construction documents and carefully lay out all work in advance of fabrication and erection in order to meet the requirements of the extremely limited spaces. Where conflicts occur, the Contractor shall meet with all involved trades and the Architect and resolve the conflict, prior to erection of any work, in the area involved.

3.2 CUTTING AND PATCHING

A. Cut and patch openings through walls, floors, etc., resulting from work in existing construction or by failure to provide proper openings or recesses in new construction.

B. Openings cut through concrete and masonry shall be made with masonry saws and/or core drills at locations acceptable to the Architect. Impact-type equipment will not be used, except where specifically acceptable to the Architect. Openings in Precast concrete slabs for pipes, conduits, outlet boxes, etc., shall be core drilled or cast to exact size.

C. All openings shall be restored to as-new condition under the appropriate Specification Section for the materials involved, and shall match remaining surrounding materials and/or finishes.

D. Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry. Adequate supports shall be provided during the cutting operation to prevent any damage to the masonry occasioned by the operation. All structural members, supports, etc., shall be of the proper size and shape, and shall be installed in a manner acceptable to the Architect.

E. All mechanical work in areas containing plaster shall be completed prior to the application of the finish plaster coat. Cutting of finish plaster coat will not be permitted.

F. No cutting, boring, or excavating, which will weaken the structure, shall be undertaken. NO STRUCTURAL MEMBER MAY BE CUT WITHOUT THE WRITTEN APPROVAL OF THE ARCHITECT.

3.3 FABRICATION OF PIPE

A. All the various piping systems shall be made up straight and true and run at proper grades to permit proper flow of the contained material. Lines shall also be graded for proper drainage.

B. Piping shall follow as closely as possible the routes shown on plans, but shall take into consideration conditions to be met at the site.

C. Should any unforeseen conditions arise, lines shall be changed or rerouted as required after approval has been obtained.

D. All piping shall be installed with due regard to expansion and contraction and so as to prevent excessive strain and stress in the piping, in connections, and in equipment to which lines are connected.

E. All piping shall be clean when it is installed. Before installation it shall be checked, upended, swabbed, if necessary, and all rust or dirt from storage shall be removed. Pipe shall not be permitted to lie on the ground during storage. Pipe ends shall be sealed during storage.

3.4 IDENTIFICATION AND LABELING

A. The Contractor shall make it possible for the personnel operating and maintaining the equipment and systems in this project to readily identify the various pieces of equipment, valves, piping, etc., by marking them.

B. All items of mechanical and electrical equipment shall be identified by the attachment of engraved nameplates constructed from laminated phenolic plastic, at least 1/16 in. thick, 3-ply, with black surfaces and white core. Engraving shall be condensed gothic, at least 1/2 in. high, appropriately spaced. Nomenclature on the label shall include the name of the item, its mark number, area, space, or equipment served, and other pertinent information. Equipment to be labeled shall include, but not be limited to, the following:

1. Rooftop units
2. Air Handling Units
3. Furnaces
4. Exhaust Fans
5. Vent Fans
6. Roof mounted fans
7. Condensing Units
8. Heat Pumps
9. Circulating Pumps
10. Air conditioning control panels and switches
11. Motor controllers
12. Miscellaneous similar and/or related items.

C. The Contractor shall install identification tags to be affixed to those valves that have functions that are not obvious. For example, it would not be expected that valves at a pressure reducing station in a machine room would be tagged. The valve identification tags shall be brass discs, 2 in. in diameter. Each tag shall be attached to its valve with copper clad annealed iron wire or other approved material.

3.5 TESTS AND INSPECTIONS

A. The Contractor shall, during the progress of the work and upon its completion, test his work and make all tests as required by the specifications, state, municipal and other authorities having jurisdiction of the work. Piping pressure tests shall be made before pipe is concealed or covered. Tests shall be made in the presence of authorities requiring tests. The Contractor shall pay all costs, inspection charges and fees required for the tests of his work.

B. The Contractor shall provide all apparatus, temporary piping connection, etc., required for tests. The Contractor shall take all due precautions to prevent damage to the building or its contents incurred by such tests. The Contractor shall repair and make good at his own expense any damage caused by failures or leaks during the tests.

C. Leaks, defects or deficiencies shall be repaired and/or replaced, and tests shall be repeated until the test requirements are complied with fully.

D. All equipment shall be placed in operation and tested for proper automatic control before the final balancing of the system is started.

E. All tests shall have pertinent data logged by the Contractor at the time of testing. Data shall include date, time, personnel, description, and extent of system tested, test condition, test results, specified results, and any other pertinent data. Data shall be delivered to the Architect.

3.6 COOPERATION AND CLEANUP

A. It shall be the responsibility of each trade to cooperate fully with the other trades on the job to help keep the job site in a clean and safe condition. At the end of each day's work, each trade shall properly store all of his tools, equipment and materials and shall clean his debris from the job. Upon the completion of the job, each trade shall immediately remove all of his tools, equipment, any surplus materials and all debris caused by his portion of the work.

3.7 CLEANING AND PAINTING

A. All equipment, piping, ductwork, grills, insulation, etc., in finished areas furnished and installed by the Contractor shall be painted. Finished areas include mechanical rooms, boiler rooms, and outside the building as well as occupied areas inside the building. Final painting is to be done by the General Contractor. This Contractor shall thoroughly clean all part of materials and equipment of cement, plaster, and other materials, and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out. Exposed metal work shall be carefully brushed down with steel brushes to remove rust and other spots and left smooth and clean.

B. This Contractor shall thoroughly clean the finish on all parts of the materials and equipment with factory applied finishes. Exposed parts in equipment rooms, above crawl space slabs, and all other spaces except sealed chases and attics shall be thoroughly cleaned of cement, plaster and other materials, and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out. If the finish has been damaged, the Contractor shall re-paint to the satisfaction of the Architect.

C. All canvas finishes shall be painted with one sizing coat if not already sized, containing a mildew resistant additive and Arabol adhesive prior to any other specified finish paint.

D. No nameplates on equipment shall be painted, and suitable protection shall be afforded to the plates to prevent their being rendered illegible during painting operation.

3.8 ELECTRICAL PROVISIONS OF MECHANICAL WORK

A. The extent of electrical provisions to be provided as mechanical work is indicated in other mechanical sections of the specifications, on the drawings and as further specified in this section.

B. Starters, Controllers: In general, mechanical work includes furnishing combination starters. Controllers are specifically included as electrical work when mounted in motor control centers. Electrical work includes installation, mounting and wiring of starters and controllers that are furnished as mechanical work. Free standing, large motor controllers shall be set in place, on pads, as mechanical work.

C. Electrical heating equipment shall be furnished complete with internal or integral fusing and subdivision of loads to comply with the NEC.

D. Wherever possible, match the elements of the electrical provisions of mechanical work with similar elements of the electrical work specified in electrical sections of the specifications.

E. Standards:

1. For electrical equipment and products, comply with applicable NEMA standards, and refer to NEMA standards to definitions of terminology herein.

2. Comply with National Electrical Code (NFPA No. 70) for installation requirements.

3. Comply with National Electrical Contractors Association (NECA) Standard of Installation .

3.9 TEMPORARY FACILITIES

A. Unless noted otherwise in the Supplementary General Conditions; provide temporary facilities.

3.10 EQUIPMENT INSTALLATION REQUIREMENTS

A. All mechanical equipment shall be furnished and installed complete and ready for use.

B. All mechanical equipment and appliances shall be installed in a manner that all Code required access and services space is provided. Coordinate exact position of equipment and appliances with routing of new ductwork and piping, and with all existing conditions to provide required clearances.

1. Ensure that a minimum of 30” deep and 30” wide working space is provided in front of the control side of each appliance and piece of air moving equipment.

2. Ensure that air moving equipment and appliance in attics are installed so that they also have Code required clear passageway.

C. Others shall furnish certain Owner process equipment. Contractor shall be responsible for furnishing and installing all items as required to make complete operating systems. The Contractor shall furnish and install all auxiliary piping, valves, controls, control wiring, conduit, alarms, etc., required. All necessary devices, control wiring, conduit, etc., will not necessarily be shown on the drawings.

3.11 OWNER FURNISHED EQUIPMENT

A. The Contractor's responsibility shall include receiving and installing all Owner-furnished equipment.

END OF SECTION 23 0010

SECTION 23 0506 - MECHANICAL DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Demolition of:

1. HVAC air handling units and related ductwork.
2. Grilles, registers, diffusers, variable air volume boxes.
3. Chilled water piping.
4. Boilers, pumps and associated piping.
5. Plumbing fixtures and trim, specialties, equipment and associated piping.
6. Fire protection equipment and associated piping.
7. Hanger and support devices.
8. All other appliances or devices associated with equipment or devices to be removed.

B. Demolition of all power wiring and conduit from each mechanical item to be removed back to the point of supply.

1.2 QUALITY ASSURANCE

A. Perform all demolition and removal work necessary to arrive at the arrangement shown on the Contract Drawings.

B. Perform all operations in such a method to cause minimum damage to items to be relocated, salvaged, or to remain intact and in use.

1.3 JOB CONDITIONS

A. Perform site repair and removal of salvaged items at times approved by the Owner. Accomplish repair and removal of items in a continuous and diligent manner in order to limit interference with Owner's on-going operations.

B. Drawings may not indicate and specifications may not identify every item required to be moved or removed.

C. Before submitting bids, visit and examine the site of the work and become familiar with the scope of the work and the details of the demolition work to be accomplished.

D. Submittal of a bid will be evidence that such an examination has been made and the various details noted.

E. Claims for extra compensation because of additional labor, materials, or equipment required because of difficulties encountered, will not be recognized unless items were concealed at time of inspection of the Contract Documents. Bring all such items to the attention of the Owner's Representative and the Architect for their disposition before continuing with the work.

F. Execute demolition work in a manner to protect adjacent equipment and other existing items against damage.

G. Provide and erect lights, barricades, warning signs, and other items as required for protection of the Owner's employees, building occupants, and the public.

H. Maintain barricades in good condition throughout the project to substantial completion.

I. Control the dust resulting from demolition to prevent it from spreading the occupied areas of the building and to avoid creating a nuisance in the immediate surrounding area.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 PROTECTION

A. Provide protection for all building elements, all items which are to remain, all occupants and all workers at all times, and in accordance with all requirements of the Owner.

3.2 PROTECTION OF BUILDING FROM THE WEATHER

A. Maintain weather protection for the space(s) being worked in at all times, and in accordance with all requirements of the Owner.

3.3 DEMOLITION

A. Perform demolition in accordance with all requirements of the Owner.

3.4 DISPOSITION OF MATERIALS

A. Dispose of all demolition items and materials in a legal off-site location.

3.5 RELOCATION AND REUSE OF MECHANICAL ITEMS

A. Relocate items indicated on the Contract Drawings as required to accommodate the new construction. Remove, relocate and reconnect equipment and accessories that are to be reused.

B. Coordinate the work with the Electrical Contractor. Determine which items and equipment are to remain, to be relocated or to be removed. Perform the work consistent with the scope of the project.

C. Transport and store materials removed and designated for relocation as directed by the Owner's Representative.

D. Remove all salvage items not be reused or delivered to the Owner, from the property at the end of each workday.

E. Maintain full water, drain, electrical service, etc., to all equipment and apparatus that remains in service in the building.

3.6 CLEANING

A. Section 23 0010 - Basic Mechanical Requirements.

3.7 REMOVAL OF WATER

A. Be responsible for the removal of water in areas in which scheduled work is to be performed.

1. Remove water by pumping, siphoning, absorbent mopping, or compressed air brooming.

2. Do not use any method of removal that will cause damage to new or reused adjacent equipment or materials.

3.8 SCHEDULING

A. Schedule demolition in strict compliance with the Owner's instructions.

3.9 DISCONNECTION AND RECONNECTION OF UTILITIES

A. Do not disconnect or reconnect any utilities until notifying the Owner's Representative.

B. Notify the Electrical Contractor when requiring Electrical Disconnect or Reconnect.

END OF SECTION 23 0506

SECTION 23 0512 - MECHANICAL AND ELECTRICAL COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Refer to Section 260510 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.

B. Refer to Section 21 0010 - BASIC FIRE PROTECTION REQUIREMENTS.

C. Refer to Section 22 0010 - BASIC PLUMBING REQUIREMENTS.

D. Refer to Section 23 0010 - BASIC MECHANICAL REQUIREMENTS.

1.2 SUMMARY

A. This Section describes the coordination between the Fire Protection, Plumbing, Mechanical and Electrical portions of the work.

B. This Section is included under the Division 21 portion of the Specifications as Section 21 0512, under the Division 22 portion of the Specifications as Section 22 0512, under the Division 23 portion of the Specifications as Section 23 0512, and under the Division 26 portion of the Specifications as Section 260512.

1.3 WORK INCLUDED

A. Responsibility: Unless otherwise indicated, motors and controls shall be furnished, set in place and wired in accordance with the following schedule. **This schedule may include equipment and systems that are not required for this project. Only the equipment and systems that are required on the drawings and/or specified elsewhere will be required by this section:**

	ITEM	FURNISHED UNDER DIVISION	INSTALLED UNDER DIVISION	WIRED AND CONNECTED UNDER DIVISION
1.	Equipment Motors	21/22/23	21/22/23	26
2.	Magnetic Motor Starters			
	a. Automatically controlled, with or without HOA switches	21/22/23	26	Notes 1,3,5
	b. Automatically controlled, with or without HOA switches and furnished as part of factory wired equipment	21/22/23	22/23	Notes 1,3,5
	c. Manually controlled	21/22/23	26	Notes 1,3,5
	d. Manually controlled and furnished as part of factory wired equipment	21/22/23	26	Notes 1,3,5
	e. Furnished in Motor Control Centers	26	26	Notes 1,3,5
3.	Variable Speed (Frequency) AC Drives	22/23	26	Notes 1,4,5

	ITEM	FURNISHED UNDER DIVISION	INSTALLED UNDER DIVISION	WIRED AND CONNECTED UNDER DIVISION
4.	Line voltage thermostats, time clocks, etc., not connected to control panel systems	23	26	23
5.	Electric thermostats, time clocks, remote bulb thermostats, motorized valves, float controls, etc. which are an integral part or directly attached to ducts, pipes, etc.	22/23	22/23	22/23
6.	Temperature control panels and time switches mounted on temperature control panels	23	23	23
7.	Motorized valves, motorized dampers, solenoid valves, EP and PE switches, etc.	23	23	Note 1
8.	Alarm bells furnished with equipment installed by Division 22 or 23	22/23	22/23	22/23
9.	Wiring to obtain power for control circuits, including circuit breaker	21/22/23	21/22/23	21/22/23
10.	Low voltage controls	21/22/23	21/22/23	21/22/23
11.	Fire protection system (sprinkler) controls	21	21	Note 8
12.	Fire and smoke detectors installed on mechanical units and in ductwork	28	23	Note 8
13.	All relays required for fan shutdown, motorized dampers, smoke control devices, and other items integral with HVAC equipment to provide operation and control of HVAC equipment	23	23	Note 1
14.	Smoke dampers, and combination fire/smoke dampers	23	23	Note 7
15.	Boiler and water heater controls, boiler burner controls panels	22/23	22/23	22/23
16.	Pushbutton stations, pilot lights	22/23	22/23	22/23
17.	Heat Tape	21/22/23	21/22/23	26
18.	Disconnect switches, manual	21/22/23	21/22/23	Notes 1,5

	ITEM	FURNISHED UNDER DIVISION	INSTALLED UNDER DIVISION	WIRED AND CONNECTED UNDER DIVISION
	operating switches furnished as a part of the equipment			
19.	Disconnect switches, manual operating switches furnished separate from equipment	26	26	26
20.	Multispeed switches	23	23	26
21.	Thermal overloads	21/22/23	21/22/23	21/22/23
22.	Control relays, transformers	21/22/23	21/22/23	21/22/23
23.	Refrigeration cycle, cooling tower and controls	23	23	23
24.	Tamper switches for fire protection (sprinkler) system	21	21	28
25.	Flow and/or pressure switches for fire protection (sprinkler) system	21	21	28
26.	Fire and jockey pump controllers and automatic transfer switch	21	21	Note 6
27.	Alarm bells or horns for fire protection (sprinkler) system	21	21	28
28.	Generator (underground) fuel tank	22	22	--
29.	Generator fuel level indicator	22	22	26
30.	Generator fuel piping from tank to generator	22	22	--
31.	Underground fuel tank leak detection and monitoring system	22	22	22

NOTES:
(1) Power wiring as defined in Section 262913 of the specifications shall be provided under Division 26; control wiring as defined in Section 262913 of the specifications shall be provided under Division 21/22/23.
(2) Wiring from alarm contacts to alarm systems provided by Division 26, wiring from auxiliary contacts to air handling system controls provided by Division 23. Division 26 shall provide power to smoke detector. Smoke detectors required for all air handling systems 2000 CFM or greater. Refer to other Division 23 specifications, Division 26 and Drawings for more specific requirements.
(3) For requirements for Magnetic Motor Starters, refer to Section 23 8965 - MOTOR CONTROLLERS.
(4) For requirements for Variable Speed (Frequency) AC drives, refer to Section 23 8965 - MOTOR CONTROLLERS.

(5) Disconnect switches, operating switches, starters and other similar items that are factory-mounted, as a part of complete assembly, shall comply with applicable provisions of the National Electric Code. All such disconnect switches shall be fused.

(6) Power wiring from energy source to controllers and automatic transfer switch shall be provided under Division 26. Interconnection power and control wiring from controllers and automatic transfer switch to pumps shall be provided under Division 21, 22 or 23 and conforming to Division 26 specifications. Control wiring from automatic transfer switch to generator starter shall be provided under Division 26.

(7) Division 26 will provide power to all smoke and combination fire/smoke dampers, and Division 28 will provide control for all such dampers using area smoke detectors.

(8) Wiring for sprinkler system controls to be provided by Division 21. Wiring from devices to Fire Alarm System to be provided by Division 28.

B. CONNECTIONS: Make all connections to controls that are directly attached to ducts, piping and mechanical equipment with flexible connections.

C. PRECEDENCE

1. In general, piping systems that require a stated grade for proper operation shall have precedence over other systems.

2. Precedence for pipe, conduit and duct systems shall be as follows.

a. Building lines

b. Structural members

c. Soil and drain piping

d. Vent piping

e. Steam piping

f. Condensate piping

g. Refrigerant piping

h. Electrical bus duct

i. Supply ductwork

j. Return ductwork

k. Exhaust ductwork

l. Chilled water and heating water piping

m. Automatic Fire Protection Sprinkler Piping

n. Natural gas piping

o. Domestic hot and cold water piping

p. Electrical conduit

3. Lighting Fixtures shall have precedence over air grilles and diffusers.

D. FINAL INSPECTION AND REPORT

1. At the completion of the work, there shall be a meeting of the Fire Protection, Plumbing, Mechanical, Electrical Fire Alarm and Temperature Control Contractors, representatives of mechanical and electrical equipment manufactures whose equipment was actually installed on the project, and similarly-involved individuals, who shall thoroughly inspect all systems, and who shall mutually agree that all equipment has been properly wired and installed, and that all temperature and safety controls are properly functioning. A written report of this meeting, listing those in attendance, and the companies that they represent, shall be filed with the Owner and Architect or Engineer.

END OF SECTION 23 0512

SECTION 23 0529 - MECHANICAL SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of supports and anchors required by this section is indicated on Drawings and/or specified in other Division 23 sections.

B. Types of supports and anchors specified in this section include the following:

1. Pipe and equipment hangers, supports, and anchors.

2. Equipment bases.

C. Supports and anchors furnished as part of factory-fabricated equipment are specified as part of equipment assembly in other Division 23 sections.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of supports and anchors, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. Code Compliance: Comply with applicable plumbing codes pertaining to product materials and installation of supports and anchors.

2. Fire Protection Compliance: Install in accordance with NFPA 13-latest edition. Provide products that are UL-listed and FM approved.

3. MSS Standard Compliance:

a. Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-58.

b. Select and apply pipe hangers and supports, complying with MSS SP-69.

c. Fabricate and install pipe hangers and supports, complying with MSS SP-89.

d. Terminology used in this section is defined in MSS SP-90.

C. All hangers, supports and attachments shall be manufactured with materials compatible with the environment in which they will be installed. Unless directed otherwise, all hangers, supports, and attachments installed exterior to the building or within high humidity environments shall be galvanized steel or stainless steel.

D. Manufacturers of Hangers and Supports:

1. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following:

a. B-Line Systems Inc. (Cooper)

b. ANVIL International

1.3 SUBMITTALS

A. Submit product data as required under provisions of Division 01 and Section 23 0010.

B. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor.

C. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components.

D. Maintenance Data: Submit maintenance data and parts list for each type of support and anchor. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 01.

PART 2 - PRODUCTS

2.1 HORI ONTAL-PIPING HANGERS AND SUPPORTS

A. General: Except as otherwise indicated, provide factory-fabricated horizontal-piping hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems.

B. Adjustable Steel Clevis Hangers: MSS Type 1.

C. Yoke Type Pipe Clamps: MSS Type 2.

D. Steel Double Bolt Pipe Clamps: MSS Type 3.

E. Steel Pipe Clamps: MSS Type 4.

F. Pipe Hangers: MSS Type 5.

G. Adjustable Swivel Pipe Rings: MSS Type 6.

H. Adjustable Steel Band Hangers: MSS Type 7.

I. Adjustable Band Hangers: MSS Type 9.

J. Adjustable Swivel Rings, Band Type: MSS Type 10.

K. Split Pipe Rings: MSS Type 11.

L. Extension Split Pipe Clamps: MSS Type 12.

M. U-Bolts: MSS Type 24.

N. Clips: MSS Type 26.

O. Pipe Slides and Slide Plates: MSS Type 35, including one of the following plate types:

1. Plate: Unguided type.

2. Plate: Guided type.

3. Plate: Hold-down clamp type.

P. Pipe Saddle Supports: MSS Type 36, including steel pipe base-support and cast-iron floor flange.

Q. Pipe Stanchion Saddles: MSS Type 37, including steel pipe base support and cast-iron floor flange.

R. Adjustable Pipe Saddle Supports: MSS Type 38, including steel pipe base support and cast-iron floor flange.

S. Single Pipe Rolls: MSS Type 41.

T. Adjustable Roller Hangers: MSS Type 43.

U. Pipe Roll Stands: MSS Type 44.

V. Pipe Rolls and Plates: MSS Type 45.

W. Adjustable Pipe Roll Stands: MSS Type 46.

2.2 VERTICAL-PIPING CLAMPS

A. General: Except as otherwise indicated, provide factory-fabricated vertical-piping clamps complying with MSS SP-58, of one of the following types listed, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated clamps for copper-piping systems.

B. Two-Bolt Riser Clamps: MSS Type 8.

C. Four-Bolt Riser Clamps: MSS Type 42.

2.3 HANGER-ROD ATTACHMENTS

A. General: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.

B. Steel Turnbuckles: MSS Type 13.

C. Steel Clevises: MSS Type 14.

D. Swivel Turnbuckles: MSS Type 15.

E. Malleable Iron Sockets: MSS Type 16.

F. Steel Weldless Eye Nuts: MSS Type 17.

2.4 BUILDING ATTACHMENTS

A. General: Except as otherwise indicated, provide factory-fabricated building attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems.

B. Top Beam C-Clamps: MSS Type 19.

C. Side Beam or Channel Clamps: MSS Type 20.

D. Center Beam Clamps: MSS Type 21.

E. Welded Beam Attachments: MSS Type 22.

F. C-Clamps: MSS Type 23.

G. Top Beam Clamps: MSS Type 25.

H. Side Beam Clamps: MSS Type 27.

I. Steel Beam Clamps W/Eye Nut: MSS Type 28.

J. Linked Steel Clamps W/Eye Nut: MSS Type 29.

K. Malleable Beam Clamps: MSS Type 30.

L. Steel Brackets: One of the following for indicated loading:

1. Light Duty: MSS Type 31, suspending 750 lbs. max.

2. Medium Duty: MSS Type 32, suspending 1500 lbs. max.

3. Heavy Duty: MSS Type 33, suspending 3000 lbs. max.

M. Side Beam Brackets: MSS Type 34.

N. Plate Lugs: MSS Type 57.

O. Horizontal Travelers: MSS Type 58.

2.5 CONCRETE INSERTS

A. Cast-In-Place Spot Type: Malleable iron, or steel with recommended insert nut. Size inserts nut to suit threaded hanger rod. MSS SP-69, Type 18.

B. Drill-In Spot Type: Steel, attached wedge, lock washer and nut. Size inserts to suit threaded hanger rod.

1. Acceptable Manufacturers and Models:

a. Hilti Kwik Bolt

b. Ramset Wedge Anchor

c. Rawl Stud

C. Continuous Channel Type: Steel, anchoring lugs, with channel nuts, rated for 2000 lbs. per foot minimum load. Size channel nut to suit threaded hanger rod.

1. Acceptable Manufacturers and Models:

a. B-Line B22

b. Elcen 1150

c. Unistrut P3200

2.6 SADDLES AND SHIELDS

A. General: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.

B. Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.

C. Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation.

D. Thermal Hanger Shields: Constructed of 360 insert of high density, 125-psi compressive strength, and water-proofed calcium silicate, encased in 360 sheet metal shield. Provide assembly of same thickness as adjoining insulation.

1. Manufacturer: Subject to compliance with requirements, provide thermal hanger shields of one of the following:

a. Elcen Metal Products Co.

b. Pipe Shields, Inc.

2.7 SPRING HANGERS AND SUPPORTS

A. General: Except as otherwise indicated, provide factory-fabricated spring hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select spring hangers and supports to suit pipe size and loading.

B. Restraint Control Devices: MSS Type 47.

C. Spring Cushion Hangers: MSS Type 48.

D. Spring Cushion Roll Hangers: MSS Type 49.

E. Spring Sway Braces: MSS Type 50.

F. Variable Spring Hangers: MSS Type 51; preset to indicated load and limit variability factor to 25 .

G. Variable Spring Base Supports: MSS Type 52; preset to indicated load and limit variability factor to 25 ; include load flange.

H. Variable Spring Trapeze Hangers: MSS Type 53; preset to indicated load and limit variability factor to 25 .

I. Constant Supports: Provide one of the following types, selected to suit piping system. Include auxiliary stops for erection and hydrostatic test, and field load-adjustment capability.

1. Horizontal Type: MSS Type 54.

2. Vertical Type: MSS Type 55.

3. Trapeze Type: MSS Type 56.

2.8 MISCELLANEOUS MATERIALS

A. Metal Framing: Provide products complying with NEMA STD ML 1.

B. Steel Plates, Shapes and Bars: Provide products complying with ASTM A 36.

C. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

D. Auxiliary Steel: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards.

E. Pipe Guides: Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base with two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

2.9 CONCRETE HOUSEKEEPING BASES

A. Refer to Structural Specifications and Drawings for information and requirements of concrete housekeeping bases.

2.10 SLEEVES, INSETS AND FASTENINGS

A. Pipes passing through concrete or cinder walls and floor or other corrosive material shall be protected by a protective sheathing or wrapping or by sleeves, as required to meet the local code. Annular spaces between sleeves and pipes shall be filled or tightly caulked in an approved manner. Annular spaces between sleeves and pipes in fire-resistance-rated assemblies shall be filled or tightly caulked in accordance with the local code.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

B. For all supports and anchors intended to be used as a part of this project, Contractor shall coordinate all requirements with existing conditions and Structural Engineer prior to installation.

3.2 PREPARATION

A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments.

B. Prior to installation of hangers, supports, anchors and associated work, Installer shall meet at project site with Contractor, installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

3.3 INSTALLATION OF BUILDING ATTACHMENTS

A. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at all changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Install additional at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at all changes in direction of piping. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

C. Support fire-water piping independently of other piping.

D. Prevent electrolysis in support of copper tubing by use of hangers and supports that are copper plated, or by other recognized industry methods.

E. Support and laterally brace vertical pipe runs at every floor level and at intervals not to exceed 20 ft. 0 in. Support vertical pipe with riser clamps installed below hubs, couplings or lugs welded to the pipe.

F. Provisions for Movement:

1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.

2. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

3. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 Pressure Piping Codes are not exceeded.

G. Insulated Piping: Comply with the following installation requirements.

1. Clamps: Attach clamps, including spacers (if any), to piping with clamps; do not exceed pipe stresses allowed by ANSI B31.

2. Piping hangers shall be sized large enough to allow insulation to pass through. Hangers for piping 2-1/2 in. and greater shall be provided with pipe covering protection saddle, or high compressive strength insulation saddle. Hangers for piping 2 in. and less shall be provided with pipe covering shields. On cold or chilled water piping provide vapor barrier through hanger.

3. Do NOT utilize pipe size hangers or clamps with insulation placed over the pipe and hanger or clamp.

H. Unless directed otherwise, all hangers, supports, and attachments installed exterior to the building or within high humidity environments shall be galvanized steel or stainless steel.

3.5 INSTALLATION OF ANCHORS

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31, and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure. Comply with ANSI B31 and with AWS standards.

C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to limit movement of piping and forces to maximums recommended by manufacturer for each unit.

D. Anchor spacings: Where not otherwise indicated, install anchors at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

3.6 CONCRETE HOUSEKEEPING BASES

A. Provide concrete housekeeping bases for all floor-mounted equipment furnished as part of the work of Division 23 in accordance with Division 03. Size bases to extend minimum of 4 in. beyond equipment base in any direction; and 6 in. above finished floor elevation, unless otherwise noted on Drawing. Construct of reinforced concrete, roughen floor slab beneath base for bond, and provide steel rod anchors between floor and base. Locate anchor bolts using equipment manufacturer's templates. Chamfer top and edge corners.

3.7 ADJUSTING AND CLEANING

A. Hanger Adjustments: Adjust hangers so as to distribute loads equally on attachments.

B. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.

C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION 23 0529

SECTION 23 0553 - MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of mechanical identification work required by this section is indicated on Drawings and/or specified in other Division 23 sections.

B. Types of identification devices specified in this section include the following:

1. Plastic Duct Markers.

2. Engraved Plastic-Laminate Signs.

C. Mechanical identification furnished as part of factory-fabricated equipment, is specified as part of equipment assembly in other Division 23 sections.

D. Refer to other Division 23 sections for identification requirements at central-station mechanical control center; not work of this section.

E. Refer to Division 26 sections for identification requirements of electrical work; not work of this section.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.

B. Maintenance Data: Include product data and schedules in maintenance manuals; in accordance with requirements of Division 01.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide mechanical identification materials of one of the following:

1. Allen Systems, Inc.

2. Brady (WHO) Co.; Signmark Div.

3. Industrial Safety Supply Co., Inc.

4. Seton Name Plate Corp.

2.2 MECHANICAL IDENTIFICATION MATERIALS

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 23 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.3 PLASTIC DUCT MARKERS

A. General: Provide manufacturer's standard laminated plastic, color-coded duct markers. Conform to the following color code:

1. Green: Cold air.

2. Yellow: Hot air.

3. Yellow/Green: Supply air.

4. Blue: Exhaust, outside, return, and mixed air.

5. For hazardous exhausts, use colors and designs recommended by ANSI A13.1.

B. Nomenclature: Include the following:

1. Direction of airflow.

2. Duct service (supply, return, exhaust, etc.).

3. Duct origin (from).

4. Duct destination (to).

5. Design CFM.

2.4 ENGRAVED PLASTIC-LAMINATE SIGNS

A. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

B. Thickness: 1/8 in., except as otherwise indicated.

C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.5 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.

1. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification that indicates individual system number as well as service (as examples; Boiler No. 3, Air Supply No. 1H, Standpipe F12).

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Coordination: Where identification is to be applied to surfaces that require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 DUCTWORK IDENTIFICATION

A. General: Identify air supply, return, exhaust, intake and relief ductwork with duct markers; showing ductwork service and direction of flow, in black or white (whichever provides most contrast with ductwork color).

B. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment), and at 50' spacings along exposed runs.

C. Access Doors: Provide duct markers on each access door in ductwork and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions, and appropriate safety and procedural information.

D. Concealed Doors: Where access doors are concealed above acoustical ceilings or similar concealment, plasticize tags may be installed for identification in lieu of specified signs, at Installer's option.

3.3 MECHANICAL EQUIPMENT IDENTIFICATION

A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:

1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.

2. Meters, gauges, thermometers and similar units.

3. Fuel-burning units including boilers, furnaces, heaters, stills and absorption units.

4. Pumps, compressors, chillers, condensers and similar motor-driven units.

5. Heat exchanger, coils, evaporators, cooling towers, heat recovery units and similar equipment.

6. Fans, blowers, primary balancing dampers and mixing boxes.

7. Packaged HVAC central-station and zone-type units.

8. Tanks and pressure vessels.

9. Strainers, filters, humidifiers, water treatment systems and similar equipment.

B. Optional Sign Types: Where lettering larger than 1 in. height is needed for proper identification, because of distance from normal location of required identification.

C. Lettering Size: Minimum 1/4 in. high lettering for name of unit where viewing distance is less than 2 ft. 0 in., 1/2 in. high for distances up to 6 ft. 0 in., and proportionately larger lettering for greater distances. Provide secondary lettering 2/3 to 3/4 of size of principal lettering.

D. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

3.4 ADJUSTING AND CLEANING

A. Adjusting: Relocate any mechanical identification device, which has become visually blocked by work of this division or other divisions.

B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

END OF SECTION 23 0553

SECTION 23 0593 - MECHANICAL TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 SUMMARY

A. Adjust and balance Mechanical Air systems

B. Check each piece of operating equipment provided under Division 23.

C. Provide Balancing Report

1.2 QUALITY ASSURANCE

A. Independent Subcontractor: All testing, adjusting and balancing shall be performed by a Testing, Adjusting and Balancing firm that is independent from the HVAC systems installer.

B. Balancing Work: Under direct supervision of AABC accredited testing organization certified supervisor.

1.3 REFERENCES

A. Reference Standards: Comply with AABC National Standards for Total System Balance, latest edition.

1.4 SUBMITTALS

A. Certificate: Before beginning work, submit certification of AABC certified supervisor and AABC firm certification in accordance with Section 23 0010.

B. Balancing Report: At completion of work, submit balancing report in accordance with Section 23 0010. After adjustments have been made submit three (3) copies of a complete detailed report on mechanical systems and their operation to include:

1. Blackline prints with air openings marked to correspond with data sheets and with thermometer locations clearly marked.

2. Data sheets showing amount of air handled at each opening, instrument used, velocity readings and manufacturer free area factors.

3. Equipment data sheets giving make, size, etc., of fans, motors and drives. Include supply fans, exhaust and recirculating fans.

4. Operating data including fan RPM, measured motor current and voltage BHP and CFM (total).

5. Equipment and operating data at each section of the unit and at the unit connection points including air temperatures entering and leaving coils (maximum air temperature rise), together with corresponding air flow and air pressure drop, water temperatures entering and leaving coils and/or water pressure drop through coil.

6. Equipment and operating data as required to show performance of H V units, fan coils, cabinet heaters, unit heaters, temperature control devices, pumps and domestic hot water circulating systems.

7. Static pressure loss across variable air volume boxes and associated reheat coils.

8. Prime source refrigeration equipment operating data at design conditions including temperature measurements, flow conditions and corresponding power consumption.

9. A statement outlining any abnormal or notable conditions not covered in above data. Make special note of any discrepancies between tabulated data and specified conditions.

1.5 PROJECT CONDITIONS

A. Existing Conditions: Verify following conditions before proceeding with work:

1. Installation of the designated system is complete and in full operation.

2. Outside temperature conditions, occupant loads, lighting loads, special equipment requiring extra sensible or ventilation requirements, and solar conditions are within a reasonable range relative to design conditions.

PART 2 - PRODUCTS

2.1 INSTRUMENTS

A. Calibration and maintenance of instruments shall be in accordance with manufacturer's standards and recommendations and requirements of AABC.

B. Calibration histories for each instrument shall be available for examination.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect preceding work in accordance with Section 23 0010 BASIC MECHANICAL REQUIREMENTS.

3.2 PREPARATION

A. Air Systems: Check:

1. Filters are clean.

2. Filter leakage.

3. Damper operation and leakage.

4. Duct leakage.

5. Fan rotation.

6. Equipment vibration.

3.3 ADJUSTING AND BALANCING

A. General: Check, adjust and balance air and water system to meet the design performance and tabulate results on acceptable forms. Minimum data to include amperage, voltage input, and thermal heater capacity of each motor, equipment nameplate data and operating speed, pressure drop across each filter bank, pressure rise across each fan and pump, CFM capacity each outlet, zone and fan, and heating or cooling capacity of each coil or element.

B. Belt Drives: Adjust so that when the desired speed and belt tension had been established, the variable speed pulley and the belt tension adjustment shall be at approximately the midpoint of their range.

C. Air Systems:

1. Adjust dampers for the delivery and distribution of air quantities indicated on the drawings.

2. Mark balancing device at final setting.

3. Replacement of adjustable pulleys, installation of additional balancing dampers or pressure taps, required to effect proper air balance shall be furnished and installed by the HVAC Contractor at no additional cost to the Owner.

4. Adjust exhaust and recirculation air systems for air quantities indicated on drawings and to establish the proper relationship between supply and exhaust.

5. Adjust distribution system to obtain uniform space temperature free from objectionable drafts and noise within the capabilities of the system.

6. Acceptable Tolerances: Adjust fan systems, air devices, etc. as follows:

a. Supply air fan CFM: -5 to 5 of scheduled

b. Return air fan CFM: -5 to 5 of scheduled

c. Exhaust air fan CFM: -0 to 10 of scheduled

d. Supply air device CFM: -10 to 10 of scheduled

e. Return air device CFM: -10 to 10 of scheduled

f. Exhaust air device CFM: -0 to 10 of scheduled

g. Outside air CFM: -0 to 10 of scheduled

D. Test Run: In order to determine that the system installation is complete and will operate satisfactorily, make a test run with equipment operating per normal temperature control schedule and sequence. Run test and operate and adjust equipment as may be required during test run.

3.4 COMPLETION SERVICES

A. Final Check: Make final checks and do any rebalancing as directed.

B. Report: Submit Balancing Report as specified above.

C. Acceptance: Final acceptance of the project will not be made until a satisfactory report is received. Owner reserves the right to spot check the report by field verification prior to final acceptance.

END OF SECTION 23 0593

SECTION 23 0713 - HVAC DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of mechanical insulation required by this section is indicated on Drawings and schedules, and by requirements of this section.

B. Types of mechanical insulation specified in this section include the following:

1. Ductwork System Insulation:

a. Fiberglass

C. Refer to Section 23 0529 - MECHANICAL SUPPORTS AND ANCHORS for protection saddles, protection shields, and thermal hanger shields; not work of this section.

D. Refer to Section 23 3113 - METAL DUCTWORK for duct linings; not work of this section.

E. Refer to Section 23 0553 - MECHANICAL IDENTIFICATION for installation of identification devices for piping, ductwork, and equipment; not work of this section.

1.2 REFERENCES

A. NFPA 90A Standard for the Installation of Air-Conditioning and Ventilating Systems.

B. NFPA 90B Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

C. UL 723 Standard for Test for Surface Burning Characteristics of Building Materials.

D. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.

E. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials.

F. ASTM E119 Standard Test Method for Fire Tests of Building Construction and Materials.

G. ASTM E136 Standard Test Method for Behavior of materials in a Vertical Tube Furnace at 750ºC.

H. ASTM C177 Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

I. ASTM C411 Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

J. ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

K. ASTM C553 Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

L. ASTM C612 Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

M. ASTM C 916 Standard Specification for Adhesives for Duct Thermal Insulation.

N. ASTM C1071 Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).

O. ASTM C1290 Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC.

P. ASTM C1393 Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.

C. Flame/Smoke Ratings: Provide composite mechanical (insulating material, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (UL723) method.

D. Insulations shall not contain formaldehyde, asbestos, lead, mercury, mercury compounds, or poly-brominated diphenyl ether fire retardants.

E. Fiberglass insulations shall have a minimum of 50 percent recycled glass content; certified and UL Validated.

F. Fiberglass insulations shall have a bio-based, formaldehyde-free binder and be UL GREENGUARD Gold certified.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.

B. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide fiberglass products of one of the following:

1. Certainteed.

2. Manson.

3. Knauf.

4. Johns Manville.

5. Owens-Corning.

2.2 DUCTWORK INSULATION MATERIALS

A. Rigid Fiberglass Ductwork Insulation: ASTM C 612, Type IA.

B. Flexible Fiberglass Ductwork Insulation: ASTM C 553, Type I

C. Jackets for Ductwork Insulation: ASTM C 921, Type I (vapor barrier) for ductwork with temperatures below ambient; Type II for ductwork with temperatures above ambient.

1. Encase exterior ductwork insulation with aluminum jacket with weatherproof construction, as specified.

D. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

E. Ductwork Insulation Compounds: Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

B. Thickness of insulation shall be as recommended by the manufacturer for the temperatures and duct sizes involved, and in accordance with standards of NAIMA.

3.2 DUCTWORK SYSTEM INSULATION

A. Insulation Omitted: Do not insulate fibrous glass ductwork or lined ductwork.

B. Dual Temperature Ductwork:

1. Application Requirements: Insulate the following dual temperature ductwork:

    a. Hot/cold supply and return ductwork between fan discharge or HVAC unit discharge and room terminal outlets; except omit insulation on return air ductwork located in return air ceiling plenums.

2. Insulate each ductwork system specified above with one of the following types and thicknesses of insulation:

    a. Rigid Fiberglass: 1-1/2 in. thick, increase thickness to 2 in. in machine, fan and equipment rooms.

    b. Flexible Fiberglass: 2.2 in. thick, application limited to concealed locations. Flexible insulation will not be used in machine, fan and equipment rooms.

C. Cold Ductwork (Below Ambient Temperature):

1. Application Requirements: Insulate the following cold ductwork:

    a. Outdoor air intake ductwork between air entrance and fan inlet or HVAC unit inlet.

    b. HVAC supply ductwork between fan discharge, or HVAC unit discharge and room terminal outlet.

    c. Insulate neck and bells of supply diffusers.

    d. HVAC return ductwork between room terminal inlet and return fan inlet, or HVAC unit inlet; except omit insulation on return ductwork located in return air-ceiling plenums.

    e. HVAC plenums and unit housings not pre-insulated at factory or lined.

2. Insulate each ductwork system specified above with one of the following types and thicknesses of insulation:

    a. Rigid Fiberglass: 2.2 in. thick, increase thickness to 3 in. in machine, fan and equipment rooms.

    b. Flexible Fiberglass: 2 in. thick, application limited to concealed locations. Flexible insulation will not be used in machine, fan and equipment rooms.

D. Hot Ductwork (Above Ambient Temperature):

1. Application Requirements: Insulate the following hot ductwork:

    a. Hot supply and return ductwork between fan discharge, or heating unit discharge, and room terminal outlet; except omit insulation on return ductwork located in return air ceiling plenums.

    b. Heating plenums and unit housings not pre-insulated at factory or lined.

2. Insulate each ductwork system specified above with one of the following types and thicknesses of insulation:

a. Rigid Fiberglass: 1-1/2 in. thick, increase thickness to 2 in. in machine, fan and equipment rooms.

b. Flexible Fiberglass: 2.2 in. thick, application limited to concealed locations. Flexible insulation will not be used in machine, fan and equipment rooms.

E. Ductwork insulation density and thickness shall comply with applicable IECC requirements: Minimum installed R-valve of 6.0 inside the building envelope, R-valve of 8.0 outside the building envelope.

3.3 INSTALLATION OF DUCTWORK INSULATION

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

B. Install insulation materials with smooth and even surfaces.

C. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

D. Maintain integrity of vapor-barrier on ductwork insulation, and protect it to prevent puncture and other damage.

E. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated.

F. Lined Ductwork: Except as otherwise indicated, omit insulation on ductwork where internal insulation or sound absorbing linings have been installed to meet IECC requirements.

G. Corner Angles: Except for oven and hood exhaust duct insulation; install corner angles on external corners of insulation on ductwork in exposed finished spaces before covering with jacketing.

3.4 EXISTING INSULATION REPAIR

A. Repair damaged sections of existing mechanical insulation, both previously damaged or damaged during this construction period. Use insulation of same thickness as existing insulation, install new jacket lapping and sealed over existing.

3.5 PROTECTION AND REPLACEMENT

A. Replace damaged insulation that cannot be repaired satisfactorily, including units with vapor barrier damage and moisture-saturated units.

B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 23 0713

SECTION 23 0923 - BUILDING CONTROL SYSTEM (BCS)

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Provide labor, material, equipment, related services, and supervision required, including, but not limited to, manufacturing, fabrication, configuration and installation for complete fully integrated building automation system (also identified as BMS, Direct Digital Control System For HVAC) including all necessary hardware and all operating and applications software as required for the complete performance of the Work, as shown on the Drawings, as specified herein.

B. Related Sections: Related sections include, but shall not be limited to, the following:

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

2. Applicable general requirements for electrical Work specified within Divisions 23, 25 Specification Sections apply to this Section.

C. Network level components of the system – workstations, servers, etc. shall communicate using the BACnet protocol, as defined by ASHRAE Standard 135-2004, EIA standard 709.1, the LonTalk™ protocol.

D. At a minimum, provide controls for the following:

1. Power wiring to DDC devices, smoke control dampers and BAS panels except as otherwise specified

2. Smoke evacuation sequence of AHUs and return fans including smoke control dampers and fire command override panel

3. Variable volume and constant volume box control

E. Except as otherwise noted, the control system shall consist of all necessary Ethernet Network Controllers, Standalone Digital Control Units, Room Controllers, workstations, software, sensors, transducers, relays, valves, dampers, damper operators, control panels, and other accessory equipment, along with a complete system of electrical interlocking wiring to fill the intent of the specification and provide for a complete and operable system. Except as otherwise specified, provide operators for equipment such as dampers if the equipment manufacturer does not provide these. Coordinate requirements with the various Contractors.

F. The BAS system supplier shall review and study all HVAC drawings and the entire specification to familiarize themselves with the equipment and system operation and to verify the quantities and types of dampers, operators, alarms, etc. to be provided.

G. All work performed under this section of the specifications will comply with all governing codes, laws and governing bodies. If the drawings and/or specifications are in conflict with governing codes, the Contractor, with guidance from the engineer, shall submit a proposal with appropriate modifications to the project to meet code restrictions. If this specification and associated drawings exceed governing code requirements, the specification will govern. The Contractor shall obtain and pay for all necessary construction permits and licenses.

H. Related Sections

1. This Section includes the Building Management System (BMS) control equipment for HVAC systems and components, including open protocol control components for terminal heating and cooling units. Depending on the scope of the project, the complete specification may have numerous sections that interface to this section, including several from Division 25, 26, & 28.

1.2 REFERENCES

A. General, Code Compliance: The code listed below form a part of this Specification to the extent referenced. The codes are referred to in the text by the basic designation only. The edition/revision of the referenced code shall be the latest date as of the date of the Contract Documents, unless otherwise specified.

1. Provide BAS components and ancillary equipment, which are UL-916 listed and labeled.

2. All equipment or piping used in conditioned air streams, spaces or return air plenums shall comply with NFPA 90A Flame/Smoke/Fuel contribution rating of 25/50/0 and all applicable building codes or requirements.

3. All wiring shall conform to the National Electrical Code.

4. All smoke dampers shall be rated in accordance with UL 555S.

5. Comply with FCC rules, Part 15 regarding Class A radiation for computing devices and low power communication equipment operating in commercial environments.

6. Comply with FCC, Part 68 rules for telephone modems and data sets.

1.3 DEFINITIONS

A. Unless specifically defined within the Contract Documents, the words or acronyms contained within this specification shall be as defined within, or by the references listed within this specification, the Contract Documents, or, if not listed by either, by common industry practice.

1. Standard

a. ASHRAE: American Society Heating, Refrigeration, Air Conditioning Engineers

b. AHU: Air Handling Unit

c. BACnet: Building Automation Controls Network

d. BMS: Building Management System

e. DDC: Direct Digital Control

f. EIA: Electronic Industries Alliance

g. GUI: Graphical User Interface

h. HVAC: Heating, Ventilation, and Air Conditioning

i. IEEE: Institute Electrical Electronic Engineers

j. MER: Mechanical Equipment Room

k. PID: Proportional, Integral, Derivative

l. VAV: Variable Air Volume Box

2. Communications and protocols

a. ARP: Address Resolution Protocol

b. BACnet: Building Automation and Control Networks

c. CORBA: Common Object Request Broker Architecture

d. CSMA/CD: Carrier Sense Multiple Access/Collision Detect

e. DDE: Dynamic Data Exchange

f. FTP: File Transfer Protocol

g. FTT: Free Topology Transceivers

h. HTTP: Hyper Text Transfer Protocol

i. IIOP: Internet Inter-ORB Protocol

j. IP: Internet Protocol

k. LAN: Local Area Network

l. LON: Echelon Communication – Local Operating Network

m. MS/TP: Master Slave Token Passing

n. OBIX: Open Building Information Exchange

o. ODBC: Open Database Connectivity

p. ORB: Object Request Broker

q. SNVT: Standard Network Variables Types

r. SQL: Structured Query Language

s. UDP: User Datagram Protocol

t. XML: eXtensible Markup Language

3. Controllers

a. ASD: Application Specific Device

b. AAC: Advanced Application Controller

c. ASC: Application Specific Controller

d. CAC: Custom Application Controller

e. DCU: Distributed Control Unit

f. HRC: Hotel Room Controller

g. LCM: Local Control Module

h. MC: MicroControllers

i. MPC: Multi-purpose Controller

j. NSC: Network Server Controller

k. PEM: Package Equipment Module

l. PPC: Programmable Process Controller

m. RC: Room controller

n. RPC: Room Purpose Controller

o. SDCU: Standalone Digital Control Units

p. SLC: Supervisory Logic Controller

q. UEC: Unitary Equipment Controller

r. VAVDDC: Variable Air Volume Direct Digital Controller

4. Tools and Software

a. AFDD: Automated Fault Detection and Diagnostic

b. APEO: Automated Predictive Energy Optimization

c. DR: Demand Response

d. CCDT: Configuration, Commissioning and Diagnostic Tool

e. BPES: BACnet Portable Engineering Station

f. LPES: LON Portable Engineering Station

g. POT: Portable Operator’s Terminal

h. PEMS: Power and Energy Management Software

i. MTBF: Mean Time Between Failure

1.4 SYSTEM DESCRIPTION

A. In accordance to the scope of work, the system shall also provide a graphical, web-based, operator interface that allows for instant access to any system through a standard browser. The contractor must provide PC-based programming workstations, operator workstations and microcomputer controllers of modular design providing distributed processing capability, and allowing future expansion of both input/output points and processing/control functions.

B. For this project, the system shall consist of the following components:

1. Administration and Programming Workstation(s): The BAS system supplier shall include Operation software and architecture as described in Part 2 of the specification. These workstations must be running the standard workstation software developed and tested by the manufacturer of the network server controllers and the standalone controllers. No third party front-end workstation software will be acceptable. Workstations must conform to the B-OWS BACnet device profile.

2. Web-Based Operator Workstations: The BAS system supplier shall furnish licenses for web connection to the BAS system. Web-based users shall have access to all system points and graphics, shall be able to receive and acknowledge alarms, and shall be able to control setpoints and other parameters. All engineering work, such as trends, reports, graphics, etc. that are accomplished from the WorkStation shall be available for viewing through the web browser interface without additional changes. The web-based interface must conform to the B-OWS BACnet device profile.

3. Ethernet-based Network Router and/or Network Server Controller(s): The BAS system supplier shall furnish needed quantity of Ethernet-based Network Server Controllers as described in Part 2 of the specification. These controllers will connect directly to the Operator Workstation over Ethernet at a minimum of 100mbps, and provide communication to the Standalone Digital Control Units and/or other Input/Output Modules. Network Server Controllers shall conform to BACnet device profile B-BC. Network controllers that utilize RS232 serial communications or ARCNET to communicate with the workstations will not be accepted. Network Controllers shall be tested and certified by the BACnet Testing Laboratory (BTL) as BACnet Building Controllers (B-BC).

4. Standalone Digital Control Units (SDCUs): Provide the necessary quantity and types of SDCUs to meet the requirements of the project for mechanical equipment control including air handlers, central plant control, and terminal unit control. Each SDCU will operate completely standalone, containing all of the I/O and programs to control its associated equipment. Each BACnet protocol SDCU shall conform to the BACnet device profile B-AAC. BACnet SDCUs shall be tested and certified by the BACnet Testing Laboratory (BTL) as BACnet Advanced Application Controllers (B-AAC).

C. The Local Area Network (LAN) shall be either a 10 or 100 Mpbs Ethernet network supporting BACnet, Modbus, XML and HTTPS for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Server Controllers (NSCs), user workstations and a local host computer system.

D. The Enterprise Ethernet (IEEE 802.3) LAN shall utilize Carrier Sense Multiple/Access/Collision Detect (CSMA/CD), Address Resolution Protocol (ARP) and User Datagram Protocol (UDP) operating at 10 or 100 Mbps.

E. The system shall enable an open architecture that utilizes EIA standard 709.1, the LonTalk™ protocol and/or ANSI / ASHRAE™ Standard 135-2004, BACnet functionality to assure interoperability between all system components. Native support for the LonTalk™ protocol and the ANSI / ASHRAE™ Standard 135-2004, BACnet protocol are required to assure that the project is fully supported by the HVAC open protocols to reduce future building maintenance, upgrade, and expansion costs.

F. The system shall enable an architecture that utilizes a MS/TP selectable 9.6-76.8 KBaud protocol, as a common communication protocol between controllers and integral ANSI / ASHRAE™ Standard 135-2004, BACnet functionality to assure interoperability between all system components. The AAC shall be capable of communicating as a MS/TP device or as a BACnet IP device communicating at 10/100 Mbps on a TCP/IP trunk. The ANSI / ASHRAE™ Standard 135-2004, BACnet protocol is required to assure that the project is fully supported by the leading HVAC open protocol to reduce future building maintenance, upgrade, and expansion costs.

G. LonTalk™ packets may be encapsulated into TCP/IP messages to take advantage of existing infrastructure or to increase network bandwidth where necessary or desired.

1. Any such encapsulation of the LonTalk™ protocol into IP datagrams shall conform to existing LonMark™ guide functionality lines for such encapsulation and shall be based on industry standard protocols.

2. The products used in constructing the BMS shall be LonMark™ compliant.

3. In those instances, in which Lon-Mark™ devices are not available, the BMS system supplier shall provide device resource files and external interface definitions for LonMark devices.

H. The software tools required for network management of the LonTalk™ protocol and the ANSI / ASHRAE™ Standard 135-2004, BACnet protocol must be provided with the system. Drawings are diagrammatic only. Equipment and labor not specifically referred to herein or on the plans and are required to meet the functional intent, shall be provided without additional cost to the Owner. BACnet clients shall comply with the BACnet Operator Workstation (B-OWS) device profile; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet IP or MS/TP. Physical connection of LonWorks devices shall be via Ethernet IP or FTT-10A.

I. The system shall provide support for Modbus TCP and RTU protocols natively, and not require the use of gateways.

J. Complete temperature control system to be DDC with electronic sensors and electronic/electric actuation of Mechanical Equipment Room (MER) valves and dampers and electronic actuation of terminal equipment valves and actuators as specified herein. The BMS is intended to seamlessly connect devices throughout the building regardless of subsystem type, i.e. variable frequency drives, low voltage lighting systems, electrical circuit breakers, power metering and card access should easily coexist on the same network channel.

1. The supplied system must incorporate the ability to access all data using HTML5 enabled browsers without requiring proprietary operator interface and configuration programs. The system shall not require JAVA to be enabled in the browser.

2. Data shall reside on a supplier-installed server for all database access.

3. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network.

K. All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the approved manufacturer's local field office. The approved manufacturer's local field office shall have a minimum of 3 years of installation experience with the manufacturer and shall provide documentation in the bid and submittal package verifying longevity of the installing company's relationship with the manufacturer when requested. Supervision, hardware and software engineering, calibration and checkout of the system shall be by the employees of the approved manufacturer's local field office and shall not be subcontracted. The control contractor shall have an in-place support facility within 500 miles of the site with factory certified technicians and engineers, spare parts inventory and all necessary test and diagnostic equipment for the installed system, and the control contractor shall have 24 hours/day, 7 days/week emergency service available. If not within 500 miles, there must be agreement of phone support to help client in event of emergency.

1.5 SUBMITTALS

A. General: Submittals shall be in accordance with the requirements of Section 01 33 00 Submittals and Section 23 00 10 Mechanical, in addition to those specified herein.

1. All shop drawings shall be prepared in Visio Professional. In addition to the drawings, the Contractor shall furnish digital web interface site for obtaining versions of drawings at current state. Drawings shall be 11" by 17" or larger if printed.

2. Shop drawings shall include a riser diagram depicting locations of all controllers and workstations, with associated network wiring. Also included shall be individual schematics of each mechanical system showing all connected points with reference to their associated controller. Typicals will be allowed where appropriate.

3. Submittal data shall contain manufacturer's data on all hardware and software products required by the specification. Valve, damper and air flow station schedules shall indicate size, configuration, capacity and location of all equipment.

4. Submit data and shop drawings to the Engineer for review prior to ordering or fabrication of the equipment. The Contractor, prior to submitting, shall check all documents for accuracy.

5. The Engineer will make corrections, if required, and return to the Contractor. The Contractor will then resubmit with the corrected or additional data. This procedure shall be repeated until all corrections are made to the satisfaction of the Engineer and the submittals are fully approved.

6. The following is a list of post construction submittals that shall be updated to reflect any changes during construction and re-submitted as "As-Built".

a. System architecture drawing.

b. Layout drawing for each control panel

c. Wiring diagram for individual components

d. System flow diagram for each controlled system

e. Instrumentation list for each controlled system

f. Sequence of control

7. Information common to the entire system shall be provided in final O&M. This shall include but not be limited to the following.

a. Product manuals for the key software tasks.

b. Operating the system.

c. Administrating the system.

d. Engineering the operator workstation.

e. System Architecture Diagram.

f. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.

g. Licenses, guarantees, and warranty documents for equipment and systems.

8. Information common to the systems in a single building shall be provided.

a. System architecture diagram for components within the building annotated with specific location information.

b. As-built drawing for each control panel.

c. As-built wiring design diagram for all components.

d. Installation design details for each I/O device.

e. As-built system flow diagram for each system.

f. Sequence of control for each system.

g. Product data sheet for each component.

h. Installation data sheet for each component.

9. Software shall be provided:

a. Submit a copy of all software installed on the servers and workstations.

b. Submit all licensing information for all software installed on the servers and workstations.

c. Submit a copy of all software used to execute the project even if the software was not installed on the servers and workstations.

d. Submit all licensing information for all of the software used to execute the project.

e. All software revisions shall be as installed at the time of the system acceptance.

1.6 QUALITY ASSURANCE

A. All bidders must be building automation contractors in the business of installing direct digital control building automation systems for a minimum of 3 years.

1. The Building Management System contractor shall have a full service facility within 500 miles of the project that is staffed with engineers trained and certified by the manufacturer in the configuration, programming and service of the automation system. The contractor’s technicians shall be fully capable of providing instructions and routine emergency maintenance service on all system components.

2. Any installing contractor, not listed as prequalified in the Approved Manufacturer's section, shall submit credentials as detailed in the Pre-bid Submittal section for the engineer’s review 2 weeks prior to bid date. Failure to follow the attached formats shall disqualify potential alternate bidders. Credentials must attest that the contractor meets all requirements of the specification and the Engineers judgment regarding approval to bid as an acceptable installer after reviewing the data will be final.

B. All bidders must be authorized distributors or branch offices of the manufacturers specified.

C. The following bidders have been pre-qualified:

1. Schneider Electric - Sustainability Business

D. Any installing contractors or manufacturers interested in participating as acceptable bidders for this project that are not pre-qualified shall furnish a detailed technical pre-bid submittal to the consulting engineer. All information must be submitted 2 weeks prior to the published bid date to allow the engineer adequate time to review the bidder’s credentials.

E. The Pre-Bid submittal shall contain the following information as a minimum:

1. A profile of the manufacturer and the local installation and service/organization.

2. Description of how the system meets and achieves all the specified criteria in terms of configuration, operation, and control.

3. System Architecture with single line riser diagram showing all major components (digital controllers, routers, hubs, etc.) that will be required for this project.

4. Product Data Sheets for all components, DDC panels, and all accessories listed per the appropriate specification sections herein.

5. Examples of actual graphic screens for other similar projects.

6. List of 2 similar systems in size, point capacity, total installed value, installed and commissioned by the local office with a list of the installers/manufacturers design team members for each project and the owners contact information.

7. Samples of service offerings and a list of current similar service contracts with contact information.

F. Each point in the system shall be tested for both hardware and software functionality. In addition, each mechanical and electrical system under control of the BAS will be tested against the appropriate sequence of operation specified herein. Successful completion of the system test shall constitute the beginning of the warranty period. A written report will be submitted to the owner indicating that the installed system functions in accordance with the control design drawings and specifications.

G. The BAS system supplier shall commission and set in operating condition all major equipment and systems, such as the chilled water, hot water and all air handling systems, in the presence of the equipment manufacturer's representatives, as applicable, and the Owner and Architect's representatives. If the vendor is providing an AFDD/CC system, use of the analytics shall be used to help commission the system.

H. Startup Testing shall be performed for each task on the startup test checklist, which shall be initialed by the technician and dated upon test was completion along with any recorded data such as voltages, offsets or tuning parameters. Any deviations from the submitted installation plan shall also be recorded.

I. A performance verification test shall also be completed for the operator interaction with the system. Test elements shall be written to require the verification of all operator interaction tasks including, but not limited to the following.

1. Graphics navigation.

2. Trend data collection and presentation.

3. Alarm handling, acknowledgement and routing.

4. Time schedule editing.

5. Application parameter adjustment.

6. Manual control.

7. Report execution.

8. Automatic backups.

9. Web Client access.

J. A Startup Testing Report and a Performance Verification Testing Report shall be provided upon test completion.

1.7 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate equipment from other divisions including "Intrusion Detection," "Lighting Controls," "Motor Control Centers," "Panel boards," and "Fire Alarm" to achieve compatibility with equipment that interfaces with those systems.

C. Coordinate supply of conditioned electrical circuits for control units and operator workstation.

D. Coordinate location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete".

E. Coordinate with the Owner's IT department on locations for NSC's, Ethernet communication cabling and TCP/IP addresses.

1.8 OWNERSHIP

A. The Owner shall retain licenses to software for this project.

B. The Owner shall sign a copy of the manufacturer’s standard software and firmware licensing agreement as a condition off this contractor. Such license shall grant use of all programs and application software to the Owner as defined by the manufacturer’s license agreement, but shall protect the manufacturer’s rights to disclosure of Trade Secrets contained within such software.

C. The licensing agreement shall not preclude the use of the software by individuals under contract to the owner for commissioning, servicing or altering the system in the future. Use of the software by individuals under contract to the owner shall be restricted to use on the owner’s computers and only for the purpose of commissioning, servicing, or altering the installed system.

D. All project developed software, files and documentation shall become the property of the Owner. These include but are not limited to:

1. Server and workstation software

2. Application programming tools

3. Configuration tools

4. Network diagnostic tools

5. Addressing tools

6. Application files

7. Configuration files

8. Graphic files

9. Report files

10. Graphic symbol libraries

11. All documentation

1.9 WORK BY OTHERS

A. The BAS system supplier shall cooperate with other contractors performing work on this project necessary to achieve a complete and neat installation. To that end, each contractor shall consult the drawings and specifications for all trades to determine the nature and extent of others' work.

B. The BAS system supplier shall furnish all Control Valves, Flow Meters, Sensor Wells for installation by the Mechanical Contractor and/or others.

C. The BAS system supplier shall provide field supervision to the designated contractor for the installation of the following:

1. The Electrical Contractor shall provide:

a. All 120VAC power wiring to motors, heat trace, junction boxes for power to BAS panels.

b. Furnish smoke detectors and wire to the building fire alarm system. HVAC Contractor to mount devices. BAS system supplier to hardwire to fan shut down.

c. Auxiliary contact (pulse initiator) on the electric meter for central monitoring of kWh and KW. Electrical Contractor shall provide the pulse rate for remote readout to the BAS. BAS system supplier to coordinate this with the electrical contractor.

D. Prior to delivery to the Project site, ensure that suitable storage space is available to store materials in a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres. Materials shall be protected during delivery and storage and shall not exceed the manufacturer stated storage requirements. As a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. In addition, protect electronics from all forms of electrical and magnetic energy that could reasonably cause damage.

E. Deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and equipment tag number or service name as identified within the Contract Documents.

F. Inspect and report any concealed damage or violation of delivery storage, and handling requirements to the Engineer.

1.10 WARRANTY

A. All components, system software, and parts furnished and installed by the BMS system supplier shall be guaranteed against defects in materials and workmanship for 1 year of substantial completion. Labor to repair, reprogram, or replace these components shall be furnished by the BMS system supplier at no charge during normal working hours during the warranty period. Materials furnished but not installed by the BMS system supplier shall be covered to the extent of the product only. Installation labor shall be the responsibility of the trade contractor performing the installation. All corrective software modifications made during warranty periods shall be updated on all user documentation and on user and manufacturer archived software disks. The Contractor shall respond to the owner's request for warranty service within 24 standard working hours.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Product: Subject to compliance with requirements, provide products by one of the following pre-qualified manufacturers:

1. Electric Components

a. Schneider-Electric Field Devices

1) All BCS components shall be compatible with the existing Schneider Electric Building Controls System.

(a) Schneider Electric Contact for this building/project is Cregg Moore (Cregg.Moore@se.com; 972-207-7323).

PART 3 EXECUTION

3.1 GENERAL

A. In addition to the requirements specified herein, execution shall be in accordance with the requirements of Specification Section 23 00 00 and Drawings.

B. Examine equipment exterior and interior prior to installation. Report any damage and do not install any equipment that is structurally, moisture, or mildew damaged.

C. Verification of Conditions: Examine areas and conditions under which the work is to be installed, and notify the Contractor in writing, with a copy to the Owner and the Engineer, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

D. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.

E. Install equipment in accordance with reviewed product data, final shop drawings, manufacturer’s written instructions and recommendations, and as indicated on the Drawings.

F. Provide final protection and maintain conditions in a manner acceptable to the manufacturer that shall help ensure that the equipment is without damage at time of Substantial Completion.

G. Access to Site

1. Unless notified otherwise, entrance to building is restricted. No one will be permitted to enter the building unless their names have been cleared with the Owner or the Owner's Representative.

H. Cleanup

1. At the completion of the work, all equipment pertinent to this contract shall be checked and thoroughly cleaned, and all other areas shall be cleaned around equipment provided under this contract.

3.2 SYSTEM ACCEPTANCE TESTING

A. All application software will be verified and compared against the sequences of operation.

B. Control loops will be exercised by inducing a setpoint shift of at least 10% and observing whether the system successfully returns the process variable to setpoint. Record all test results and attach to the Test Results Sheet.

C. Test each alarm in the system and validate that the system generates the appropriate alarm message, that the message appears at all prescribed destinations (workstations or printers), and that any other related actions occur as defined (i.e. graphic panels are invoked, reports are generated, etc.). Submit a Test Results Sheet to the owner.

D. Perform an operational test of each unique graphic display and report to verify that the item exists, that the appearance and content are correct, and that any special features work as intended. Submit a Test Results Sheet to the owner.

E. Perform an operational test of each third party interface that has been included as part of the automation system. Verify that all points are properly polled, that alarms have been configured, and that any associated graphics and reports have been completed. If the interface involves a file transfer over Ethernet, test any logic that controls the transmission of the file, and verify the content of the specified information.

3.3 INSTALLATION

A. Hardware Installation Practices for Wiring

1. All controllers are to be mounted vertically and per the manufacturer's installation documentation.

2. The 120VAC power wiring to each Ethernet or Remote Site controller shall be a dedicated run, with a separate breaker. Each run will include a separate hot, neutral and ground wire. The ground wire will terminate at the breaker panel ground. This circuit will not feed any other circuit or device.

3. A true earth ground must be available in the building. Do not use a corroded or galvanized pipe, or structural steel.

4. Wires are to be attached to the building proper at regular intervals such that wiring does not droop. Wires are not to be affixed to or supported by pipes, conduit, etc.

5. Conduit in finished areas will be concealed in ceiling cavity spaces, plenums, furred spaces and wall construction. Exception; metallic surface raceway may be used in finished areas on masonry walls. All surface raceway in finished areas must be color matched to the existing finish within the limitations of standard manufactured colors.

6. Conduit, in non-finished areas where possible, will be concealed in ceiling cavity spaces, plenums, furred spaces, and wall construction. Exposed conduit will run parallel to or at right angles to the building structure.

7. Wires are to be kept a minimum of three (3) inches from hot water, steam, or condensate piping.

8. Where sensor wires leave the conduit system, they are to be protected by a plastic insert.

9. Wire will not be allowed to run across telephone equipment areas.

10. Provide fire caulking at all rated penetrations.

B. Installation Practices for Field Devices

1. Well-mounted sensors will include thermal conducting compound within the well to insure good heat transfer to the sensor.

2. Actuators will be firmly mounted to give positive movement and linkage will be adjusted to give smooth continuous movement throughout 100 percent of the stroke.

3. Relay outputs will include transient suppression across all coils. Suppression devices shall limit transients to 150% of the rated coil voltage.

4. Water line mounted sensors shall be removable without shutting down the system in which they are installed.

5. For duct static pressure sensors, the high pressure port shall be connected to a metal static pressure probe inserted into the duct pointing upstream. The low pressure port shall be left open to the plenum area at the point that the high pressure port is tapped into the ductwork.

6. For building static pressure sensors, the high pressure port shall be inserted into the space via a metal tube. Pipe the low pressure port to the outside of the building.

C. Wiring, Conduit, and Cable

1. All wire will be copper and meet the minimum wire size and insulation class listed below:

a. Power - 12 Gauge - 600 Volt

b. Class One - 14 Gauge Std. - 600 Volt

c. Class Two - 18 Gauge Std. - 300 Volt

d. Class Three - 18 Gauge Std. - 300 Volt

e. Communications - Per Mfr.

2. Power and Class One wiring may be run in the same conduit. Class Two and Three wiring and communications wiring may be run in the same conduit.

3. Where different wiring classes terminate within the same enclosure, maintain clearances and install barriers per the National Electric Code.

4. Where wiring is required to be installed in conduit, EMT shall be used. Conduit shall be minimum 1/2 inch galvanized EMT. Set screw fittings are acceptable for dry interior locations. Watertight compression fittings shall be used for exterior locations and interior locations subject to moisture. Provide conduit seal-off fitting where exterior conduits enter the building or between areas of high temperature/moisture differential.

5. Flexible metallic conduit (max. 3 feet) shall be used for connections to motors, actuators, controllers, and sensors mounted on vibration producing equipment. Liquid-tight flexible conduit shall be use in exterior locations and interior locations subject to moisture.

6. Junction boxes shall be provided at all cable splices, equipment termination, and transitions from EMT to flexible conduit. Interior dry location J-boxes shall be galvanized pressed steel, nominal four-inch square with blank cover. Exterior and damp location JH-boxes shall be cast alloy FS boxes with threaded hubs and gasketed covers.

7. Where the space above the ceiling is a supply or return air plenum, the wiring shall be plenum rated. Teflon wiring can be run without conduit above suspended ceilings. EXCEPTION: Any wire run in suspended ceilings that is used to control outside air dampers or to connect the system to the fire management system shall be in conduit.

8. Fiber optic cable shall include the following sizes; 50/125, 62.5/125 or 100/140.

9. Only glass fiber is acceptable, no plastic.

10. Fiber optic cable shall only be installed and terminated by an experienced contractor. The BAS system supplier shall submit to the Engineer the name of the intended contractor of the fiber optic cable with his submittal documents.

D. Enclosures

1. For all I/O requiring field interface devices, these devices where practical will be mounted in a field interface panel (FIP). The Contractor shall provide an enclosure which protects the device(s) from dust, moisture, conceals integral wiring and moving parts.

2. FIPs shall contain power supplies for sensors, interface relays and contactors, and safety circuits.

3. The FIP enclosure shall be of steel construction with baked enamel finish; NEMA 1 rated with a hinged door and keyed lock. The enclosure will be sized for twenty percent spare mounting space. All locks will be keyed identically.

4. All wiring to and from the FIP will be to screw type terminals. Analog or communications wiring may use the FIP as a raceway without terminating. The use of wire nuts within the FIP is prohibited.

5. All outside mounted enclosures shall meet the NEMA-4 rating.

6. The wiring within all enclosures shall be run in plastic track. Wiring within controllers shall be wrapped and secured.

E. Existing Controls.

1. Existing controls which are to be reused must each be tested and calibrated for proper operation. Existing controls which are to be reused and are found to be defective requiring replacement, will be noted to the Owner. The Owner will be responsible for all material and labor costs associated with their repair.

F. Location

1. The location of sensors is per mechanical and architectural drawings.

2. Space humidity or temperature sensors will be mounted away from machinery generating heat, direct light and diffuser air streams.

3. Outdoor air sensors will be mounted on the north building face directly in the outside air. Install these sensors such that the effects of heat radiated from the building or sunlight is minimized.

4. Field enclosures shall be located immediately adjacent to the controller panel(s) to which it is being interfaced.

G. Software Installation

1. The Contractor shall provide all labor necessary to install, initialize, start-up and debug all system software as described in this section. This includes any operating system software or other third party software necessary for successful operation of the system.

3.4 TRAINING

A. The BAS system supplier shall provide both on-site and classroom training to the Owner’s representative and maintenance personnel per the following description:

B. On-site training shall consist of a minimum of (20) hours of hands-on instruction geared at the operation and maintenance of the systems. The curriculum shall include

1. System Overview

2. System Software and Operation

3. System access

4. Software features overview

5. Changing setpoints and other attributes

6. Scheduling

7. Editing programmed variables

8. Displaying color graphics

9. Operational sequences including start-up, shutdown, adjusting and balancing.

10. Equipment maintenance

END OF SECTION 23 0923

SECTION 23 3113 - METAL DUCTWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of metal ductwork is indicated on drawings and in schedules, and by requirements of this section.

B. All duct dimensions shown on drawings are net inside clear dimensions.

1.2 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Firms regularly engaged in manufacture of metal ductwork products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer’s Qualifications: Firm with at least 3 years of successful installation experience on projects with metal ductwork systems similar to that required for project.

C. Codes and Standards:

1. SMACNA Standards: Comply with SMACNA's “HVAC Duct Construction Standards, Metal and Flexible”, First Edition, 2005, for fabrication and installation of metal ductwork.

2. ASHRAE Standards: Comply with ASHRAE Handbook latest edition, HVAC Systems and Equipment volume, Chapter 16 “Duct Construction”, for fabrication and installation of metal ductwork.

3. NFPA Compliance: Comply with latest editions of NFPA 90A “Installation of Air Conditioning and Ventilating Systems” and NFPA 90B” Installation of Warm Air Heating and Air Conditioning Systems”.

D. Field Reference Manual: Have available for reference at project field office, copy of SMACNA “HVAC Duct Construction Standards, Metal and Flexible”.

E. Flame/Smoke Ratings: Provide composite mechanical system (insulating material, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

F. All adhesives, sealants and sealant primers shall contain low VOC (Volatile Organic Compunds), as outlined in the South Coast Air Quality Management District (SCAQMD) Rule #1168.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s technical product data and installation instructions for metal ductwork materials and products.

B. Shop Drawings: Submit scaled layout drawings of metal ductwork and fittings including, but not limited to, duct sizes, locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spatial relationship between ductwork and proximate equipment. Show modifications of indicated requirements, made to conform to local shop practice, and how those modifications ensure that free area, materials and rigidity are not reduced.

C. Record Drawings: At project closeout, submit record drawings of installed metal ductwork and ductwork products, in accordance with requirements of Division 01.

D. Maintenance Data: Submit maintenance data and parts lists for metal ductwork materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements of Division 01.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protection: Protect shop fabricated and factory fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

B. Storage: Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 DUCTWORK MATERIALS

A. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials that are free from visual imperfections including pitting, seam marks, roller marks, and stains and discolorations, and other imperfections, including those that would impair painting.

B. Sheet Metal: All interior ducts shall be constructed with G-60 or better galvanized steel (ASTM A 653/A 653M) LFQ, chem treat. Exterior ductwork or duct exposed to high humidity conditions (i.e. moisture laden exhausts not specified to be stainless steel) shall be G-90 or better galvanized steel LFQ, chem treat.

C. Stainless Steel Sheet: Where indicated, provide stainless steel complying with ASTM A167; Type 302, 304, or 316; with No. 4 finish where exposed to view in occupied spaces, No. 1 finish elsewhere. Protect finished surfaces with mill-applied adhesive protective paper, maintained through fabrication and installation.

D. Aluminum Sheet: Where indicated, provide aluminum sheet complying with ASTM B209, Alloy 3003, Temper H14.

E. Copper Sheet: Where indicated, provide copper sheet complying with ASTM B370; H00 temper, except where 060 temper is required for unusual forming.

2.2 MISCELLANEOUS DUCTWORK MATERIALS

A. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.

B. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15° change of direction per section. Unless specifically detailed otherwise, use 45° laterals and 45° elbows for branch takeoff connections. Where 90° branches are indicated, provide conical type tees.

C. Duct Liner:

1. Fibrous glass, complying with Thermal Insulation Manufacturer's Association (TIMA) AHC-101; of thickness indicated with a minimum installed R-Value equal to 6.0 (1-1/2 in. thick minimum), with black-coated, fire-resistant airstream face, with EPA-registered antimicrobial agent.

2. Flexible Unicellular

a. Ductwork Liner: ASTM C534 Type 1, Thickness 1-1/2 : with a minimum R-value equal to R-6.0.

3. Manufacturers:

a. Certainteed "Toughgard".

b. Knauf Type "EM".

c. Johns Mansville "Permacote Linacoustic".

d. Owens-Corning "Aeroflex Plus".

e. No Substitutions

D. Duct Liner Adhesive:

1. Comply with ASTM C 916 "Specifications for Adhesives for Duct Thermal Insulation." Application shall conform to Manufacturer's written recommendations for the apparent application.

2. Adhesives shall be non-inflammable after curing.

3. Manufacturers:

a. Benjamin-Foster.

b. Duro Dyne "FPG".

c. Kinco 15-137.

d. Miracle PF-91.

e. Manufacturer of duct liner used for this project.

E. Duct Liner Fasteners:

1. Comply with SMACNA "Installation Standards for Rectangular Ducts using Flexible Liner", Articles S2.0 through S2.11.

2. Comply with lining details as shown in the referenced SMACNA Section, Figures 2-22 and 2-23.

3. Clinched-pin type fasteners shall be “Grip-Nail”, or approved equal.

4. Projecting pins in Type 3 or Type 4 applications shall be clipped off close enough to the retaining disc to provide proper anchoring and to prevent injury to personnel.

F. Duct Sealant:

1. Duct sealer shall be flexible, water-based, adhesive sealant designed for use in all pressure duct systems. After curing, it shall be resistant to ultraviolet light and shall seal out water, air, and moisture. Sealer shall be UL listed and conform to ASTM E 84.

2. Comply with requirements of SMACNA Table 1-2.

3. Manufacturers:

a. Benjamin-Foster

b. Ductmate - PROseal.

c. Duro Dyne S2.

d. Hardcast.

e. United Sheet Metal.

G. Duct Cement:

1. Non-hardening, non-migrating mastic or liquid elastic sealant of type applicable for fabrication/installation detail as compounded and recommended by manufacturer specifically for cementing fitting components, or longitudinal seams in ductwork.

2. Comply with requirements of SMACNA Table 1-2.

3. Manufacturers:

a. Benjamin-Foster.

b. Duro Dyne S2.

c. Hardcast.

d. United Sheet Metal.

H. Ductwork Support Materials:

1. General:

a. Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

b. Comply with applicable provisions of SMACNA 2005 Standards, Figures 4-1 through 4-8, and Tables 4-1 through 4-3.

2. Except where space is indicated as “High Humidity” area, interior support materials of not less than 1/4 in. diameter or 3/16 in. thickness may be plain (not galvanized).

3. For exposed stainless steel ductwork, provide matching stainless steel support materials. For copper ductwork, provide copper, bronze or brass support materials.

4. For aluminum ductwork, provide aluminum support materials except where materials are electrolytically separated from ductwork.

2.3 FLEXIBLE DUCTS

A. General:

1. Spiral wound spring steel with flameproof metallized polyester sheathing, complying with UL181.

2. Comply with applicable provisions of SMACNA 2005 Standards, pages 3-13 through 3-20.

3. Installation shall conform to conditions under which UL listing was granted.

4. Flexible Ductwork runouts shall be limited to 6' - 0" extended length.

B. Insulation:

1. Insulate all flexible ducts, both supply and return, with a minimum R-Value of 6.0, per International Energy Conservation Code – latest edition. Duct shall have a continuous flexible fiberglass sheath with UL approved metallized polyester barrier jacket.

C. Flexible Ductwork shall be equal to ATCO #036

D. Manufacturers: Subject to compliance with requirements, provide flexible ducts manufactured by one of the following:

1. ATCO.

2. Thermaflex.

3. Quietflex.

2.4 FABRICATION

A. Shop-fabricate ductwork in 4,8,10, or 12 ft. lengths, unless otherwise indicated or required to complete runs. Preassemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match mark sections for reassembly and coordinated installation.

B. All duct dimensions shown on drawings are net inside clear dimensions.

C. Shop-fabricate ductwork of gauges and reinforcement complying with SMACNA 2005 Standards as follows:

1. Rectangular, Steel:

a. Tables 1-1 through 1-13.

b. Figures 1-2 through 1-18.

c. Fittings and Construction, Section II.

2. Rectangular, aluminum: Pages 1-31 through 1-33.

3. Round, Oval and Flexible Duct: Section III.

D. Shop fabricate ductwork of gauges and reinforcement complying with ASHRAE Handbook, HVAC Systems and Equipment Volume, Chapter 16 “Duct Construction”.

E. Longitudinal Seams: Pittsburgh lock shall be used on all longitudinal seams. All longitudinal seams will be sealed with mastic sealant. Snaplock is not acceptable.

F. Ductmate or W.D.C.I. proprietary duct connection systems will be acceptable. Duct constructed using these systems will refer to the manufacturers guidelines for sheet gauge, intermediate reinforcement size and spacing, and joint reinforcements.

G. Formed on flanges (T.D.C./T.D.F./T-25A/T-25B) will only be acceptable when submitted for approval prior to installation of any ductwork. Formed on flanges will be constructed as SMACNA T-25 flanges, whose limits are defined on Page 1.36 of the 2005 SMACNA Manual, First Edition. No other construction pertaining to form on flanges will be acceptable. Formed on flanges shall be acceptable for use on ductwork 42 in. wide or less, with 2 in. positive pressure static or less, and must include the use of corners, bolts and cleat.

H. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center line radius equal to associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. Limit angular tapers to 30° for contracting tapers and 20° for expanding tapers.

I. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division 23 Section “Ductwork Accessories” for accessory requirements.

J. Fabricate ductwork with duct liner in each section of duct where indicated. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining and adhesive, and fasten with mechanical fasteners. Comply with previous paragraph 2.2.

K. Round Duct Joints:

1. 0 in. - 20 in. diameter, interior slip coupling beaded at center, fastened to duct with sealing compound applied continuously around joint before assembling and after fastening. Wrap joints with 3 in. wide duct tape.

2. 21 in. - 72 in. diameter, use 3 piece, gasketed, flanged joints consisting of 2 internal flanges (with integral mastic sealant) split to accommodate minor differences in duct diameter, and one external closure band designed to compress gasketing between internal flanges. Example: Ductmate Spiralmate or equal.

3. 73 in. diameter and up, use companion angle flanged joints only as defined on page 3-6 of the SMACNA Manual. Refer to manual for proper sizing and construction details. Ductwall to be welded longitudinal seams.

L. Pressure Classifications:

1. Static pressure ratings for ductwork systems shall be as noted on the drawings, and/or shall conform to requirements of 2005 SMACNA Standards, Table 1-1.

2. In no case shall the pressure rating of the duct be less than that indicated in Table 1-1 for the apparent duct velocity.

3. Gauges of metal and reinforcing methods shall conform to SMACNA requirements as follows:

a. Rectangular Steel: Table 1-3 through 1-13.

b. Rectangular Aluminum: Tables 1-14 through 1-16.

c. Round, or Flat Oval, Steel: Table 3-2.

d. Round Aluminum: Table 3-3.

2.5 FACTORY-FABRICATED DUCTWORK

A. At Contractor’s option, factory-fabricated ductwork sections, fittings, etc., may be substituted for shop-made items.

B. Factory-fabricated items shall comply in every respect with SMACNA requirements listed previously in this Section, or show proof from a recognized, approved independent laboratory, prior to bidding, that the proposed construction methods produce products that equal, or exceed, the SMACNA 2005 Standards.

C. Comply with applicable provisions of International Mechanical Code and local ammendments.

D. Manufacturers: Subject to compliance with requirements, provide factory-fabricated ductwork and/or fittings of one of the following:

1. Ductmate, Inc., Monongahela, PA.

2. Semco Mfg., Inc.

3. United Sheet Metal Div., United McGill, Inc.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Examine areas and conditions under which metal ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF METAL DUCTWORK

A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air tight (5% leakage for systems rated 3 in. and under; 1% for systems rated over 3 in.) and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8 in. misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type that will hold ducts true to shape and to prevent buckling. Support vertical ducts at every floor. Seal all longitudinal and transverse duct joints and seams with non-hardening duct mastic.

B. All round duct taps shall be conical type. All rectangular duct taps shall have 45° mitered entry per SMACNA.

C. Inserts: Install concrete inserts for support of ductwork in coordination with formwork, as required to avoid delays in work.

D. Field Fabrication: Complete fabrication of work at project as necessary to match shop fabricated work and accommodates installation requirements.

E. Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Where possible, locate insulated ductwork for 1 in. clearance outside of insulation. Limit clearance to 1/2 in. where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with structural members, suspended ceiling, lighting layouts, sprinkler piping, plumbing systems and similar finished work.

F. Electrical Equipment Spaces: Do not route ductwork through Electric Rooms, transformer vaults, and other electrical equipment spaces and enclosures.

G. Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gauge as duct. Overlap opening on 4 sides by at least 1-1/2 in. Fasten to duct and substrate.

1. Where ducts pass through fire rated floors, walls, or partitions, provide fire stopping between duct and substrate, in accordance with requirements of Division 07 Section “FIRE STOPPING”.

H. Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.

I. Installation: Install metal ductwork in accordance with SMACNA HVAC Duct Construction Standards.

3.3 INSTALLATION OF DUCT LINER

A. General: Install duct liner in accordance with SMACNA HVAC Duct Construction Standards, pages 2-25 thru 2-29.

B. All supply and return ductwork serving air handlers and terminal units shall be lined with 1-1/2 in. thick acoustical lining for 20 feet from the unit.

3.4 INSTALLATION OF FLEXIBLE DUCTS

A. Maximum Length: For any duct run using flexible ductwork, do not exceed 6 ft. 0 in. extended length.

B. Installation: Install in accordance with Section III of SMACNA's, HVAC Duct Construction Standards, Metal and Flexible".

3.5 FIELD QUALITY CONTROL

A. Leakage Tests: After installation of each duct system that is constructed for duct classes over 3 in. is completed, test for duct leakage. Repair leaks and repeat tests until total leakage is less than 1% of system design airflow.

B. The testing shall be performed as follows:

1. Perform testing in accordance with HVAC Air Duct Leakage Test Manual.

2. Use a certified orifice tube for measuring the leakage.

3. Define section of system to be tested and blank off.

4. Determine the percentage of the system being tested.

5. Using that percentage, determine the allowable leakage (CFM) for that section being tested.

6. Pressurize to operating pressure and repair any significant or audible leaks.

7. Re-pressurize and measure leakage.

8. Repeat steps 6 and 7 until the leakage measured is less than the allowable defined in step 5.

3.6 EQUIPMENT CONNECTIONS

A. General: Connect metal ductwork to equipment as indicated; provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery. Provide access doors as indicated.

3.7 ADJUSTING AND CLEANING

A. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances that might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

B. Strip protective paper from stainless ductwork surfaces, and repair finish wherever it has been damaged.

C. Temporary Closure: At ends of ducts that are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering that will prevent entrance of dust and debris until time connections are to be completed.

D. Balancing: Refer to Division 23 Section “TESTING, ADJUSTING AND BALANCING” for air distribution balancing of metal ductwork; not work of this section. Seal any leaks in ductwork that become apparent in balancing process.

END OF SECTION 23 3113

SECTION 23 3113.19 - DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of ductwork accessories work is indicated on drawings and in schedules, and by requirements of this section.

B. Types of ductwork accessories required for project include the following:

1. Dampers.
    a. Low-pressure manual dampers.
    b. Control dampers.
2. Fire dampers.
3. Turning vanes.
4. Duct hardware.
5. Duct access doors.
6. Flexible connections.
7. Concealed Damper Regulators.

C. Refer to other Division 23 sections for testing, adjusting, and balancing of ductwork accessories; not work of this section.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of ductwork accessories, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Codes and Standards:

1. SMACNA Compliance: Comply with applicable portions of SMACNA “HVAC Duct Construction Standards, Metal and Flexible,” 2005 edition.
2. Industry Standards: Comply with latest ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.
3. UL Compliance: Construct, test, and label fire dampers in accordance with UL Standard 555 “Fire Dampers and Ceiling Dampers.”
4. NFPA Compliance: Comply with applicable provisions of NFPA 90A latest edition “Installation of Air Conditioning and Ventilating Systems”, pertaining to installation of ductwork accessories.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction; and installation instructions.

B. Shop Drawings: Submit manufacturer’s assembly type Shop Drawings for each type of ductwork accessory showing interfacing requirements with ductwork, method of fastening or support, and methods of assembly of components.

C. Maintenance Data: Submit manufacturer’s maintenance data including parts lists for each type of duct accessory. Include this data, product data, and Shop Drawings in maintenance manual; in accordance with requirements of Division 01.

PART 2 - PRODUCTS

2.1 DAMPERS

A. Low Pressure Manual Dampers: Provide dampers of single blade type or multi blade type, constructed in accordance with SMACNA “HVAC Duct Construction Standards.” Each damper shall have an orange ribbon on the handle for identificaitno for balancing.

B. Control Dampers: Provide dampers with parallel blades for 2-position control, or opposed blades for modulating control. Construct blades of 16-ga steel; provide heavy-duty molded self-lubricating nylon bearings, 1/2 in. diameter steel axles spaced on 9 in. centers. Construct frame of 2 in. x 1/2 in. x 1/8 in. steel channel for face areas 25 sq.ft. and under; 4 in. x 1-1/4 in. x 16-ga channel for face areas over 25 sq.ft. Provide galvanized steel finish with aluminum touch up.

C. Control Dampers: Refer to Division 23 Section “CONTROL SYSTEMS”: for control dampers; not work of this section.

D. Counterbalanced Relief Dampers: Provide dampers with parallel blades, counterbalanced and factory set to relieve at indicated static pressure. Construct blades of 16-ga aluminum, provide 1/2 in. diameter ball bearings, 1/2 in. diameter steel axles spaced on 9 in. centers. Construct frame of 2 in. x 1/2 in. x 1/8 in. steel channel for face areas 25 sq.ft. and under; 4 in. x 1-1/4 in. x 16-ga channel for face areas over 25 sq.ft. Provide galvanized steel finish on frame with aluminum touch-up.

E. Manufacturer: Subject to compliance with requirements, provide dampers of one of the following:

1. Air Balance, Inc.

2. Nailor

3. American Warming & Ventilating, Inc.

4. Louvers & Dampers, Inc.

5. Penn Ventilator Co.

6. Ruskin Mfg. Co.

7. Pottorff

F. Fire Damper (FD)

1. Fabricated Fire Dampers: Provide dampers constructed in accordance with SMACNA “Fire Damper and Heat Stop Guide”.

2. Damper frames shall be constructed of minimum 16 gauge welded galvanized steel channel. Frames in excess of 36 in. height shall have corner braces or equivalent means of strengthening to ensure squareness and rigidity. Frames shall be constructed for flanged ductwork connection. “Slip In” (insertion) type dampers shall not be acceptable. Frames shall be sized to match the final dimensions of the ducts including allowance where applicable, for the duct lining materials. Coordinate required installation details with Mechanical Installer.

3. Fire Dampers: Provide Class B or C Fire dampers, of types and sizes indicated. Provide fusible link rated at 160 to 165°F (71 to 74°C) unless otherwise indicated or required for special exhaust systems. Provide damper with positive lock in closed position, and with the following additional features:

   a. Damper Blade Assembly: Multi blade type, completely out of airstream.

   b. Damper Blade Assembly: Curtain type, completely out of the airstream.

   c. Blade Material: Steel, match casing.

   d. Blade Material: Stainless Steel.

4. Measurements diagonally from upper to lower opposite corners of the installed damper assembly, including multiple section dampers shall not differ by more than 1/8 in. or 0.2%, whichever is the greater.

5. Manufacturer: Subject to compliance with requirements, provide fire and smoke dampers of one of the following:

   a. Air Balance, Inc.

   b. American Warming & Ventilating, Inc.

   c. Greenheck

   d. Louvers and Dampers, Inc.

   e. Nailor

   f. National Control Air

   g. Penn Ventilator Co.

   h. Pottorff

2.2 TURNING VANES

A. Fabricated Turning Vanes: Provide fabricated turning vanes and vane runners, constructed in accordance with SMACNA “HVAC Duct Construction Standards”.

B. Turning Vanes: Turning vanes shall be double wall turning vanes fabricated from the same material as the duct. Tab spacing shall be SMACNA standard. Rail systems with non-standard tab spacings shall not be accepted. All tabs shall be used, do not skip tabs. Mounting rails shall have friction insert tabs that align the vanes automatically. Vanes shall be subjected to tensile loading and be capable of supporting 250 lbs when fastened per the manufacturer’s instructions.

C. Acoustic Turning Vanes: Provide acoustic turning vanes constructed of air-foil shaped aluminum extrusions with perforated faces and fiberglass fill.

D. Manufacturer: Subject to compliance with requirements, provide turning vanes of one of the following:

1. Aero Dyne Co.

2. Anemostat Products Div.; Dynamics Corp. Of America

3. Barber-Colman Co.

4. Ductmate Industries, Inc.

5. Duro Dyne Corp.

6. Hart & Cooley Mfg. Co.

7. Register & Grille Mfg. Co., Inc.

2.3 DUCT HARDWARE

A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:

1. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.

2. Quadrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12 in. Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

B. Manufacturer: Subject to compliance with requirements, provide duct hardware of one of the following:

1. Ventfabrics, Inc.

2. Young Regulator Co.

2.4 DUCT ACCESS DOORS

A. General: Provide where indicated, duct access doors of size indicated.

B. Construction: Construct of same or greater gauge as ductwork served, provide insulated doors for insulated ductwork. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. Provide one side hinged, other side with one handle-type latch for doors 12 in. high and smaller, 2 handle-type latches for larger doors.

C. As an option, clamping type access doors may be installed.

D. Manufacturer: Subject to compliance with requirements, provide duct access doors of one of the following:

1. Air Balance Inc.

2. Ductmate Industries, Inc.

3. Duro Dyne Corp.

4. Register & Grille Mfg. Co., Inc.

5. Ruskin Mfg. Co.

6. Ventfabrics, Inc.

7. Zurn Industries, Inc; Air Systems Div.

2.5 FLEXIBLE CONNECTIONS

A. General: Provide flexible duct connections wherever ductwork connects to vibrating equipment. Construct flexible connections of neoprene coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibrations of connected equipment.

B. Manufacturer: Subject to compliance with requirements, provide flexible connections of one of the following:

1. American/Elgen Co,; Energy Div.

2. Ductmate Industries

3. Duro Dyne Corp.

4. Flexaust (The) Co.

5. Ventfabrics, Inc.

2.6 CONCEALED DAMPER REGULATORS: FOR VOLUME DAMPERS LOCATED ABOVE GYP BOARD, PLASTER OR OTHER HARD CEILINGS:

A. Concealed damper regulators shall be designed to control volume dampers from the ceiling line. Regulators shall be imbedded so the entire unit is flush with the finished surface. The regulator cover plate shall cover the joint between the box and the ceiling. The cover shall be adjustable from 1/2 in. to 1-1/8 in. utilizing the manufacturer's spanner wrench. Coverplate to have zinc plated finish, suitable for painting. Concealed damper regulators to be Young Regulator Model 315.

B. Volume dampers for concealed damper regulators shall be Young Regulator Model 5020-B (round) or Model 820A-C (rectangular), designed and installed for operation by ceiling mounted regulators.

C. Where required, provide Young Regulator Model 927 Right Angle Miter Gears, or Model 1200 Right Angle Worm Gear Regulator, to allow control of a damper that has the damper shaft perpendicular to the shaft from the ceiling mounted damper regulator.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF DUCTWORK ACCESSORIES

A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

B. Install turning vanes in square or rectangular 90° elbows in supply, return and exhaust air systems, and elsewhere as indicated.

C. Install manual balancing dampers for branch ducts and individual runout ducts as close to the main duct as possible.

D. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.

E. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.3 FIELD QUALITY CONTROL

A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leak proof performance.

3.4 ADJUSTING AND CLEANING

A. Adjusting: Adjust ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action.

1. Label access doors in accordance with Division 23 Section “MECHANICAL IDENTIFICATION”.

2. Final positioning of manual dampers is specified in Division 23 Section “MECHANICAL TESTING, ADJUSTING AND BALANCING”.

B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer’s touch-up paint.

3.5 EXTRA STOCK

A. Furnish extra fusible links to Owner, one link for every 10 installed of each temperature range; obtain receipt.

END OF SECTION 23 3113.19

SECTION 23 3319 - SOUND ATTENUATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of sound attenuators work required by this section is indicated on Drawings and schedules, and by requirements of this section.

B. Refer to other Division 23 sections for ductwork, and external insulation of sound attenuators; not work of this section.

C. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of sound attenuators with characteristics, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

D. Codes and Standards:

1. NFPA Compliance: Construct sound attenuators using acoustical fill complying with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," latest edition.

2. ASTM Compliances: Comply with applicable requirements of ASTM E90 and E477.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including performance data for each size and type of sound attenuator furnished; schedule showing drawing designation, room location, number furnished, model number, size, and accessories furnished; and installation and start-up instructions.

B. Shop Drawings: Submit manufacturer's assembly-type shop Drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.

C. Maintenance Data: Submit maintenance data and parts list for each type of sound attenuator; including "trouble-shooting" maintenance guide. Include this data, product data, and shop Drawings in maintenance manual; in accordance with requirements of Division 01.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver sound attenuators with identification on outside of casings indicating type of sound attenuator and location to be installed. Avoid crushing or bending, and prevent dirt and debris from entering and settling in sound attenuators.

B. Store sound attenuators so as to protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 CROSS TALK SILENCERS

A. General: Provide factory-fabricated and tested cross talk silencers as indicated, selected with performance characteristics which match or exceed those indicated on schedule.

B. Construction:

1. Air transfer silencers shall be constructed in accordance with ASHRAE and SMACNA Standards for the pressure and velocity classification specified for the air distribution system in which it is installed.

2. Air transfer silencers shall be constructed of :

a. 24 gauge solid galvanized steel casing.

b. 24 gauge perforated galvanized steel liner.

c. Absorptive acoustic fiberglass.

3. Acoustic media:

a. Acoustic media shall be shot-free inorganic glass fiber with long, resilient fibers, bonded with thermosetting resin.

b. Glass fiber shall be packed with a minimum of 10% compression to eliminate voids and settling.

c. Acoustic media shall be lined with a layer of fiberflass sloth securely wrapped around the internal acoustic media to prevent contamination from moisture and airborne particulate that may be present in the airstream.

4. Fire-Performance Characteristics:

a. Air transfer silencer assemblies, including acoustic media fill, sealants, and acoustical spacers shall have combustion rating equal to or less than shown below when tested according to ASTM E84, NFPA 255 or UL 723:

1) Flame-spread index not exceeding 25.

2) Smoke-developed index not exceeding 50.

C. Pressure Drop: Provide units that have equal or less pressure drop than that scheduled, and certify that static pressure has been measured by independent laboratory in accordance with AMCA 210, "Laboratory Methods of Testing Fans for Rating Purposes".

D. Acoustical Characteristics: Provide units that have equal or greater noise reduction characteristics than those scheduled, and certify that noise reduction data has been measured by independent laboratory in accordance with ASTM E90, "Method for Laboratory Measurement of Airborne-Sound Transmission Loss of Building Partitions."

E. Manufacturers: Subject to compliance with requirements, provide cross talk silencers of one of the following:

1. Aeroacoustic Corporation.

2. Gale Noise Control; Div of Norwood Manufacturing Corp.

3. Industrial Acoustics Co.

4. Rink Corp.

5. Tempmaster Corp; Subs of Temperature Industries Inc.

6. Titus Products; Div of Philips Industries Inc.

7. Vibro - Acoustics

8. Kinetics

9. Price Industries

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which sound attenuators are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF SOUND ATTENUATORS

A. General: Install sound attenuators as indicated, and in accordance with manufacturer's installation instructions.

B. Location: Install each unit level and accurately in position indicated in relation to other work; and maintain sufficient clearance for normal service and maintenance, but in no case less than that recommended by manufacturer.

3.3 FIELD QUALITY CONTROL

A. Upon completion of installation and prior to initial operation, test and demonstrate that sound attenuators, and duct connections to sound attenuators, are leak tight.

B. Repair or replace sound attenuators and duct connections as required to eliminate leaks, and retest to demonstrate compliance.

3.4 CLEANING

A. Clean exposed factory finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION 23 3319

SECTION 23 3613 - AIR TERMINALS

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of air terminals work required by this section is indicated on Drawings and schedules, and by requirements of this section.

B. Types of air terminals specified in this section include the following:

1. Central Air Terminals:

a. Shutoff Single Duct

b. Dual-Duct

C. Refer to other Division 23 sections for external insulation of air terminals; not work of this section.

D. Refer to other Division 23 sections for testing, adjusting and balancing of air terminals; not work of this section.

E. Refer to other Division 23 sections for temperature controls that are to be furnished by others but installed as work of this section.

F. Refer to other Division 23 sections for temperature controls for air terminals; not work of this section.

G. Refer to Division 26 sections for the following work; not work of this section.

1. Power supply wiring from power source to power connection on air terminals. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

H. Provide the following electrical work as work of this section, complying with requirements of Division 26 sections:

1. Control wiring between field-installed controls and air terminals.

a. Control wiring specified as work of Division 23 for Automatic Temperature Controls is work of that section.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of air terminals with characteristics, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. ADC Compliance: Provide air terminals that have been tested and rated in accordance with ADC standards, and bear ADC Seal.

2. ARI Compliance: Provide air terminals that have been tested and rated in accordance with ARI 880 "Industry Standard for Air Terminals" and bear ARI certification seal.

3. NFPA Compliance: Construct air terminals using acoustical and thermal insulations complying with NFPA 90A " Installation of Air Conditioning and Ventilating Systems", latest edition.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including performance data for each size and type of air terminal furnished; schedule showing drawing designation, room location, number furnished, model number, size, and accessories furnished; and installation and start-up instructions.

B. Shop Drawings: Submit manufacturer's assembly-type shop Drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.

C. Wiring Diagrams: Submit ladder-type-wiring diagrams for electric power and control components, clearly indicating required field electrical connections.

D. Maintenance Data: Submit maintenance data and parts list for each type of air terminal; including "trouble-shooting" maintenance guide. Include this data, product data, shop Drawings, and maintenance data in maintenance manual; in accordance with requirements of Division 01.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver air terminals wrapped in factory-fabricated fiberboard type containers. Identify on outside of container type of air terminal and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in boxes.

B. Store air terminals in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide air terminals of one of the following:

1. Anemostat Products Div.; Dynamics Corp. of America.

2. Air Buensod, Inc.

3. Carnes Co.

4. ETI

5. Titus Products Div.; Philips Industries, Inc.

6. Carrier Corp.; Sub. of United Technologies Corp.

7. Tempmaster Corp.

8. Trane (The) Co.

9. Krueger

2.2 AIR TERMINALS

A. General: Provide factory-fabricated and tested air terminals as indicated, selected with performance characteristics which match or exceed those indicated on schedule.

B. Casings: Construct of die-cast aluminum or sheet metal of the following minimum thickness:

	STEEL	ALUMINUM
Upstream Pressure Side:	24 gauge	0.032 in.
Downstream Pressure Side:	26 gauge	0.025 in.

1. Provide hanger brackets for attachment of supports.

2. Linings: Line inside surfaces of casings with lining material to provide acoustic performance, thermal insulation, and to prevent condensation on outside surfaces of casing. Secure lining to prevent delamination, sagging, or settling.

   a. Cover liner surfaces and edges with coating or perforated metal.

3. Access: Provide removable panels in casings to permit access to air dampers and other parts requiring service, adjustment, or maintenance.

   a. Provide airtight gasket and quarter-turn latches.

4. Leakage: Construct casings such that when subjected to 0.5-in wg. pressure for low-pressure units, and 3.0-in wg. pressure for high pressure units, total leakage does not exceed 4% of specified air flow capacity with outlets sealed and inlets wide open. Construct air dampers such that when subjected to 6.0-in wg. inlet pressure with damper closed, total leakage does not exceed 10% of specified airflow capacity.

5. Multiple Duct Connectors: For air terminals serving more than one air outlet, provide lined outlet plenum with duct collar, butterfly-type damper, and locking device in each outlet.

C. Air Dampers: Construct of materials that cannot corrode, do not require lubrication, nor require periodic servicing. Provide maximum volume dampers that are calibrated in CFM, factory-adjusted, and marked for specified air capacities. Provide mechanism to vary air volume thru damper for minimum to maximum, in response from signal from thermostat.

D. Controls: Provide controls accurate to 1.5°F (0.8°C) and adjustable from 65°F (22°C) to 85°F (29°C).

1. Provide duct pressure powered controls, designed to operate with duct pressures 1.0 to 5.0-in wg.

2. Provide electronic DDC controls, compatible with electronic temperature control system specified in other Division 23 sections.

E. Identification: Provide label on each unit indicating Unit Number, CFM range, CFM factory-setting, and calibration curve (if required).

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which air terminals are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF AIR TERMINALS

A. General: Install air terminals as indicated, and in accordance with manufacturer's installation instructions.

B. Location: Install each unit level and accurately in position indicated in relation to other work; and maintain sufficient clearance for normal service and maintenance, but in no case less than that recommended by manufacturer.

C. Duct Connections: Connect ductwork to air terminals in accordance with Division 23 ductwork sections.

3.3 FIELD QUALITY CONTROL

A. Upon completion of installation and prior to initial operation, test and demonstrate that air terminals, and duct connections to air terminals, are leak tight.

B. Repair or replace air terminals and duct connections as required to eliminate leaks, and retest to demonstrate compliance.

3.4 CLEANING

A. Clean exposed factory-finished surfaces. Repair any marred or scratched surfaces with manufacturers touch-up paint.

END OF SECTION 23 3613

SECTION 23 3713 - AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of air outlets and inlets work is indicated by Drawings and schedules, and by requirements of this section.

B. Types of air outlets and inlets required for project include the following:

1. Ceiling return air grilles.

2. Ceiling air diffusers.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. ARI Compliance: Test and rate air outlets and inlets in accordance with ARI 650 "Standard for Air Outlets and Inlets".

2. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets", latest edition.

3. ADC Compliance: Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual".

4. ADC Seal: Provide air outlets and inlets bearing ADC Certified Rating Seal.

5. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Installation of Air Conditioning and Ventilating Systems" latest edition.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:

1. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.

2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.

3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses, throw and drop, and noise criteria ratings. Indicate selections on data.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver air outlets and inlets wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 CEILING AIR DIFFUSERS

A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of aluminum, and as required for complete installation.

B. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction Drawings and specifications for types of ceiling systems that will contain each type of ceiling air diffuser. All air devices installed in plaster, gyp board or other hard ceilings or walls shall be provided with a separate mounting frame.

D. Types: Provide ceiling diffusers of type, capacity, and with accessories and finishes as listed on the air device schedule.

E. Diffuser Finishes:

1. Finish shall be white baked enamel.

2. Color selection shall be from manufacturer's standard color chips, unless otherwise noted.

F. Manufacturer: Subject to compliance with requirements, provide diffusers of one of the following:

1. Metalaire,

2. Krueger,

3. Nailor,

4. Price,

5. Titus,

6. No Substitutions.

2.2 CEILING GRILLE

A. General: Except as otherwise indicated, provide manufacturer's standard grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide grilles that have, as minimum, noise criteria ratings for each size device as listed in manufacturer's current data.

C. Ceiling Compatibility: Provide grilles with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling construction with accurate fit and adequate support. Refer to general construction Drawings and specifications for types of ceiling construction that will contain each type of ceiling grille.

D. Types: Provide ceiling grilles of type and with accessories as listed on the air device schedule.

E. Grille Finishes:

1. Finish shall be white baked enamel.

2. Color selection shall be from manufacturer's standard color chips, unless otherwise noted.

F. Manufacturer: Subject to compliance with requirements, provide grilles of one of the following:

1. Metalaire,

2. Krueger,

3. Nailor,

4. Price,

5. Titus,

6. No Substitutions.

2.3 OPPOSED BLADE DAMPER

A. Provide opposed blade dampers for all air devices unless where otherwise indicated on the plans.

B. Square damper frames shall be heavy duty extruded aluminum and interlocked to prevent corner separation. The blades shall be heavy gauge extruded aluminum, webbed to prevent bowing in large sizes and tapered to ensure tight closure. Blades shall be assembled on 1 in. centers and pivot on nylon bushings to ensure jam-free operation. Square neck opposed blade dampers shall be Metalaire Model D7 or approved equal.

C. Radial opposed blade dampers shall provide full radial volume control and manufactured of corrosion resistant aluminum material. Radial dampers shall provide durable, jam-free operation for the life of the air handling system. Radial dampers shall have overlapping blade design that insures positive shut-off when required. Radial damper operator shall be accessible through an opening located in the diffuser center cone. Radial opposed blade damper shall be Metalaire Model D3 or approved equal.

D. Radial slide dampers are not acceptable.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended functions.

B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.

C. Locate ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling modules.

3.3 SPARE PARTS

A. Furnish to Owner, with receipt, 3 operating keys for each type of air outlet and inlet that require them.

END OF SECTION 23 3713

SECTION 26 0000 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. General Requirements specifically applicable to Division 26.

B. The Contractor shall be responsible for:

1. The work included consists of furnishing all materials, supplies, equipment and tools, and performing all labor and services necessary for installation of a completely functional power, lighting, and signaling systems. Complete systems in accordance with the intent of Contract Documents.
2. Coordinating the details of facility equipment and construction for all Specification Divisions, which affect the work covered under this Division.
3. Furnishing and installing all incidental items not actually shown or specified, but which are required by good practice to provide complete functional systems.
4. Temporary power service and lighting for construction. Coordinating all shutdown dates and schedules with Owner's Representative and obtain all work-permits required by Owner.

C. Intent of Drawings:

1. The Drawings are necessarily diagrammatic by their nature, and are not intended to show every connection in detail or every device or raceway in its exact location, unless specifically dimensioned. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the work in order to avoid interference between the various phases of work. The Contractor shall be responsible for the proper routing of raceway, subject to prior review by the Owner and Engineer. Work shall be organized and laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. All work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
2. The intent of the Drawings is to establish the type of systems and functions, but not to set forth each item essential to the functioning of the system. The drawings and specifications are cooperative, and work or materials called for in one and not mentioned in the other shall be provided. Review pertinent drawings and adjust the work to conditions shown. In case of doubt as to work intended, or where discrepancies occur between drawings, specifications, and actual conditions, immediately notify the Architect/Engineer and the Owner’s representative, and propose a resolution.

1.2 RELATED WORK

A. This Section shall be used in conjunction with the following other specifications and related Contract Documents to establish the total general requirements for the project electrical systems and equipment.

1. Division 01 Sections included in the project specifications.
2. The contract.

1.3 DESIGN CRITERIA

A. Equipment and devices to be installed outdoors or in enclosures where the temperatures are not controlled shall be capable of continuous operation under such conditions per manufacturer's requirements.

B. Compliance by the Contractor with the provisions of this Specification does not relieve him of the responsibilities of furnishing equipment and materials of proper design, mechanically and electrically suited to meet operating guarantees at the specified service conditions.

C. Electrical components shall be UL listed and labeled.

1.4 REFERENCE CODES AND STANDARDS, REGULATORY REQUIREMENTS

A. Standards of the following organizations as well as those listed in Division 01, may be referenced in the specification. Unless noted otherwise, references are to standards or codes current at the time of bidding. Work, materials and equipment must comply with the latest rules and regulations of the following.

1. International Building Code
2. Texas Accessibility Standards (State mandated)
3. Americans with Disability Act (ADA)
4. Association of Edison Illuminating Companies (AEIC)
5. American National Standards Institute (ANSI)
6. Institute of Electrical and Electronics Engineers (IEEE)
7. Insulated Cable Engineers Association (ICEA)
8. 2020 National Electrical Code (NEC)
9. National Electrical Manufacturers Association (NEMA)
10. National Electrical Safety Code
11. National Fire Protection Association (NFPA)

    a. 2020 NFPA 70
    b. 2018 NFPA 101 Life Safety Code

12. Underwriters' Laboratories (UL)
13. FM Standards
14. 2018 International Energy Conservation Code
15. 2018 International Existing Building Code
16. National Electrical Safety Code
17. Occupational Safety and Health Act (OSHA)
18. American Society for Testing and Materials (ASTM)
19. University of North Texas Health Science Center Design and Construction Guidelines
20. Applicable state and federal codes, ordinances and regulations

B. Discrepancies. The drawings and specifications are intended to comply with listed codes, ordinances, regulations and standards. Where discrepancies occur, immediately notify the Owner's representative in writing and ask for an interpretation. Should installed materials or workmanship fail to comply, the Contractor is responsible for correcting the improper installation. Additionally, where sizes, capacities, or other such features are required in excess of minimum code or standards requirements, provide those specified or shown.

C. Contractor shall obtain permits and arrange inspections required by codes applicable to this Section and shall submit written evidence to the Owner and Engineer that the required permits, inspections and code requirements have been secured.

1.5 SUBMITTALS

A. Submit the following in addition to and in accordance with the requirements of Division 01 for submittal requirement.

1. Include inspection and permit certificates and certificates of final inspection and acceptance from the authority having jurisdiction.
2. Manufacturer's standardized schematic diagrams and catalog cuts shall not be acceptable unless applicable portions of it are clearly indicated and non-applicable portions clearly deleted or crossed out.
3. All schematic, connection and/or interconnection diagrams shall be in accordance with the latest edition of NEMA.
4. Provide submittals as required by individual specification Section.

B. Provide the following with each submittal:

1. Catalog cuts with manufacturer's name clearly indicated. Applicable portions shall be circled and non-applicable portions shall be crossed out.
2. Line-by-line specification review by equipment manufacturer and contractor with any exceptions explicitly defined.

C. Equipment Layout Drawing: 1/4-inch scale minimum drawings indicating electrical equipment locations. Dimensions for housekeeping pads should be indicated on these drawings. Indicate routing of conduit 2 inches and over on these drawings.

D. Within the specified time window after award of contract, submit list of equipment and materials to be furnished.

1. Itemize equipment and material by specification Section number; include manufacturer and identifying model or catalog numbers.
2. Replace rejected items with an acceptable item within 2 weeks after notification of rejection.
3. If a satisfactory replacement is not submitted within a two-week period, owner will notify contractor as to equipment manufacturer or type and make or material to be furnished. Provide designated items at no additional cost to owner.

E. As-Built Record Drawings: The Contractor shall maintain a master set of As-Built Record Drawings that show changes and any other deviations from the drawings. The markups must be made as the changes are done. At the conclusion of the job, these As-Built Record Drawings shall be transferred to AutoCAD electronic files, in a format acceptable to the Owner, and shall be complete and delivered to the Owner's Representative prior to final acceptance.

1.6 SAFETY

A. The Contractor shall follow the safety procedures in addition to, and in accordance with, the requirements of Project Safety Manual (PSM).

1. The Contractors shall be responsible for training all personnel under their employ in areas concerning safe work habits and construction safety. The Contractor shall continually inform personnel on hazards particular to this project and update the information as the project progresses.
2. The Contractor shall secure all electrical rooms, to limit access, prior to energizing any switchgear and shall control access during the project after energization. The Contractor shall post and maintain warning and caution signage in areas where work is ongoing near energized equipment. The Contractor shall cover all energized live parts when work is not being done in the equipment. This includes lunch and breaks.

3. The Contractor shall strictly enforce OSHA lock out/tag out procedures. Initial infractions shall result in a warning; a second infraction shall result in the removal of the workman and his foreman from the site. Continued infractions shall result in removal of the Contractor from the site.

1.7 SHORING AND EQUIPMENT SUPPORTS

A. The Contractor shall provide all permanent and temporary shoring, anchoring, and bracing required to make all parts absolutely stable and rigid; even when such shoring, anchoring, and bracing are not explicitly called for.

B. The Contractor shall adequately support all freestanding panels, switchgear, switchboard, enclosures, and other equipment. This shall include bolting to the floor or solid structural steel to prevent tipping. Install free-standing electrical equipment on 4" thick concrete housekeeping pads. Under no condition shall equipment be fastened to non-rigid building steel (i.e., removable platform steel gratings, handrails, etc.).

C. The Contractor shall provide racks and supports, independently mounted at structure, to support electrical equipment and systems supplied and installed under this contract. At no time shall the Contractor mount or suspend equipment from other disciplines' supports.

1.8 TEMPORARY POWER REQUIREMENTS

A. Provide power distribution system sufficient to accommodate construction operations requiring power, use of power tools, electrical heating, lighting, and start-up/testing of permanent electric-powered equipment prior to its permanent connection to electrical system. Provide proper overload protection. Ground fault circuit interrupters (GFCI) are to be used on all 120-volt, single-phase, 15 and 20 amp receptacle outlets where portable tools and equipment are used. Ground fault circuit interrupters shall be tested weekly by the Contractor.

B. Temporary power feeders shall originate from a distribution panel. The conductors shall be multi-conductor cord or cable per NEC for hard and extra-hard service multi-conductor cord.

C. Branch circuits shall originate in an approved receptacle or panelboard. The conductors shall be multi-conductor cord or cable per NEC for hard and extra-hard service multi-conductor cord. Each branch circuit shall have a separate equipment grounding conductor.

D. All receptacles shall be of the grounding type and electrically connected to the grounding conductor.

E. Provide temporary lighting by factory-assembled lighting strings or by manually-assembled units. All lamps for general lighting shall be protected from accidental contact or breakage. Protection shall be provided by installing the lights a minimum of 7 feet from the work surface or by lamp holders with guards. Branch circuits supplying temporary lighting shall not supply any other load. Provide sufficient temporary lighting to ensure proper workmanship by combined use of day lighting, general lighting, and portable plug-in task lighting. Comply with OSHA required foot-candle levels and submit plan for approval by the owner.

F. For temporary wiring, suitable fencing, barriers, or other effective means shall be provided to prevent access of anyone other than authorized and qualified personnel.

G. Temporary power cords shall be kept off the ground or floor. The Contractor shall provide temporary supports as required to keep temporary cords off the ground or floor.

1.9 SUBSTITUTION OF MATERIALS AND EQUIPMENT

A. Refer to Uniform General Conditions and Supplementary General Conditions for substitution of materials and equipment.

B. The intent of the Drawings and/or Specifications is neither to limit products to any particular manufacturer nor to discriminate against an "APPROVED EQUAL" product as produced by another manufacturer. Some proprietary products are mentioned to set a definite standard for acceptance and to serve as a reference in comparison with other products. When a manufacturer's name appears in these Specifications, it is not to be construed that the manufacturer is unconditionally acceptable as a provider of equipment for this project. The successful manufacturer or supplier shall meet all of the provisions of the appropriate specification(s).

C. The specified products have been used in preparing the Drawings and Specifications and thus establish minimum qualities with which substitutes must at least equal to be considered acceptable. The burden of proof of equality rests with the Contractor. The decision of the designer is final.

D. When requested by the Architect/Engineer, the Contractor shall provide a sample of the proposed substitute item. In some cases, samples of both the specified item and the proposed item shall be provided for comparison purposes.

E. Timeliness: The burden of timeliness in the complete cycle of submittal data, shop Drawings, and sample processing is on the Contractor. The Contractor shall allow a minimum of six (6) weeks time frame for review of each submission by the office of the design discipline involved after receipt of such submissions by that design discipline. The Contractor is responsible for allowing sufficient time in the construction schedule to cover the aforementioned cycles of data processing, including time for all resubmittal cycles on unacceptable materials, equipment, etc. covered by the data submitted. Construction delays and/or lack of timeliness in the above regard are the responsibility of the Contractor and will not be considered in any request for scheduled construction time extensions and/or additional costs to the Owner.

F. All equipment installed on this project shall have local representation; local factory authorized service, and a local stock of repair parts.

G. Acceptance of materials and equipment will be based on manufacturer's published data and will be tentative subject to the submission of complete shop Drawings indicating compliance with the contract documents and that adequate and acceptable clearances for entry, servicing, and maintenance will exist. Acceptance of materials and equipment under this provision shall not be construed as authorizing any deviations from the Specifications, unless the attention of the Architect/Engineer has been directed in writing to the specific deviations. Data submitted shall not contain unrelated information unless all pertinent information is properly identified.

H. Certification: The Contractor shall carefully examine all data forwarded for approval and shall sign a certificate to the effect that the data has been carefully checked and found to be correct with respect to dimensions and available space and that the equipment complies with all requirements of the Specifications.

I. Physical Size of Equipment: Space is critical; therefore, equipment of larger sizes than shown, even though of specified manufacturer, will not be acceptable unless it can be demonstrated that ample space exists for proper installation, operation, and maintenance.

J. Should a substitution be accepted, and should the substitute material prove defective, or otherwise unsatisfactory for the service intended within the guarantee period, this material or equipment shall be replaced with the material or equipment specified at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and Equipment: Labeled and/or listed as acceptable to the authority having jurisdiction as suitable for the use intended. Materials shall be of a standard industrial quality if no specifications or specific model numbers are given.

B. Where two or more units of the same class of material are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.

C. All materials shall be new and unused.

PART 3 - EXECUTION

3.1 WORKMANSHIP

A. Install work in compliance with NEC latest edition.

B. Install material and equipment in accordance with manufacturers' instructions. Provide calibrated torque wrenches and screwdrivers and tighten all terminals, lugs, and bus joints using it.

C. Comply with startup procedures as defined by Construction Manager and Owner.

D. Arrange electrical work in a neat, well-organized manner. Do not block future connection points of electrical service. Install all electrical work parallel or perpendicular to building lines unless noted otherwise, properly supported with purpose-designed apparatus, in a neat manner.

E. Apply, install, connect, erect, use, clean, adjust, and condition materials and equipment as recommended by the manufacturers in their published literature.

F. Make opening through masonry and concrete by core drilling in acceptable locations. Restore openings to original condition to match remaining surrounding materials.

3.2 SERVICE CONTINUITY

A. Maintain continuity of electric service to entire facility. Phase construction work to accommodate Owner’s occupancy requirements.

B. Arrange temporary outages for cutover work with the Owner. Keep the outages to a minimum number and minimum length of time.

C. All service outages shall be requested in writing a minimum of four weeks prior to the date. Owner reserves the right to postpone shutdowns up to 24 hours prior to the shutdown at no additional cost. Outage requests shall include a schedule of the work to be performed, identification of areas impacted, and the time requirements.

D. The Contractor shall obtain all appropriate Owner permits for working in equipment.

3.3 HAZARDOUS LOCATIONS

A. Equipment, wiring, devices, and other components located within hazardous areas to be of appropriate type per NFPA requirements.

B. Ground exposed non-current carrying parts of entire electrical system in hazardous areas, in accordance with NEC and as instructed by Owner.

3.4 SLEEVES AND SEALS

A. Provide sealing and/or fire stopping where electrical system passes through walls, ceilings, and floors. Seals shall be watertight and/or fire rated as applicable.

B. Where coring foundation walls, vault wall, etc.; provide sufficient space between penetrations to maintain the structural integrity of the wall. Provide rubber sleeve equal to Link-Seal near the interior surface of the wall. The same space shall have waterproofing installed on the exterior side of the rubber seal.

3.5 CONSTRUCTION REVIEW

A. The Engineer or Owner's representative will review and observe installation work to ensure compliance by the Contractor with requirements of the Contract Documents.

B. Review, observation, assistance, and actions by the Engineer or Owner’s representative shall not be construed as undertaking supervisory control of the work or of methods and means employed by the Contractor. The review and observation activities shall not relieve the Contractor from the responsibilities of these Contract Documents.

C. The fact that the Engineer or Owner’s representative do not make early discovery of faulty or omitted work shall not bar the Engineer or Owner’s representative from subsequently rejecting this work and insisting that the Contractor make the necessary corrections.

D. Regardless of when discovery and rejection are made, and regardless of when the Contractor is ordered to correct such work, the Contractor shall have no claim against the Engineer or Owner’s representative for an increase in the Contract price, or for any payment on account of increased cost, damage, or loss.

3.6 WARRANTY

A. Provide warranties in accordance with the requirements of Uniform General and Supplementary Conditions (UGC).

END OF SECTION 26 0000

SECTION 26 0500 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Hinged cover enclosures and cabinets

B. Contactors

C. Control relays

D. Push buttons, and selector switches

E. Terminal blocks and accessories

F. Penetration sealing systems (fire stops)

G. Electrical/control portion of HVAC work covered by Division 23 pertaining basic electrical materials and methods shall follow the requirement set forth by this specification.

1.2 APPLICABLE CODES AND STANDARDS

A. NFPA 70, National Electrical Code (2020 edition)

B. American National Standard C2, National Electrical Safety Code, (latest edition)

C. Applicable publications of NEMA, ANSI, IEEE, and ICEA

D. Underwriters Laboratories, Inc. Standards (UL)

E. Federal, city, state, and local codes and regulations having jurisdiction

F. OSHA requirements

G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)

H. NEMA WD 1 - General-Purpose Wiring Devices

I. UL 98 - Enclosed Switches

1.3 INTENT

A. This Section is not, and shall not be interpreted to be, a complete listing of all materials or equipment that is Contractor furnished and erected. It is intended to clarify and further define the Contractor scope of work, procurement, and responsibilities for those incidental materials that are not specified by other specifications, but important to a complete and operational system.

B. The Contractor shall furnish all equipment and materials, whether or not specified in other Sections of specification and on drawings, for installation and connection required to place equipment into satisfactory operating service. The Contractor shall review the Drawings and specifications for clarification of his responsibility in the handling and installation of equipment and material. Where applicable, and not in contradiction with the Drawings and specifications,

the Contractor shall install and connect the equipment in accordance with the manufacturer's recommendations and instructions.

C. All materials and equipment shall be of types and manufacturer specified wherever practical. Should materials or equipment so specified be unattainable, the Contractor shall submit the description and manufacturer's literature, reason for substitution request, and shall secure the approval of the Engineer before substitution of other material or equipment is purchased. This Section establishes performance requirements and the quality of equipment acceptable for use and shall in no way be construed to limit procurement from other manufacturer.

1.4 SUBMITTALS

A. Provide submittals in addition and in accordance with Section 26 0000, Basic Electrical Requirements, and Division 01 for submittal requirement.

B. Submit manufacturer's literature and specification data sheets for each type of basic material, which is applicable to the project.

1.5 DELIVERY, STORAGE AND HANDLING

A. Provide factory-wrapped waterproof flexible barrier material for covering materials, where applicable, to protect against physical damage in transit. Damaged materials shall be removed from project site.

B. In their factory-furnished coverings, store materials in a clean, dry indoor space, which provides protection against the weather.

PART 2 - PRODUCTS

2.1 ENCLOSURES AND CABINETS

A. Enclosures and cabinets for all Contractor furnished electrical equipment and devices shall be suitable for the location and environmental conditions and shall be of the NEMA type as shown in Table 1. Exceptions shall be as specifically designated on the Drawings.

Table 1
Enclosures

Location	Environment	Enclosure Type
Indoor Utility	Dry, subject to dust, falling dirt and dripping non-corrosive liquids	NEMA 12
Indoor	Clean, Dry	NEMA 1
Outdoor	Subject to windblown dust and rain, splashing water, and hose-directed water	NEMA 4
Indoor	Wet, subject to hose-directed water	NEMA 4
Outdoor	Subject to falling rain, sleet, and external ice formation	NEMA 3R
Indoor or Outdoor	Subject to corrosion, windblown dust and rain, splashing water and hose-directed water	NEMA 4X

B. Enclosures shall have the following properties:

1. Hinged Cover Enclosures: NEMA 250.

a. Type 1: Steel.
b. Type 4: Steel with gasket door, rain tight.
c. Type 4X: Stainless steel.
d. Type 12: Steel with gasketed door, dust-tight.

C. Finish: Exterior, manufacturer's standard gray enamel finish; interior, white enamel finish.

D. Covers: Continuous hinge, held closed by flush latch operable by hasp and staple for padlock. Where required for NEMA ratings, gaskets shall be neoprene rubber.

E. Interior Panel for Mounting Terminal Blocks or Electrical Components: 14-gauge steel, white enamel finish.

F. Provide protective pocket inside front cover with schematic diagram, connection diagram, and layout drawing of control wiring and components within enclosure.

G. Forced Ventilation: Where indicated, provide 115V single-phase fan motor, filtered with air plenum, finger guard, and stainless steel grille. Washable aluminum filter, accessible for cleaning from outside the enclosure; 20,000-hour continuous operation without lubrication or service. Provide matching exhaust grille assembly. Mount fan in lower side corner, exhaust grille in opposite upper side corner.

2.2 CONTACTORS

A. Acceptable Manufacturers:

1. Square D; a brand of Schneider Electric.
2. Siemens
3. Eaton
4. GE is not an approved manufacturer.

B. Contactors: NEMA ICS 2; electrically held or mechanically held as indicated on Drawings. Two-wire control for electrically held contactors and three-wire control for mechanically held contactors.

C. Enclosure: NEMA 1 unless indicated otherwise on Drawings.

D. Coil operating voltage; 110 volts, 60 Hz or as per drawings.

E. Size: NEMA ICS 2; size as shown or as required.

F. Contacts: Ampacity as indicated on Drawings; 600 Volts, 60 Hz. (minimum 30A).

G. Provide solderless pressure wire terminals on bus terminals suitable for mounting in panelboard as indicated on Drawings.

2.3 CONTROL RELAYS

A. Acceptable Manufacturers:

1. Square D; a brand of Schneider Electric.
2. Siemens
3. Eaton
4. GE is not an approved manufacturer.

B. Provide magnetic control relays, NEMA Class A: A300 (300 volts, 10 amps continuous, 7,200 VA make, 720 VA break), industrial control type with field-convertible contacts, and meeting the requirements of NEMA ICS 2.

C. Where time delay relays are specified or required, unless otherwise noted, provide magnetic control relays with a solid-state timer attachment adjustable from 0.2 to 60 seconds (minimum) or with range as indicated. Provide with field convertible from ON delay to OFF delay and vice versa.

D. Where latching (mechanically held) relays or motor thermal detector relays are specified or required, provide magnetic control relays with mechanical latch attachment with unlatching coil and coil clearing contacts.

2.4 PUSH BUTTONS, AND SELECTOR SWITCHES

A. Acceptable Manufacturers:

1. Square D; a brand of Schneider Electric.
2. Siemens
3. Eaton
4. GE is not an approved manufacturer.
5. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedureDivision 01.

B. For non-hazardous, indoor, dry locations, including control panels, and individual stations, provide heavy duty, NEMA 13, oil tight type pushbuttons, indicating lights, selector switches, and stations for these devices.

C. For non-hazardous, outdoor, or normally wet locations, or where otherwise indicated, provide heavy duty corrosion resistant, NEMA 4, watertight type pushbuttons, indicating lights, or selector switches mounted in NEMA 4 watertight enclosures. Provide special gasketing required to make complete station watertight.

D. For hazardous locations, provide control station listed by UL for Class I, Divisions 01 and 02, Groups C and D; Class II, Division 01 and 02, Groups E, F, and G. Specific type shall be in accordance with area classification.

E. Provide devices meeting the requirements of NEMA ICS 2, and having individual, extra-large nameplates indicating their specific function. Provide push-button stations with laminated plastic nameplates indicating the drive they control. Provide contacts with NEMA designation rating A600. Install provisions for locking pushbuttons and selector switches in the OFF position wherever lockout provisions are indicated. Nameplates shall be as specified in Section 26 0553.

F. Utilize selector switches having standard operating levers. All indicating lights shall be LED type, push-to-test type. Provide ON or START pushbuttons colored black. Provide OFF or STOP pushbuttons colored red.

2.5 TERMINAL BLOCKS AND ACCESSORIES

A. Signal and Control Terminals:

1. Acceptable Manufacturers:

a. Phoenix Contact
b. Buchanan
c. Weidmüller
d. Entrelec
e. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in 230000 and Division 01 for substitution requirement.

2. Signal and Control Terminals: Modular construction type, DIN 46 277/3 channel mounted; screw clamp compression connectors, rated 300 volts. Minimum terminal width of 0.24-inch, capable of holding two No. 12 or two No. 14 AWG conductors in each connector. Terminal identification numbers shall be thermoset characters (black) on a white background. Provide 25 percent spare terminals.

B. Power Terminals:

1. Acceptable Manufacturers:

a. Buchanan
b. Ilsco
c. Square D Company
d. Burndy
e. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in 26 0000 and Division 01 for substitution requirement.

2. Power Terminals: Unit construction type, closed-back type, with tubular pressure screw connectors, rated 600 volts, size as required. Provide 25 percent spare terminals.

2.6 PENETRATION SEALING SYSTEMS (FIRE STOPS)

A. Provide penetration sealing where conduit, etc. pass through rated walls, ceilings, and floors.

2.7 UL LISTING

A. All equipment and materials shall be new and conform to the requirements of this Section. All equipment and materials shall be UL listed, and shall bear their label whenever standards have been established and level service is regularly furnished. All equipment and materials shall be of the best grade of their respective kind for the purpose.

PART 3 - EXECUTION

3.1 FABRICATION - CONTROL ENCLOSURES AND CABINETS

A. Shop assembles enclosures and cabinets housing terminal blocks or electrical components in accordance with NEMA ICS 6.

3.2 INSTALLATION - ENCLOSURES AND CABINETS

A. Install cabinets and enclosures plumb; anchor securely to wall and structural supports at each corner, minimum. Direct attachment to dry wall is not permitted.

B. Provide accessory feet for freestanding equipment enclosures.

C. Install trim plumb.

3.3 ERECTION OF EQUIPMENT

A. Manufacturer's Installation Instructions: Where furnished or called for by the manufacturer equipment manufacturer's installation instructions shall be considered a part of this specification and fully complied with. Where the Contractor damages the finishing coat of paint in existing or completed areas, he shall refinish with matching paint.

B. Mounting Heights: Individual safety switches and buttons and devices shall normally be installed at the following mounting heights, when not specified on the Drawings.

1. Safety Switches: 6 feet 0 inches (to top).
2. Pushbuttons: 4 feet 0 inches (to center).
3. Control Panels: 6 feet 0 inches (to top).

C. Mounting: Equipment and control devices shall be supported independent of conduit connections. Panels or cabinets shall be mounted on metal frame supports independently of equipment. Control devices and metal enclosures shall be bolted or welded to steel channel or steel plate. All electrical equipment and devices not covered by the above, such as miscellaneous switches, thermostats, duct switches, temperature switches, floats, photoelectrical devices, and similar electrical devices shall be located and set as suitable for the application. Where control panels are provided as part of the equipment racks mounted on the floor, they shall be provided to support conduits and flexible connections to control panels.

3.4 COORDINATION

A. Exact location of all electrical equipment, devices and fixtures shall be determined in field by contractor and verified by Engineer's field representative prior to installation.

END OF SECTION 26 0500

SECTION 26 0512 - ELECTRICAL TESTING AND LOAD BALANCING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Perform test, balance, final adjustment, etc., and record data for electrical work as described herein.

1.2 SUBMITTALS

A. Submit data record forms for approval before conducting any tests or making final adjustments, torquing, balancing, etc.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 TESTING

A. 600V Conductors:

1. Megger test feeder conductors at 600 volts dc. Record value for each feeder conductor. Conductors which test below 50 megohms shall be replaced. Retest new conductors and record data.
2. Perform continuity test on all feeder and branch circuit conductors.
3. Torque all feeder and branch circuit connections and terminations to manufacturer's recommended values.

B. Grounding:

1. Measure and record ground resistance from system neutral connection at service entrance to ground reference point using suitable ground testing equipment. Resistance shall not exceed 2 ohms.
2. Test continuity and bonding of cable trays, wireways, etc.
3. Record data for each test.

C. Metering and Control Wiring:

1. Test for proper connection before energization of equipment. System shall be completely tested to verify proper operation and multipliers.
2. Include metering and generator system remote annunciation/control.

D. Switchboards and Panelboards:

1. Test insulation resistance for each panelboard and switchboard bus, component, connecting supply, feeder, and control circuit.
2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard and panelboard.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

E. Other Cable, Switchgear, Transformers, etc.

1. Refer to individual specification section for additional testing requirements.

3.2 DEVICE TRIP SETTINGS

A. Equipment manufacturer field service personnel shall adjust and set all devices in accordance with approved results of "System Coordination and Analysis".

3.3 BUS TORQUING

A. All bolted bus connections shall be made using a torque wrench.

B. Bus and lug connections in panelboards and switchboards shall be in accordance with manufacturer's specifications.

3.4 LOAD/VOLTAGE DATA

A. Record amperage of each phase and neutral in each panelboard and switchboard.

B. Record voltage line-to-neutral and line-to-line of all phases in each panelboard and switchboard. Record each reading.

C. Lighting only panelboards shall be arranged so that under full load all phases carry the same load as near as possible.

3.5 PHASE ROTATION

A. Connect phases of Switchboards A, B, C, to Bus No. 1, 2, 3 from left to right or top to bottom.

B. Connect phases of Panelboards, Disconnects, Controllers A, B, C to Bus 1, 2, 3 from left to right.

C. Verify existing phase rotation and make final connection to motor loads to provide proper rotations.

3.6 MECHANICAL ADJUSTMENT

A. Adjust all operating mechanisms of electrical equipment for free mechanical movement.

END OF SECTION 26 0512

SECTION 26 0518 - ELECTRICAL CONNECTIONS TO EQUIPMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The extent of electrical connections to equipment is indicated on the drawings and in schedules, in other Divisions of the specifications, and by the requirements of this section, and is hereby defined to include (but not necessarily limited to) connections for providing electrical power to equipment.

B. The types of electrical connections specified in this section include, but are not necessarily limited to, the following:

1. To motors
2. To electric heaters
3. To motor starters
4. From motor starters to motors
5. To HVAC control and other control devices
6. To elevators and associated equipment
7. Miscellaneous equipment

1.2 SUBMITTALS

A. Submit manufacturer's product data on materials to be used on project.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. For each electrical connection indicated, provide a complete assembly of materials, including but not necessarily limited to the following:

1. Pressure connectors
2. Terminals (lugs)
3. Electrical insulating tape
4. Heat shrinkable tubing
5. Cable ties
6. Solderless wire nuts
7. Conductors

B. Furnish materials and components in compliance with equipment manufacturer's recommendations for the intended application.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL CONNECTIONS

A. Install electrical connections as indicated, in accordance with recognized industry practices to ensure that products serve the intended functions.

B. Connect electrical power supply conductors to equipment conductors in accordance with other sections of the specifications and in accordance with equipment manufacturer's written

instructions and wiring diagrams. Wherever possible, match conductors of the electrical connection for proper interface between the electrical supply and the installed equipment.

1. Cover splices with electrical insulation equivalent to, or of a higher rating, than insulation on the conductors being spliced.
2. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure a uniform and neat appearance where cables and wires are terminated.
3. Trim cables and wires to be as short as practicable and arrange routing to facilitate inspection, testing and maintenance.

C. Provide conduit for connections in accordance with other sections of the specifications.

D. Coordinate installation of electrical connections to the equipment with equipment installation work and as follows:

1. Make electrical connections to equipment furnished under other sections of the Contract Documents.
2. Furnish wiring, conduit, outlet boxes, disconnect switches, etc., as required for same throughout the project.
3. Check the General Construction, Fire Protection, Plumbing, Heating and Air Conditioning plans and specifications and determine the amount of required wiring for final connections.
4. Verify locations, horsepower, voltages, etc., of all such equipment as the work progresses.
5. Advise the Architect/Engineer immediately, for clarification, if an apparent conflict arises in control wiring, power wiring, etc.

E. Due to manufacturer's changes or substitutions, equipment furnished under the mechanical and other sections of the specifications may require different rough-in and power requirements than indicated on the plans. Secure detailed drawings from the Contractor furnishing the equipment, to determine actual rough-in locations, and conduit and conductor requirements to assure a proper and workmanlike installation.

F. Install motor controls, safety switches, etc. for all equipment on unistrut with two coats of paint to match surrounding area.

3.2 FINAL CONNECTIONS FROM MOTOR STARTERS TO MOTORS

A. Furnish and install conduit, wiring, disconnects, etc., as required to install final connections from motor starters to motors. Verify number and size of conductors, and disconnecting means requirements. Partwinding, and wye-delta starting, as well as multi-speed motors may require multiple or six pole disconnects which shall be furnished and installed under this section of the Contract Documents.

3.3 FINAL CONNECTIONS FOR EQUIPMENT FURNISHED BY OWNER OR UNDER OTHER SECTIONS OF THE CONTRACT DOCUMENTS

A. HVAC AND MECHANICAL EQUIPMENT: It is the Contractor's responsibility to obtain the submittal data for HVAC and mechanical equipment, check the data, and provide required electrical, including conduit and conductors, circuit breakers, fuses, disconnects, etc., to accommodate changes or variations in the drawings and/or specifications.

B. ELEVATOR ELECTRICAL REQUIREMENTS:

1. Provide all labor and materials for all required Circuits and Grounding as required by Code. Upgrade or replace existing as necessary to comply with items listed below.

2. Provide a main power disconnect for each elevator.
3. Provide remote tripping and Fire Safety Interface
4. Meet, as a minimum, the requirements of NEC 620-51, and 620-62
5. Do not use or provide the same power source to power to a heat detector(s) used for shunt tripping. The heat detectors must activate the shunt trip through a separate power source. This dedicated power source is required to be monitored by the supervisory fire alarm system.
6. Provide a fused, lockable, elevator cab light disconnect in the elevator equipment room for each elevator
7. Meet the requirements of NEC 620-22 (a) Car Lighting Source
8. Each cab light disconnect shall meet the requirements of NEC 620-51 (a), and 620-53
9. Connections between the fire alarm devices and the elevator equipment shall not exceed 36 inches. Armored flex is not acceptable for these connections. Wiring for these connections shall be enclosed within minimum 3/4” EMT.

C. OTHER EQUIPMENT AND SYSTEMS: It is the Contractor's responsibility to obtain the submittal data for other equipment and systems, check the data, and provide required electrical, including conduit and conductors, circuit breakers, fuses, disconnects, etc., to accommodate changes or variations in the drawings and/or specifications.

3.4 CONNECTIONS TO EXISTING EQUIPMENT TO REMAIN

A. It is the Contractor's responsibility to survey the existing building loads and equipment to ensure all existing loads are served from new panels, switchboards, etc. All existing loads are not shown on the drawings.

B. Verify all loads served from existing panels being removed. Existing panel schedules shown on drawings do not necessarily depict correct circuiting or all existing circuits.

C. Serve existing loads from new panels even if not specifically indicated on drawings at no additional cost.

D. Verify breaker sizes serving existing loads and adjust breaker size as required to properly protect load and conductors, and to comply with NEC.

END OF SECTION 26 0518

SECTION 26 0519 - CABLE, WIRE AND CONNECTORS, 600 VOLT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Building wire.

1. Power distribution circuitry.
2. Control system circuitry.
3. Lighting circuitry.
4. Appliance and equipment circuitry.
5. Motor-branch circuitry.
6. Outdoors lighting and power.
7. Other systems circuitry as designated.

B. Cable.

C. Wiring connections and terminations.

D. Electrical/control portion of HVAC work covered by Division 23 pertaining 600 volt cable, wire and connectors shall follow the requirement set forth by this specification.

1.2 REFERENCES

A. NEMA WC 3 - Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

B. NEMA WC 5 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

C. ANSI/UL 83 - Thermoplastic-Insulated Wire and Cables

D. NFPA 70 - National Electrical Code, latest edition

E. NEFA - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

F. Where application of National Electrical Code, trade association standards or publications appears to be in conflict with the requirements of this Section, the Architect/Engineer shall be asked for an interpretation.

1.3 SUBMITTALS

A. Provide submittals in accordance with and in addition to Section 26 0000, Basic Electrical Requirements, and Division 01 for submittal requirement.

B. Submit manufacturer's literature and specification data sheets for each item of cable, wire and connectors.

C. Qualification of cable and wire manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years experience.

1.4 DELIVERY, STORAGE AND HANDLING

A. Provide factory-wrapped waterproof flexible barrier material for covering wire and cable wood reels, where applicable; and weather resistant fiberboard containers for factory packaging of cable, wire and connectors, to protect against physical damage in transit. Damaged cable, wire or connectors shall be removed from project site.

B. Store cable, wire and connectors in a clean, dry indoor space in their factory-furnished coverings, which provides protection against the weather.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Generally, cable, wire and connectors shall be of manufacturer's standard materials, as indicated by published product information.

B. Provide factory-fabricated wire of the size, rating, material and type as indicated for each service. Where not indicated, provide proper selection as required to comply with installation requirements and with NEC standards. The minimum size wire to be used for power or lighting circuits shall be #12 copper with insulation as noted below. Minimum size for control shall be #14 copper.

C. If more than three phase conductors are installed in a single raceway, the conductors shall be derated in accordance with the National Electrical Code. Increase wire size so that resulting ampacity, after derating factor is applied, is equal to or greater than ampacity of conductor specified.

D. The conductors of wires and cables shall be of copper (tinned where specified), and have conductivity in accordance with the standardization rules of the IEEE. The conductor and each strand shall be round and free of kinks and defects.

E. Grounding conductors, where insulated, shall be colored solid green or identified with green color as required by the NEC. Conductors intended as a neutral shall be colored solid white, or identified as required by the NEC. All motor or equipment power wiring shall be colored according to Section 26 0553, Electrical Identification.

F. Use compression lugs for all wiring termination's, except on breakers or terminal strips in panel boards.

2.2 BUILDING WIRE

A. Thermoplastic-insulated Building Wire: NEMA WC 5.

B. Rubber-insulated Building Wire: NEMA WC 3.

C. Feeders and Branch Circuits Larger than 10 AWG: 98% conductivity copper, soft-drawn, stranded conductor, 600 volt insulation, THHN/THWN. Use XHHW conductors where installed in conduit underground.

D. Feeders and Branch Circuits 10 AWG and Smaller: 98% conductivity copper, soft-drawn, solid conductor, 600-volt insulation, THHN/THWN. Use XHHW conductors where installed in conduit underground.

2.3 REMOTE CONTROL AND SIGNAL CABLE

A. 600 Volt Insulation Control Cable for Class 1 Remote Control and Signal Circuits, Type TC:

1. Individual Conductors: 14 AWG, stranded copper, XHHW insulation. Rated 90 degrees C dry, 75 degrees C wet, color-coded per ICEA Method 1 plus one green equipment grounding conductor.
2. Assembly: Bundle wrapped with cable tape and covered with an overall PVC jacket. Cable shall pass IEEE-1202 vertical tray ribbon-burner flame test (210,000 BTU) VW-1.

B. Instrumentation Cable

1. 300 Volt Instrumentation Cable, Multiple Pairs, Overall Shield, Type PLTC:

a. Individual Conductors: 18 AWG, stranded, tinned copper, flame retardant polyethylene or PVC insulated, rated 105 degrees C, black and white numerically printed and coded pairs.
b. Assembly: Individual twisted pairs having a 100 percent coverage aluminum-polyester shield and 20 AWG stranded tinned copper drain wire. Conductor bundle shall be shielded with 100 percent coverage overall aluminum-polyester shield complete with 20 AWG drain wire. All group shields completely isolated from each other. Bundle wrapped with cable tape and covered with an overall flame retardant PVC jacket. Cable shall pass IEEE-383 vertical tray flame test (70,000 BTU) UL1581.

C. Plenum Cable for Class 3 Remote Control and Signal Circuits: 98% conductivity copper conductor, 300 volt insulation, rated 60 degree C, UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

2.4 WIRING CONNECTIONS AND TERMINATIONS

A. Provide factory-fabricated, metal connectors of the size, rating, material, type and class as indicated for each service. Where not indicated, provide proper selection as required to comply with installation requirements and with NEC standards. Select from only following types, classes, kinds and styles.

1. Type:

a. Solderless pressure connectors.
b. Crimp.
c. Threaded.
d. Insulated spring wire connectors with plastic caps for 10 AWG and smaller.

2. Class:

a. Insulated.

3. Material:

a. Copper (for CU to CU connection).

4. Style: Pigtail connector.

   a. Parallel and tee connectors equal to ILSCO and GTA and GTT with ILSCO insulating cover. Parallel and tee connections shall be used only where specifically detailed. (Split bolt type connectors are not permitted.)

PART 3 - EXECUTION

3.1 INSPECTION

A. Installer must examine the areas and conditions under which cable, wire and connectors are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Inspect wire and cable for physical damage. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 GENERAL WIRING METHODS

A. Install electrical cable, wire and connectors as indicated, in accordance with the manufacturer's written instructions, the applicable requirements of NEC and the National Electrical Contractors Association's "Standard of Installation", and as required to ensure that products serve the intended functions.

B. Coordinate cable and wire installation work with electrical raceway and equipment installation work, as necessary for proper interface. Do not install the conductors until raceway system is complete and properly cleaned.

C. Conductors shall be selected on the basis of their purpose and UL listing. Generally, use Types THWN and THHN in building interiors and other dry locations. Outdoors and underground in raceways, use Type XHHW.

D. No conductor smaller than No. 12 wire shall be used for lighting purposes. In the case of "home runs" over 50' in length, no conductor smaller than a No. 10 wire shall be used. Conductor sizes shown on drawings are minimum and shall be increased as necessary to comply with voltage drop restrictions specified herein. The sizing of all wire except remote control wire shall be accomplished in the case of both feeder and branch circuits by conforming to the following provisions.

   1. 120/208 Volt Branch Circuits: The voltage drop in the case of 120/208 volt circuits shall not exceed 2.0% at maximum load and 70.0% power factor.

E. Separate neutral conductors shall be provided for each phase of the same size for 120V single-phase circuits. Do not share neutrals between circuits.

F. Remote control wires shall be no smaller than No. 14 conductors. Control wires shall be run in separate conduits. Departures from the sizes so determined shall be made only in those cases in which the National Electrical Code requires the use of larger conductors. The sizes as determined from these tables shall be regarded as the acceptable minimum under all other circumstances. In no case, however, shall there be a voltage drop greater than that specified in any feeder or branch circuit. The Contractor may, if he deems it necessary or advisable, use larger sized conductors than those shown. Under no circumstances, however, shall the Contractor use any conductors sized in a manner which does not conform to the above mentioned tables without having first secured the written approval of the Owner's duly authorized representative.

G. Exposed wire and cable is not permitted. All wire and cable shall be installed in conduit.

H. Splice branch circuits only in accessible junction or outlet boxes. Control cable shall never be spliced except the final connection to field devices. Where terminations of cables that are installed under this Section are to be made by others, provide pigtail of adequate length for neat, trained and bundles connections, minimum 5 feet at each location, unless noted otherwise on drawings.

I. Wiring within an Enclosure: Contractor shall bundle ac and dc wiring separately within an enclosure. The Contractor shall utilize panel wireways when they are provided. Where wireways are not provided the Contractor shall neatly tag, bundle wires and secure to sub-panel at a minimum of every three inches with T&B Type TC5355 heavy duty mounting bases.

J. Do not bend any conductor either permanently or temporarily during installation to radii less than four times the outer diameter of 600-volt insulated conductors.

3.3 WIRING INSTALLATION IN RACEWAYS

A. Wire and cable shall be pulled into clean dry conduit. Do not exceed manufacturer's recommended values for maximum pulling tension and sidewall pressure.

B. Pull conductors together where more than one is being installed in a raceway.

C. Use UL listed pulling compound or lubricant, when necessary; compound must not deteriorate conductor and insulation.

D. Do not use a pulling means, including fish tape, cable or rope, which can damage the raceway.

E. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.

F. Place an equal number of conductors for each phase of a circuit in same raceway.

G. Provide separate conduit or raceway for line and load conductors of motor starters, safety disconnect switches, and similar devices. Those devices shall not share the same raceway.

H. All conduits shall contain a green equipment grounding conductor. Provide isolated ground conductor to all isolated ground receptacles. Provide isolated ground conductor in 120/208 volt feeders as noted on drawings. Conduit, wireways, or boxes shall not be used as the equipment grounding conductor.

I. Provide separate conduit system for emergency power circuits. These circuits shall not share raceways with normal power or lighting circuits.

J. Conductors carrying more than 150 volts to ground shall not be installed in conduits with conductors carrying less than 150 volts to ground.

3.4 CABLE INSTALLATION

A. Provide protection for exposed cables where subject to damage during construction. Do not install cable before the completion of raceway system.

B. Cable shall be in conduit. Cables, conduits and raceways shall not be laid on ceiling tiles or strapped to ceiling wire.

C. Use suitable cable fittings and connectors.

D. It shall be the Contractor's responsibility to accurately measure all cable runs before the cable is cut. The Contractor shall furnish all tools and equipment, have sufficient properly trained personnel and shall exercise necessary care to ensure that the cable is not damaged during installation. Cable found to be damaged before installation shall not be installed. Cable damage during installation shall be removed and replaced. Repairs to cables can only be done with written permission from the Owner's Representative and only under special circumstances.

E. PVC jacketed cable shall not be installed or worked in any way at temperatures below 32 degrees F, unless cable has been previously stored in a heated area 48 hours prior to being pulled and transported to a heated pulling area.

F. Each cable entering an enclosure shall have its conductors bundled together and identified with the cable number. All groups of conductors within an enclosure shall be shaped and formed to provide a neat appearance to facilitate future additions or rework. All control conductors shall be numbered and shall be labeled at each termination with this number, using markers designed for the application.

G. Do not route power and control cables through communications rooms.

H. Fire alarm cable shall be installed in a separate conduit system.

I. Instrument Cable: Instrument cable shall be installed in conduit. They shall not be spliced at any point. The shields and drain wires of shielded signal cables shall be grounded only at one point.

3.5 WIRING CONNECTIONS AND TERMINATIONS

A. Install splices, taps and terminations, which have equivalent-or-better mechanical strength and insulation as the conductor. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

B. Keep conductor splices and taps accessible and to a minimum, and in junction boxes only. Control circuit conductors shall terminate at terminal blocks only. Do not splice below grade or in outdoor pull boxes.

C. Use splice, tap and termination connectors, which are compatible with the conductor material.

D. Thoroughly clean wires before installing lugs and connectors.

E. Terminate spare conductors with electrical tape and label as spare. Do not energize.

F. Power and Lighting Circuits: Use solderless pressure connectors with insulating covers for copper wire splices and taps, 8 AWG and larger. For 10 AWG and smaller, use insulated spring wire connectors with plastic caps on lighting and receptacle circuits.

G. Connections for all wire sizes in motor terminal boxes where the motor leads are furnished with crimped-on lugs shall be made by installing ring type compression terminals on the motor branch circuit ends and then bolting the proper pairs of lugs together. First one layer of No. 33 scotch tape reversed (sticky side out), then a layer of rubber tape, then two layers of No. 33 half-lapped.

H. Identify conductors per Section 26 0553 - Electrical Identification.

3.6 FIELD QUALITY CONTROL

A. Torque test conductor connections and terminations to manufacturer's recommended values.

B. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.

C. Conductors in vertical conduits or raceways shall be supported in the manner set forth in the appropriate section of the latest revision of the National Electrical Code.

D. Lighting fixtures shall not be used for raceways for circuits other than parallel wiring of fixtures.

E. Conductors may be run in parallel as shown on drawings, provided all paralleled conductors are the same size, length, and type of insulation. They shall be so arranged and terminated as to insure equal division of the total current between all conductors involved.

3.7 TESTING AND ACCEPTANCE

A. Before final acceptance, the Contractor shall make voltage, insulation, and load tests, necessary to demonstrate to the Owner's representative the satisfactory installation and proper performance of all circuits.

B. Test feeder conductors clear of faults. Insulation-resistance test shall be conducted per NETA - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems. Test results below 50 megohms shall be cause for rejection of the wiring installation. Replace and retest all such rejected conductor.

C. At the completion of this project, the Contractor shall provide for the Owner three (3) complete and finally corrected sets of working drawings. These sets of working drawings shall be new, unused and in good condition, and shall include the nature, destination, path, size and type of wire and all other characteristics for complete identification of each and every conduit and circuit.

END OF SECTION 26 0519

SECTION 26 0526 - GROUNDING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Power system grounding.

B. Communication system grounding.

C. Electrical equipment and raceway grounding and bonding.

1.2 REFERENCES

A. NFPA 70 - National Electrical Code, latest edition

B. ANSI/UL 467 - Electrical Grounding and Bonding Equipment

C. ANSI/IEEE STD 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems

D. IEEE 81 - Guide for Measuring Earth Receptivity, Ground Impedance and earth Surface Potential of a ground System

E. IEEE 1100 - Recommended Practice for Powering and Grounding Sensitive Electronic Equipment

F. ANSI/TIA/EIA 607 - Commercial Building Grounding and Bonding Requirements for Telecommunications

1.3 SYSTEM DESCRIPTION

A. Ground the electrical service system neutral at service entrance equipment to grounding electrodes. Electrical systems that are grounded shall be connected to earth in a manner that will limit the voltage imposed by lightning, line surges, or unintentional contact with higher-voltage lines and that will stabilize the voltage to earth during normal operations. Concrete encased electrodes shall be connected as the most effective grounding electrodes. Provide a completely grounded and bonded system in accordance with Article 250 of the NEC.

B. Ground generator system neutral to grounding electrode system.

C. Provide communications system grounding conductor to MDF and each IDF as indicated on drawings.

D. Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, boxes, cable sheath, ground bus in electrical rooms and IT rooms, metal frame of the building, ground rods, encased electrodes, grounding conductor in raceways and cables, receptacle ground connectors, lightning protection counterpoise, and metal underground water pipe.

E. Bonding jumpers shall be installed around non-metal fittings or insulating joints to ensure electrical continuity. Bonding shall be provided where necessary to ensure electrical continuity and the capacity to conduct safely any fault current likely to be imposed.

F. Supplementary Grounding Electrode: Use driven ground rods and encased electrodes on exterior of Building.

1.4 SUBMITTALS

A. Provide submittals in accordance with and in addition to Section 26 0000, Basic Electrical Requirements, and Division 01 for submittal requirement.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Grounding system components shall be as required to comply with the design and construction of the system indicated. Components shall be as indicated in manufacturer's submittal data.

B. Ground conductors shall be stranded tinned, annealed copper cable of the sizes indicated on drawings. Bond grounding conductors at both ends of metallic conduit.

C. Grounding clips shall be Steel City Type G, or equal.

D. Ground Rods shall be copper-encased steel, 3/4" diameter, minimum length 10 feet.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install ground system as indicated, in accordance with the applicable requirements of the National Electrical Code and the National Electrical Contractors Association's "Standard of Installation".

B. Install grounding conductors continuous, without splice or connection, between equipment and grounding electrodes. Install test wells as required per drawings.

C. In feeder and branch circuits, provide a separate, insulated equipment grounding conductor. Terminate each end on a grounding lug, bus, or bushing.

D. Connect grounding electrode conductors to metal water pipe where metal pipe is available and accessible using suitable ground clamp. Make connections to flanged piping at street side of flange. Provide bonding jumper around water meter.

E. Install fusion welded ground connectors where they are concealed or inaccessible.

F. Ground each outlet by the use of an approved grounding clip attached to the junction box in such a position to be readily inspected on removal of the cover plate; or by the use of an approved grounding yoke type receptacle.

G. No strap grounding clamps shall be used; connections requiring bolting shall be made up with monel metal bolts, washers and nuts. Connections shall be made only after surfaces have been cleaned, or ground to expose virgin metal.

H. Install external ground wire on liquid tight flexible metal conduit with grounding bushings.

I. Conductor connections shall be made by means of solderless connectors such as serrated bolted clamps or split bolt and nut type connectors. .

J. Connect grounding conductors to ground rods at the upper end of the rod with the end of the rod and the connection points below finished grade. Below grade connection shall be exothermic-welded type connectors as manufactured by Cadweld, Thermoweld.

K. Provide grounding and bonding at metering equipment and pad-mounted transformer in accordance.

L. 120 volt single phase circuits shall have a dedicated separate neutral. Do not share neutrals. Replace existing circuits that share a neutral so that all existing and new circuits do not share a neutral. Provide additional conduits as required.

M. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 3/0 AWG. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

N. Separately derived system such as UPS, etc. shall be grounded and bonded per NEC.

3.2 FIELD QUALITY CONTROL

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

B. Measure ground resistance from system neutral connection at service entrance to convenient ground reference point using suitable ground testing equipment. Resistance shall not exceed 2 ohms. Provide additional ground rod as required until resistance reading is 2 ohms or less.

END OF SECTION 26 0526

SECTION 26 0529 - SECURING AND SUPPORTING METHODS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Raceway and equipment supports.

B. Fastening hardware.

C. Coordinate location of concrete equipment pads.

1.2 QUALITY ASSURANCE

A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry. Support systems shall be sized adequately to support an additional 25% for future loads

1.3 COORDINATION

A. Coordinate with other trades where conduit supports are in the same location as piping, ductwork, and work of other trades and where supports are furnished and installed under other Divisions. Supporting from the work or supports of other Contractors shall not be allowed except by express, written permission of the Owner.

1.4 SUBMITTALS

A. Provide submittals in accordance with and in addition to Section 260000, Basic Electrical Requirements, and Division 01.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Support Channel:

1. All non-corrosive locations: Hot-dip galvanized steel.

B. Hardware:

1. All non-corrosive locations: Hot-dip galvanized steel.

C. Threaded Rod: Used for rack support from structure above; 1/4-inch minimum diameter.

2.2 CONDUIT ANCHORING

A. Conduit shall be securely anchored with split ring hangers, conduit straps, or other devices specifically designed for the purpose. Wire ties and spring clips are specifically not permitted. Do not support conduits from ceiling support wires.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using precast insert system, expansion anchors, or beam clamps. Do not use spring steel clips and clamps. Provide necessary calculations to select proper support materials for electrical equipment, raceway supports.

B. Install hangers, anchors, sleeves and seals as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to insure supporting devices comply with requirements. Comply with requirements of NEC for installation of supporting devices. Install supports with spacing in compliance with NEC requirements.

C. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors in solid masonry walls; or concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.

D. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.

E. Do not use powder actuated anchors without written permission from the Engineer.

F. Do not drill structural steel members without written permission from the Structural Engineer.

G. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.

H. Bridge studs top and bottom with channels to support recessed mounted cabinets and panelboards in stud walls.

I. Install surface mounted cabinets and panelboards with a minimum of four anchors. Provide strut channel supports to stand cabinet 1-5/8 inches off wall. Utilize "Post Bases" where support channel is attached to structural floor.

J. Provide extra care in supporting PVC conduit to protect it from potential damage.

K. Use fiberglass for nonmetallic raceway systems supports in areas subject to corrosives.

L. All supports in contact with floor using stanchion type support shall be solidly bolted to the permanent structural floor.

M. Conduit supports shall have at a minimum, the bottom support member constructed of double strut. This horizontal member shall be double-nutted, and the supporting all-thread rod shall be trimmed to one inch below lowest nut.

N. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

O. Install freestanding electrical equipment minimum on 4-inch concrete pads unless noted otherwise. Pad shall be a minimum four inches larger than equipment. No crevices shall be left around the pads. Equipment includes but not limited to the following:

1. Floor mounted switchgear
2. Automatic transfer switches if floor mount type

P. Generator and pad mounted transformers shall be as detailed and noted on drawings.

Q. Do not anchor supports to columns. Where panelboards, cables, or conduits are routed on the face of a column provide “column hugging” channel supports.

3.2 TOUCH-UP

A. Touch-up all scratches on securing and supporting system, and paint the ends of channel after cutting with an approved zinc chromate or 90 percent zinc paint.

END OF SECTION 26 0529

SECTION 26 0533 - RACEWAYS, CONDUITS AND BOXES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Raceways:

1. Wireways.

B. Conduit:

1. Rigid metal conduit and fittings (RGS).
2. Intermediate metal conduit and fittings (IMC).
3. Electrical metallic tubing and fittings (EMT).
4. Flexible metal conduit and fittings.
5. Liquid-tight flexible metal conduit and fittings.
6. Non-metallic conduit and fittings (underground use only).

C. Boxes:

1. Wall and ceiling outlet boxes.
2. Pull and junction boxes.

D. Electrical/control portion of HVAC work covered by Division 23 pertaining raceway, conduit and boxes shall follow the requirement set forth by this specification.

1.2 REFERENCES

A. NFPA 70 - National Electrical Code, latest edition

B. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated

C. ANSI C80.3 - Electrical Metallic Tubing, Zinc-Coated

D. ANSI/NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies

E. EMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing

F. ANSI/NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports

G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)

H. ANSI/UL 1 - Flexible Metal Conduit

I. ANSI/UL 360 - Liquid-tight Flexible Steel Conduit

J. ANSI/UL 467 - Electrical Grounding and Bonding Equipment

K. ANSI/UL 651 - Schedule 40 and 80 Rigid PVC Conduit (underground use only)

L. ANSI/UL 797 - Electrical Metal Tubing

M. ANSI/UL 870 - Wireways, Auxiliary Gutters and Fittings

N. UL 6 - Rigid Metal Conduit

O. ANSI/UL 5C - Surface Raceways and Fittings for Use with Data, Signal, and Control Circuits

P. ANSI/UL 498 - Attachment Plugs and Receptacles

Q. ANSI/UL 943 - Ground Fault Circuit Interrupters

1.3 SUBMITTALS

A. Provide submittals in accordance with and in addition to Section 26 0000, Basic Electrical Requirements, and Division 01 for submittal requirements.

B. Shop drawings consisting of a complete list of equipment and materials, which will be used for the project, including manufacturer's descriptive and technical literature, catalog cuts and installation instructions.

C. Sealing/fire stopping materials and details.

D. Submit detailed shop drawing for Owner and Engineer approval showing all conduits 2” and larger. All conduits, regardless of size shall be concealed in finished areas of the building.

E. Submit cable pulling tension and sidewall pressure calculations for all service and feeder conduits.

1.4 STORAGE AND HANDLING

A. Handle materials carefully to avoid damage, breaking, denting and scoring. Damaged equipment or materials shall not be installed.

B. Store materials in a clean dry space and protected from the weather.

PART 2 - PRODUCTS

2.1 WIREWAYS

A. Wireways shall be of steel construction general purpose for indoor spaces and rain tight for outdoor applications with knockouts.

B. Submit proposed site and location for approval. Use wireways only where acceptable to Owner and Engineer.

C. Cover shall be hinged or screw applied as indicated on Drawings. Rain tight wireways shall be provided with full gasketing.

D. Fittings shall be so constructed to continue the "lay-in" feature through the entire installation.

E. Provide all sheet metal parts with a rust inhibiting phophatizing primer coating and finished in gray enamel. All hardware shall be cadmium plated to prevent corrosion.

2.2 CONDUIT AND FITTINGS

A. Conduit and fittings for all electrical systems on this project shall include the following:

1. Service entrance
2. Electrical power and lighting feeders
3. Electrical power and lighting circuits

a. Also includes emergency lighting circuits

1) EMT connectors and couplers shall be red color-coded, steel, size 3/4”C made by Bridgeport per Owner standards.

4. Control systems (other than HVAC)
5. Division 28 systems
6. Other electrical systems

B. For each electrical wireway system indicated, provide a complete assembly of conduit, tubing or duct with fittings including, but not necessarily limited to, connectors, nipples, couplings, locknuts, bushings, expansion fittings, other components and accessories as needed to form a complete system of the same type indicated.

C. Conduit fittings shall be designed and approved for the specific use intended. Conduit fittings, including flexible, shall have insulated throats or bushings. Rigid conduits shall have insulated bushings, unless grounding bushings are required by N.E.C. Article 250. Grounding bushings shall have insulated throats.

D. Rigid and intermediate metal conduit shall be hot-dipped galvanized. Fittings shall be threaded type. Expansion fittings shall be OZ Type DX.

E. Electrical metallic tubing shall be galvanized. Fittings shall be all steel compression water tight type. Expansion fittings shall be OZ Type TX.

F. Flexible metal conduit and fittings shall be zinc-coated steel.

G. Malleable metal fittings are not acceptable.

H. Liquid-tight flexible conduit and fittings shall consist of single strip, continuous, flexible interlocked, double-wrapped steel, galvanized inside and outside, forming smooth internal wiring channel with liquid-tight covering of flexible polyvinyl chloride (PVC). It shall be furnished with a sealing O-ring where entering an enclosure subject to moisture. Where O-Rings are used, ground type bushings shall be used in the box or enclosure.

I. Nonmetallic conduit and fittings shall be suitable for temperature rating of conductor but not less than 90°C. Nonmetallic conduit and fittings shall be molded of high impact PVC compound having noncombustible, nonmagnetic, non-corrosive and chemical resistant properties and shall be of the same manufacturer. Solvent cement shall be of the same manufacturer as the conduit and shall be of the brush-on type. Spray solvents are prohibited. PVC coated metallic fittings shall not be permitted for PVC conduit connections.

J. ENT is not acceptable.

K. Provide strain relief fittings as manufactured by OZ for cables in vertical raceways.

L. Crimp or set-screw type fittings are not acceptable.

M. Minimum conduit size shall be 3/4 inch for branch circuits.

N. Minimum conduit size shall be 1 inch for feeders.

O. 1/2 inch flexible metal conduit may only be used for light fixture whips for lay-in fixtures. Minimum length 3'-0", maximum length 6'-0".

2.3 WALL AND CEILING OUTLET BOXES

A. Galvanized steel interior outlet wiring boxes of the type, shape and size, including depth of box, to suit each respective location and installation; constructed with stamped knockouts in back and sides, and with threaded holes with screws for securing box covers or wiring devices.

1. Outlet box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, compatible with outlet boxes, compatible with outlet boxes being used and meeting requirements of individual situations.
2. Provide multi-gang outlets of single box design. Sectional boxes are not acceptable. Provide outlet boxes of sufficient volume to accommodate the number of conductors entering the box in accordance with the requirements of NEC, and not less than 1-1/2-inch deep unless shallower boxes are required by structural conditions and are approved by the A/E.

B. Outlets exposed to rain shall be equipped with cast metal in-use cover.

C. Provide 4-inch octagonal ceiling outlet boxes.

D. Surface mounted outlet boxes in interior locations shall be threaded cast type.

E. Owner standards for boxes are as follows:

1. 4 in. Square Welded Box, 2-1/8 Deep with 1/2 & 3/4 in TKO. by RACO
2. 4 in. Square Drawn Box, 1-1/2 Deep with 1/2 KO by RACO
3. 4 in. Square 1-Device Mud Ring, Raised 5/8 in. by RACO
4. 4 in. Square 2-Device Mud Ring Raised 5/8in. by RACO
5. 4 in. Square electrical Box Cover, red, polyester power coating (emergency circuits)

2.4 PULL AND JUNCTION BOXES

A. Boxes shall be galvanized sheet metal conforming to ANSI/NEMA OS 1 with screw-on cover and welded seams, stainless steel nuts, bolts, screws and washers.

B. Boxes larger than 24 inches in any dimension shall be panelboard code gauze galvanized steel with hinged cover.

C. Boxes shall be sized in accordance with NEC.

PART 3 - EXECUTION

3.1 INSTALLATION - CONDUIT

A. Install products as indicated, in accordance with the applicable requirements of NEC, NEMA and the National Electrical Contractors Association's "Standard of Installation".

B. Cut conduit square using a saw or pipe cutter. De-burr cut ends. Joints in steel conduit must be painted with T&B Kopr shield and drawn up tight. Threads for rigid metal conduit and IMC shall be deep and clean. Running threads shall not be used. Wipe plastic conduit clean and dry before joining. Apply full, even coat of cement with brush to entire area that will be inserted into fitting. Let joint cure for 20 minutes minimum. Spray type of cement is not acceptable. Install raceway and conduit system from point of origin in outlets shown, complete with support assemblies including all necessary hangers, beam clamps, hanger rods, turnbuckles, bracing, rolls, clips angles, through bolts, brackets, saddles, nuts, bolts, washers, offsets, pull boxes, junction boxes and fittings to ensure a complete functional raceway system. Where vertical drops of conduit are made to equipment in open space, the vertical conduit shall be rigidly supported from racks supported on the floor.

C. Raceway and conduit system shall be installed parallel and perpendicular to building lines unless indicated otherwise on the drawings.

D. Install rigid wall hot-dipped galvanized steel conduit or hot-dipped galvanized intermediate metal conduit for service entrance, feeders, wall or floor penetrations, mechanical rooms, electrical rooms, exposed interior locations, exposed outdoor locations, damp locations or any location as per design drawing. The following exceptions permitted:

1. EMT

    a. In sizes up to and including 4 inch, may be used inside dry locations where concealed above accessible ceilings or in dry wall partitions. EMT may not be used outside, in vault, in concrete, underground, in under floor spaces, in masonry walls, in locations likely to be damp, or where exposed. EMT may be exposed in mechanical and electrical rooms where above 5’-0” AFF, but cannot be used for service entrance.

2. PVC (underground use only)

    a. Install PVC schedule 40 conduit where direct buried in earth.
    b. Install PVC schedule 40 conduit where concrete encased in ductbank.
    c. Underground 90s shall be long radius fiberglass.
    d. Stub-ups shall be schedule 40 PVC.

3. Liquid-tight

    a. Install liquid-tight flexible metal conduit for connections to rotating, vibrating, moving or movable equipment, including mechanical equipment. Install external ground wire on flexible conduit with grounding bushings. Maximum length shall be 6 feet minimum of 2 feet.

4. Flexible Metal Conduit

    a. Install standard flexible metal conduit (not liquid-tight), which shall be only used for lighting fixture whips with internal ground wire. Maximum length shall be 6 feet minimum of 3 feet; and minimum size shall be 1/2-inch for lay-in light fixture whips.

E. Install conduits parallel and supported on Unistrut, or equal, trapezes and anchored with split ring hangers, conduit straps or other devices specifically designed for the purpose. No raceways or boxes shall be supported using wire. Arrange conduit to maintain headroom and present a neat appearance. Conduit routes shall follow the contour of the surface it is routed on. Route exposed conduit and tray above accessible ceilings parallel and perpendicular to walls and adjacent piping. Maintain 12-inch clearance between conduit and heat sources, such as flues and heating appliances. Wire ties or “wrap lock” are not permitted to support or secure conduit system. Fasten conduit with the following material:

1. Wood screws on wood
2. Toggle bolts on hollow masonry
3. Bolts and expansion anchors in concrete or brick
4. Machine screws, threaded rods and clamps on steel
5. Conduit clips on steel joists.
6. 4 inch x 4 inch penta-treated pine installed in pitch pans on roof, spaced at intervals not to exceed 5 feet. Do not install on roof without written permission from Owner. Conduits to rooftop equipment shall be installed in ceiling space and penetrate roof within equipment curb.

F. Install conduits outside of building lines at a minimum depth of 30 inches below finished grade. Refer to ductbank details for additional depth requirements. Provide additional depth as required to maintain required separation from other utilities and to avoid obstructions. Maintain twelve inches earth or two inches concrete separation between electrical conduits and other services or utilities underground.

G. Allow minimum 6” clearance from heat sources.

H. Conduits running to rooftop and exterior wall mounted equipment shall be routed inside building and stubbed out at equipment.

I. Install underground conduits with sealing glands equal to OZ Type FSK exterior to the conduit and OZ type CSB, or equal internally at the point where conduits enter the building to prevent water seepage into the building.

J. Fittings shall be approved for grounding purposes or shall be jumpered with copper grounding conductors of appropriate ampacity. Leave termination of such jumpers exposed.

K. Install expansion fittings in metal and PVC conduit as follows:

1. Conduit Crossing Building Expansion Joints:

    a. EMT all sizes
    b. IMC all sizes
    c. RMC all sizes

2. Conduits entering environmental rooms and other locations subject to thermal expansion and as required by NEC.

3. Unless expansion fitting has an integral bonding braid, as in Crouse-Hinds Type XC, a green insulated grounding conductor shall be pulled in the conduit. Both ends of the green grounding conductors shall be accessible for inspection.

L. Install conduit concealed in walls, partitions and above ceilings. Install conduit exposed in ceiling area (at structure) of electrical rooms and mechanical rooms.

M. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.

N. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture if cable or wire are not installed immediate after conduit run. Tape covering conduit ends is not acceptable.

O. Provide 200 lb. nylon cord full length in empty conduit.

P. Where conduit penetrates fire-rated walls and floors, provide pipe sleeve two sizes larger than conduit; pack void around conduit with oakum and fill ends of sleeve with fire-resistive compound or provide mechanical fire-stop fittings with UL listed fire-rating or seal opening around conduit with UL listed foamed silicone elastomer compound equal to fire-rating of floor or wall.

Q. Install no more than the equivalent of three 90-degree bends between boxes. Where four 90 degree bends are required, prior approval by the Engineer is required. Use conduit bodies to make sharp changes in direction, as around beams. Conduit bodies shall be readily accessible and sized for the cables installed. Running or rolling offsets are not approved. Use factory long radius elbows for bends in conduit larger than 2-inch size. All parallel bends shall be concentric.

R. Pull string shall be provided full length in conduit designated for future use.

S. Rigid steel conduit shall be taped where in contact with concrete. At the points where conduit penetrates concrete that is in contact with soil, the conduit shall be Schedule 80 PVC bedded in sand.

3.2 INSTALLATION - WIREWAYS

A. Bolt wireways to steel channels fastened to the wall or in self-supporting structure. Install level.

B. Gasket each joint in oil-tight wireway.

C. Mount rain tight wireway for exterior installation in horizontal position only.

3.3 INSTALLATION - BOXES

A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.

B. Provide outlet box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, compatible with outlet boxes being used and meeting requirements of individual situations.

C. Electrical box locations shown on Contract Drawings are approximate unless dimensioned. Verify location of outlets prior to rough-in.

D. Allow minimum 6” clearance from heat sources.

E. Locate and install boxes to allow access, minimum 12 inches above ceiling except where space dimensions do not allow.

F. Do not install boxes back-to-back in walls. Provide minimum 6-inch separation. Provide minimum 24-inch separation in acoustic-rated walls. If boxes are connected together, install flexible connection between the two and pack openings with fiberglass.

G. Secure boxes rigidly to the substrate upon which they are being mounted, or solidly imbed boxes in concrete or masonry. Do not support junction boxes from the raceway systems. Boxes shall not be permitted to move laterally. Boxes shall be secured between two studs. Boxes shall not be supported by a single stud.

H. Provide knockout plugs for unused openings.

I. Use multiple-gang boxes where more than one device is mounted together. Do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.

J. Install boxes in walls without damaging wall insulation.

K. Outlet boxes in plaster partitions shall be "shallow-type" set flush in wall so there is at least 5/8 inch plaster covering back of box.

L. Outlet boxes for switch shall not be used as junction boxes.

M. Coordinate mounting heights and locations of outlets mounted above counters, benches and backsplashes.

N. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening.

O. Outlet boxes supporting fixtures shall be securely anchored in place in an approved manner. Support outlet boxes and fixtures in acoustic ceiling areas from building structures, not from acoustic ceilings. Lighting fixture outlets shall be coordinated with mechanical and architectural equipment and elements to eliminate conflicts and provide a workable neat installation.

3.4 WALL AND FLOOR PENETRATIONS

A. Core drilling shall be approved by Owner prior to execution. X-ray for each required floor penetration. Avoid anchor bolt on structural column by installing “column hugging” type of unistrut support for electrical installation. PVC shall not be used for wall and floor penetration.

B. Route conduit through roof openings for piping and ductwork where possible; otherwise, route through roof jack with pitch pocket. Coordinate roof penetrations with the roofing contractor.

END OF SECTION 26 0533

SECTION 26 0553 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Nameplates and tape labels

B. Wire and cable markers

C. Conduit color coding and labeling

1.2 REFERENCES

A. NFPA 70 - National Electrical Code (latest edition)

1.3 SUBMITTALS

A. Provide submittals in accordance with and in addition to Section 26 0000, Basic Electrical Requirements, and Division 01 for submittal requirement.

1. Furnish nameplate identification schedules listing equipment type and nameplate data with letter sizes and nameplate material.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Equipment Nameplates:

1. For normal power electrical equipment, provide engraved three-layer laminated plastic nameplates, engraved white letters on a black background.
2. For emergency equipment provide engraved three-layer laminated plastic nameplates with engraved white letters on a red background.
3. For fire alarm system provide engraved three-layer laminated plastic nameplates with white letters on a yellow background.

B. Underground Warning Tape

1. Manufactured polyethylene material and unaffected by acids and alkalines.
2. 3.5 mils thick and 6 inches wide.
3. Tensile strength of 1,750 psi lengthwise.
4. Printing on tape shall include an identification note BURIED ELECTRIC LINE, and a caution note CAUTION. Repeat identification and caution notes over full length of tape. Provide with black letters on a red background.

C. Conductor Color Tape and Heat Shrink:

1. Colored vinyl electrical tape shall be applied perpendicular to the long dimension of the cable or conductor.
2. In applications utilizing tray cable, heat shrinkable tubing shall be used to obtain the proper color coding for the length of the conductor in the cabinet or enclosure. Variations to the cable color coding due to standard types of wire or cables are not acceptable.

D. Warning labels: Provide warning labels with black lettering on red background with a minimum of 1/2" lettering.

E. Receptacle, lighting control, and switch cover plates shall be custom laser engraved with panel and circuit breaker number. Stick-on tape label is not acceptable.

F. J-Box cover plate labels (existing and new J-boxes): Black stenciled letters 1/4" high. Adhesive back tapes may be used if a clear tape is applied over the label for protection. Each J-box cover shall be labeled with voltage and each circuit number contained in J-box.

1. White letters on black background for normal power.
2. White letters on red background for emergency/standby power.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Degrease and clean surfaces to receive nameplates or tape labels.

B. Install nameplates parallel to equipment lines.

C. Secure plastic nameplates to equipment fronts using screws or rivets. Use of adhesives shall be per Owner’s approval. Secure nameplate to outside face of flush mounted panelboard doors in finished locations.

3.2 WIRE IDENTIFICATION

A. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits. Label control wire with number as indicated on schematic and interconnection diagrams or equipment manufacturer's shop drawings for control wiring.

B. Conductors for power circuits to be identified per the following schedule. Verify existing color code and notify Engineer if different than below.

	SYSTEM VOLTAGE
Conductor	208/120V
Phase A	Black
Phase B	Red
Phase C	Blue
Neutral	White
Grounding IG	Green Green w/Yellow

3.3 NAMEPLATE ENGRAVING SCHEDULE

A. Provide nameplates of minimum letter height as scheduled below. Nameplates shall be same as equipment names indicated on the Drawings.

B. Individual Circuit Breakers in Switchboards, Distribution Panelboards, Disconnect Switches, Motor Starters, and Contactors: 1/4-inch; identify source to device and the load it serves, including location.

C. Automatic Transfer Switches: 3/8-inch; white letters and red background; identify equipment designation 1/4-inch; identify voltage rating, normal source, standby source and load served including location.

D. Panelboards: 3/8-inch; identify equipment designation. 1/4 -inch; identify source, voltage and bus rating.

3.4 ENCLOSURE COLOR CODING

A. The following systems shall have each junction and pull box cover completely painted per the following:

System	Color of Box Cover
FCMS	Green
Emergency Power	Red
Security**	White
Fire Alarm	Yellow

**Security shall include, but not be limited to, the following systems:
- Card Access
- Duress Alarms
- Perimeter Door Alarms
- CCTV

3.5 SWITCHGEAR LABEL

A. Switchgear shall be labeled to include arc-flash labels, personal protective equipment (PPE) and other information as required by NEC 110.16 and as described in the standards and guidelines referenced in FPN Nos. 1 and 2.

END OF SECTION 26 0553

SECTION 26 0923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following lighting control devices:
   1. Occupancy/vacancy sensors
   2. 0-10V dimming and switching power packs
   3. Lighting control stations
   4. Daylight sensors
   5. Lighting contactors
   6. Touchscreen controller

1.2 DEFINITIONS

A. PIR: Passive infrared.

1.3 SUBMITTALS

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

B. Shop Drawings: Show installation details for occupancy, vacancy, and daylight sensors.
   1. Interconnection diagrams.
   2. Sequence of operations for lighting controls in each room.
   3. Floor plan showing all system components.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 COORDINATION

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, fire alarm system, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 OCCUPANCY/VACANCY SENSORS

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

   1. Acuity nLight Occupancy/Vacancy Ceiling Sensor

B. General Description:

1. Ceiling-mounting.
2. Dual technology infrared/ultrasonic.
3. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
4. Provide required number and type of sensors, relays, etc. for full room coverage.
5. Provide required number and type of sensors, relays, etc. for dual level control as noted.
6. LED indicator to show when motion is being detected during testing and normal operation of the sensor.
7. Bypass Switch: Override the on function in case of sensor failure.
8. Bypass Off Switches: Provide wall type bypass off switches for each room.
9. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.

2.2 0-10V DIMMING AND SWITCHING POWER PACKS

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

1. Acuity nLight Dimming Module with 0–10 V- Control
2. Acuity nLight Emergency Dimming Module with 0–10 V- Control
3. Acuity nLight Switching Module
4. Acuity nLight Emergency Switching Module

B. General Description:

1. Communicates with Acuity nLight controls.
2. Plenum Rated.
3. Control wiring between sensors and control units shall be Class 2, 18-24 AWG, stranded U.L. Classified,
4. Integrated, self-contained unit consisting internally of an isolated load switching control relay.
5. Shall be compatible with all specified LED dimming types.

2.3 LIGHTING CONTROL STATIONS

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

1. Acuity nLight Dimmers and Switches

B. General Description:
1. Hubs require 120V or 277V power supply.
2. LED indicators.
3. Button configurations as shown on drawing details.
4. Scene controllers as shown on drawing schedules and details.

2.4 LIGHTING CONTACTORS

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

1. Allen-Bradley/Rockwell Automation.
2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
3. Square D; Schneider Electric.

B. Description: Electrically operated and mechanically held, combination type with nonfused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as required, matching the NEMA type specified for the enclosure.
5. Minimum contactor rating of 30 amps.
6. Provide auxiliary relays as required.

PART 3 - EXECUTION

3.1 OCCUPANCY/VACANCY SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 100 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

B. It shall be the contractor’s responsibility to locate and aim sensors in the correct location required for a complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer’s recommendations. Rooms shall have one hundred (100) percent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. The contractor shall provide additional sensors if required to properly and completely cover the respective room.

C. It is the contractor’s responsibility to arrange a pre-installation meeting with the manufacturer’s factory authorized representative, at the owner’s facility, to verify placement of sensors and installation criteria.

D. Proper judgment must be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitation or interference of structural components. The contractor shall also provide at the owner’s facility, the training necessary to familiarize the owner’s personnel with the operation, use, adjustment, and problem solving diagnosis of the occupancy sensing devices and systems.

E. Upon completion of the installation, the system shall be completely commissioned by the manufacturer’s factory authorized technician who will verify all adjustments and sensor placement to ensure a trouble-free lighting control system that complies with the construction documents and submittal shop drawings.

F. The electrical contractor shall provide both the manufacturer and the electrical engineer with ten working days written notice of the scheduled commissioning date. Upon completion of the system fine-tuning the factory authorized technician shall provide the proper training to the owner's personnel in the adjustment and maintenance of the sensors.

3.2 CONTACTOR INSTALLATION

A. Mount lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing lighting control devices and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work.

3.4 ADJUSTING

A. Occupancy/Vacancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.5 FUNCTIONAL TESTING

A. Lighting control manufacturer shall provide functional testing in accordance with IECC.

END OF SECTION 26 0923

SECTION 26 2416 - PANELBOARDS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Distribution panelboards.

B. Branch circuit panelboards.

1.2 REFERENCES

A. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.

B. NAME KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

C. NEMA PB 1 - Panelboards.

D. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

E. NEMA PB 1.2 - Application Guide for Ground-fault Protective Devices for Equipment.

F. NEMA AB 3 - Molded Case Breakers and Their Application

G. ANSI/UL 67 - Electric Panelboards

H. ANSI/UL 50 - Cabinets and Boxes

I. ANSI/UL 508 - Industrial Control Equipment

1.3 SUBMITTALS

A. Provide submittals in accordance with and in addition to Section 26 0000, Basic Electrical Requirements, and Division 01 for submittal requirement.

B. Submit dimensioned drawings showing size, circuit breaker arrangement and equipment ratings including, but not limited to, voltage, main bus ampacity, integrated short circuit ampere rating, and temperature rating of circuit breaker terminations.

C. Submit 1/4” scale drawing of each electrical room and other rooms with electrical equipment to demonstrate that all equipment being submitted will fit in the space and all clearances are obtained. This drawing must be included with the submittal for equipment specified in this section.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver distribution panelboards in factory-fabricated water-resistant wrapping.

B. Handle panelboards carefully to avoid damage to material component, enclosure and finish.

C. Store in a clean, dry space and protected from the weather.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Square D Company
   1. Square D I-Line for distribution panels
B. Siemens
C. Eaton

2.2 PANELBOARD CONSTRUCTION

A. General: Provide flush or surface mounted, circuit breaker type distribution or branch circuit panelboards with electrical ratings and configurations, as indicated on the drawings and schedules. Load center type panelboards are not acceptable.

B. Enclosure:

   1. Enclosure shall be proper NEMA type as indicated.
   2. NEMA 1 (Indoors)

      a. Back box shall be galvanized steel for flush mounted branch circuit panelboards. Back box shall have gray enamel electro-deposited finish over cleaned phosphatized steel for all other type panelboards.
      b. Provide panelboard fronts with door-in-door cover.

   3. Construct cabinet in accordance with UL 50. Use not less than 16-gauge galvanized sheet steel, with all cut edge galvanized. Provide a minimum 4-inch gutter wiring space on each side. Provide large gutter where required to accommodate the size and quantity of conductors to be terminated in the panel, and where required by code.
   4. Exterior and interior steel surfaces shall be cleaned and finished with gray enamel over rust inhibiting phosphatized coating. Color shall be ANSI 61 gray.
   5. Doors shall be equipped with flush-type combination catch and key lock. All locks shall be keyed alike.
   6. Branch circuit panelboards shall be 5-3/4-inches deep.
   7. A directory holder with heavy plastic plate, metal frame, and index card shall be mounted inside of each door.
   8. Reinforce enclosure and securely support bus bars and overcurrent devices to prevent vibration and breakage in handling.
   9. Rating: Minimum integrated short-circuit rating, voltage and current rating as shown on drawings.
   10. Labeling: The Contractor shall furnish and install engraved, laminated plastic nameplates on the trim per Section 26 0553, Electrical Identification

C. Bus:

   1. Provide panelboards with copper rounded edge phase, neutral and ground buses, rated full capacity as scheduled on drawings. Buses shall be full-length and braced for the maximum available fault current as shown on drawings.
   2. Phase bussing shall be stacked front-to-back, A-B-C.
   3. The neutral and ground bus bars shall have termination locations for each of the individual feeders and the lugs sized appropriately. In addition, space shall be provided to terminate the neutrals and grounds in two feeders equal to the largest size circuit breaker that can be installed in the panelboard. The ground bus shall be mounted in the panelboard, opposite the incoming line and neutral lugs and shall be accessible to allow easy installation of bolts, nuts and lock washers used to attach ground lugs. The neutral and

ground buses in branch circuit panelboards shall have spaces to terminate 42 neutral and 42 ground wires.

4. All lugs for phase, neutral, and ground buses shall be tin-plated copper.
5. Neutral and ground buses shall be tin-plated copper.

2.3 SWITCHING AND OVERCURRENT PROTECTIVE DEVICES

A. Provide molded case circuit breakers with manufacturer's standard construction, bolt on type, with integral inverse time delay thermal and instantaneous magnetic trip in each pole. Circuit breakers shall be constructed using glass reinforced polyester insulating material providing superior dielectric strength. Provide circuit breakers UL listed as Type HACR for air-conditioning equipment branch circuits.

B. Circuit breakers shall have an over center, trip-free, toggle operating mechanism that will provide a quick-make, quick-break contact action.

C. Piggyback breakers are not permitted.

D. Provide handle padlock attachments on circuit breakers where required. Device shall be capable of accepting a single padlock. All circuit breakers shall be capable of being individually padlocked in the off position.

E. The circuit breakers shall be connected to the bus by means of solidly bolted connection. In multi-pole breakers, the phase connections on the bussing shall be made simultaneously without additional connectors or jumpers. Multi-pole breakers shall be two or three pole as specified. Handle ties are not permitted. The circuit breaker shall have common tripping for all poles.

F. All circuit breakers shall be provided with visible ON and OFF indications.

G. Provide GFI circuit breakers as indicated on drawing and per NEC requirement.

H. Breaker voltage and trip rating shall be per drawings. Breaker faceplate shall indicate UL certificate standards with applicable voltage systems and corresponding short current rating as per drawings.

I. Molded Case Circuit Breakers:

1. Breakers 400 ampere frame and less shall be manufacturer's standard industrial construction, bolt-on type, integral inverse time delay thermal and instantaneous magnetic trip. Breakers 225 ampere through 400 ampere shall have continuously adjustable magnetic pick-ups of approximately five to ten times trip rating.
2. Breakers 600 ampere frame and above shall be equipped with solid-state trip complete with built-in current transformers, solid-state trip unit and flux transfer shunt trip.

J. Provide mission critical breakers or breakers with additional trip features as required for code required coordination.

K. Provide equipment and/or breaker features as necessary to limit arc-flash energy per NEC.

2.4 SURGE PROTECTION

A. Each distribution panel shall be equipped with stand-alone surge-protective device adjacent to panel. Include 3-pole breaker in panelboard and conduit/conductors to surge protective device.

Breaker and conduit/conductors shall be size as recommended by manufacturer. Breaker is not shown on Panel Schedule.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D (Square D is preferred for standardization)
2. Siemens
3. Eaton

C. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the panelboard short-circuit rating, and with the following features and accessories:

1. Fabrication using bolted compression lugs for internal wiring.
2. Integral disconnect switch.
3. Redundant suppression circuits.
4. Redundant replaceable modules.
5. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
6. LED indicator lights for power and protection status.
7. Audible alarm, with silencing switch, to indicate when protection has failed.
8. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
9. Six-digit, transient-event counter set to totalize transient surges.

D. Minimum Surge Current Capability (single pulse rated) per phase:

1. Panelboards: 100 kA

E. SPD shall be UL labeled as Type 1 (verifiable at UL.com), intended for use without need for external or supplemental overcurrent controls. Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal over-temperature controls.

F. SPD shall provide surge current paths for all modes of protection: L-N, L-G, and N-G for Wye systems; L-L, L-G in single phase systems.

G. UL 1449 Third Edition Listed Voltage Protection Ratings (VPRs) shall not exceed the following:

System Voltage	L-N	L-G	L-L	N-G
208Y/120	700V	700V	1200V	700V

H. UL 1449 Third Edition Listed Maximum Continuous Operating Voltage (MCOV):

System Voltage	Allowable System Voltage Fluctuation (%)	MCOV
208Y/120	25%	150V

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards in accordance with manufacturer's written instructions and the applicable requirements of the NEC, NEMA, ANSI and the National Electrical Contractors Association's "Standard of Installation".

B. Anchor enclosed firmly to walls and structural surfaces, ensuring that they are permanently and mechanically secured. Direct attachment to dry wall is not permitted. Freestanding panelboards shall be installed on a concrete housekeeping pad with anchors per manufacturer's recommendation.

C. Mounting height:

1. Distribution Panelboards: Such that highest operating handle is no greater than 79 inches above finished floor.
2. Branch Circuit Panelboards: Such that highest operating handle is no greater than 79 inches above finished floor.
3. Where panelboards occur in groups, the tops shall be aligned if it can be done without exceeding items 1 and 2 above.

D. Install panelboards plumb. Adjust trim to cover all openings. Seal all conduit openings and cap all used knockout holes.

E. Provide blank plates for unused open spaces in panelboards. Keep the front door closed after work to protect from damage, dirt, and debris at all times.

F. Install identification nameplates in accordance with Section 26 0553, Electrical Identification.

3.2 FIELD QUALITY CONTROL

A. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers and lugs.

3.3 PANELBOARD SCHEDULE

A. The Contractor shall provide engraved, laminated plastic nameplates for circuit identification as indicated on the Drawings for distribution panelboards.

B. The Contractor shall fill the index directory inside the front door of branch circuit panelboards identifying each existing and new circuit. Where changes are made, the schedule shall reflect the changes. At the end of the job, these schedules shall reflect as-built record conditions.

END OF SECTION 26 2416

SECTION 26 2726 - WIRING DEVICES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Wiring Devices:

1. Wall switches.
2. Receptacles.
3. Device plates and box covers.

B. Wiring devices for HVAC in Division 23 shall meet the requirement of this specification.

1.2 REFERENCES

A. Americans with Disabilities Act (ADA)

B. ANSI/NEMA OS 1- Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

C. ANSI/UL 20 - General Use Snap Switches.

D. ANSI/UL 498 - Attachment Plugs and Receptacles.

E. ANSI/UL 943 - Ground Fault Circuit Interrupters.

F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts maximum).

G. NEMA WD 1 - General-Purpose Wiring Devices.

H. NEMA WD 5 - Specific-Purpose Wiring Devices.

I. Texas Accessibility Standards. (TAS)

1.3 SUBMITTALS

A. Provide and Division 01 for submittal requirement.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver wiring devices individually wrapped in factory-fabricated containers.

B. Handle wiring devices carefully to avoid damage, breaking and scoring.

C. Store in a clean dry space and protected from the weather.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide factory fabricated wiring devices in the type and electrical rating for the service indicated. Where type and grade are not indicated, provide proper selection to correspond with branch circuit wiring and overcurrent protection. Attachment of wires to devices shall be by screw

pressure under the head of binding screws. Arrangements depending on spring pressure or tension are not acceptable. All binding screws shall be brass or bronze.

B. Device Color:

1. Switches and receptacles on normal power shall be white.
2. Switches and receptacles on emergency power shall be red.

2.2 WALL SWITCHES

A. Acceptable Manufacturers:

1. Eaton (Owner standard and preferred)
2. Other manufacturers equal in design and function will be considered upon Owne/A/E approval following substitution procedure in 26 0000 and Division 01 for substitution requirement.

a. Arrow-Hart
b. Hubbell
c. General Electric
d. Leviton

B. Material:

1. Wall switches for lighting circuits and motor loads under 1/3 hp shall be AC general use snap switch with toggle handle, 20 amperes and 120 volt AC with number of poles as required:

a. Eaton 1221W-BX-LW 20-Amp Single-Pole White Toggle Light Switch
b. Eaton 1223W-BX-LW 20 –Amp 3-way Toggle Light Switch

2. Pilot light type shall be equipped with red toggle handle (glow when on), 20 amperes and 120 volt AC with number of poles as required; Arrow-Hart 1990PL Series.
3. A listed manual switch having a horsepower rating not less than the rating of the motor and marked “Suitable as Motor Disconnect” shall be permitted to serve as disconnect means for stationary motor of 2 horsepower or less.
4. Switch terminal screws or connectors shall be designed to accommodate No. 10 solid conductor.

2.3 RECEPTACLES

A. Acceptable Manufacturers:

1. Eaton (Owner standard and preferred)
2. Other manufacturers equal in design and function will be considered upon Owne/A/E approval following substitution procedure in 26 0000 and Division 01 for substitution requirement.

a. Arrow-Hart
b. Hubbell
c. General Electric
d. Leviton

B. Material:

1. Hospital grade receptacles shall be installed in corridors.
2. Dedicated circuit and convenience duplex receptacles shall be rated 20 amperes, 125 volt AC:

    a. Eaton TRBR20 -20 AMP Tamper resistant duplex
    b. Eaton TWRBR20-20 AMP Tamper resistant duplex & weather resistant

3. GFCI receptacles shall be rated 20 amperes, 125 volt with integral ground fault current interrupter:

    a. Eaton TRSGF20W-SPL -SPL- 20 AMP GFCI indoor
    b. Eaton TWRSGF20W-SPL 20 AMP GFCI outdoor

4. Receptacles within 6’-0” of sink or wet area shall be GFI type.
5. All receptacles in restrooms, outdoors, and within 6’ of a sink shall be GFI type.
6. Circuit breakers serving vending machines, and EWCs shall be GFI (do not install GFI device at EWCs and vending machines).
7. Specific-use receptacles shall have volts, amps, poles and NEMA configuration as noted on drawings.
8. Heavy-duty lock-blade receptacles shall be NEMA WD5 heavy-duty specification grade.
9. Provide combination receptacle/USB outlets as shown and detailed.
10. Weatherproof receptacles as specified shall be mounted in a cast steel box with gasketed, weatherproof device plate as specified. Provide cast metal in-use cover where exposed to rain.

2.4 WALL PLATES

A. Acceptable Manufacturers:

1. Eaton (Owner standard and preferred)
2. Other manufacturers equal in design and function will be considered upon Owne/A/E approval following substitution procedure in 26 0000 and Division 01 for substitution requirement.

    a. Arrow-Hart
    b. Hubbell
    c. General Electric
    d. Leviton

B. Material:

1. All wall plates shall be white high impact nylon, 0.1-inch thick. Plastic is not acceptable.
2. Where switches or outlets are shown adjacent to each other, they shall be ganged with partitions between different type services and covered by a single custom wall plate.
3. Exposed Boxes:

    a. Dry interior spaces: Use cast metal plates with cast metal box. Use heavy cadmium-plated sheet steel plates with steel boxes and copper-free aluminum with aluminum boxes. All screws shall be stainless steel. Edges of plates must be flush with edges of boxes.
    b. Other locations: Use weatherproof devices plates. Provide cast metal plates with gasketed spring door

4. Jumbo plates are not permitted.
5. Weatherproof cover plate shall be gasketed cast aluminum or feraloy (by Crouse-Hinds) with hinged gasketed device covers (cast metal in-use cover where exposed to rain).

2.5 CUSTOM ENGRAVED COVER PLATES

A. In all areas, provide custom engraved cover plate in accordance with Section 26 0553, Electrical Identification, on all new and existing receptacles, switches, and low voltage lighting control stations indicating panelboard and circuit number with 3/16 inch black letters/numbers.

PART 3 - EXECUTION

3.1 INSPECTION

A. Installer must examine the areas and conditions under which wiring devices are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Inspect devices for physical damage. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 DEVICE COORDINATION

A. Where items of equipment are provided under other sections of this specification or by the Owner, provide a compatible receptacle and/or device plate for the cap or plug, and cord of the equipment.

3.3 INSTALLATION

A. General:

1. Install wiring devices as indicated, in accordance with the applicable requirements of the latest release of NEC, NEMA, and ANSI.
2. The approximate location of switches, power outlets, etc., is indicated on the drawings. These drawings, however, may not give complete and accurate information in regard to locations of such items. Determine exact locations by reference to the general building drawings and by actual measurements during construction of the building before rough-in, subject to the approval of the Constructor Inspector.

B. Wall Switches and Lighting Control Stations:

1. Location:

a. Install wall switches and lighting control stations in suitable outlet box centered at the height of 48-inches above finished floor, OFF position down.
b. Where wainscot occurs at the 48" level, install device in the wall below the wainscot and as near the 48" level as possible to provide the most pleasing appearance, but in no case partially in the wainscot and partially in the wall.
c. Where shown near doors, install devices not less than 2" and not more than 12" from door trim.
d. Verify all door swings before rough-in and locate devices on strike side of door as finally installed.

2. Position:

   a. Wall switches: Install wall switches in a uniform position so the same direction of operation will open and close the circuits throughout the project, generally up or to the left for the ON position.

C. Receptacles:

1. Location:

   a. Install convenience outlets in suitable steel outlet boxes centered at the height of 18 inches above the finished floor, 6 inches above countertop or at the backsplash level, or as indicated on the drawings. Coordinate with equipment and architectural drawings.
   b. Install receptacles generally where indicated on drawings. The Owner's representative reserves the right to make any reasonable changes in receptacle locations without change in the contract sum.
   c. Install specific-use receptacles at heights shown on Drawings.

2. Position:

   a. Install receptacles vertically with ground pole on top. Install receptacles horizontally, where field condition does not allow vertical installation, with ground pole on left.

3. Feed through to non-GFCI receptacles is not permitted.

D. Plates:

1. Where cover plates do not completely conceal the rough openings for the devices, it shall be the responsibility of the Contractor to patch, paint, etc. around the opening to the satisfaction of the Owner's representative.
2. All devices and cover plates shall be plumb and parallel to adjacent surfaces or trim. Devices must be flush with the finished trim cover plates and plates must be tight to surfaces over which they are installed.
3. Where switches controlling devices that are out of sight, or where three or more switches are gang mounted, plates shall be labeled to identify items being controlled, or areas being lighted. Labeling shall be 3/16-inch Condensed Gothic and shall be filled with black enamel.

END OF SECTION 26 2726

SECTION 26 2813 - FUSES, 600 VOLT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Dual-element, current limiting Class R fuses for loads up to 600 volts, 0-600 Amps.

B. Time delay, current limiting Class L fuses for loads up to 600 volts, 601-6000 Amps.

1.2 REFERENCES

A. UL 248-12 - Standard For Safety For Low-Voltage Fuses-Part 12: Class R Fuses

B. UL 248-10 - Standard For Safety For Low-Voltage Fuses-Part 10: Class L Fuses

C. Where application of local codes, trade association standard or publications appears to be in conflict with the requirements of this Section, the Architect/Engineer shall be asked for an interpretation.

1.3 SUBMITTALS

A. Provide submittals in accordance with and in addition to Section 26 0000, Basic Electrical Requirements, and Division 01 for submittal requirement.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Store fuses in a clean and dry space and protected from weather.

PART 2 - PRODUCTS

2.1 MATERIAL AND EQUIPMENT

A. Furnish fuses manufactured by Buss, or equal, in accordance with the following:

1. Motors, 0 to 600 Amp:

a. 250 volt - Buss LPN-RK, UL Class RK1.

B. Size fuses serving motor loads as specifically recommended by motor or equipment manufacturer or in the range of 150% to 175% of motor nameplate rating per NEC in accordance to the type of motor.

C. Interrupting Rating: 300,000 RMS Amps.

D. Maintenance Stock, Fuses:

1. Furnish the following:

a. Three spare fuses of each size and type for a spare set.
b. Provide spare fuse cabinet and locate in main electrical room.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fuses where indicated, in accordance with the manufacturer's written instructions, the applicable requirements of NEC, national and local codes, regulations, and requirements.

B. Provide quantity of spare fuses and fuse cabinet per the requirement of this Section at the location per drawing or the direction of Owner’s Representative, in addition to replace blown or defective fuses during installation, startup, system commissioning and acceptance.

END OF SECTION 26 2813

SECTION 26 2816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers (MCCBs).
4. Enclosures.

1.2 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.3 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. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. 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.

1.4 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.

1.5 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Fuse Pullers: Two for each size and type.

PART 2 - PRODUCTS

2.1 FUSIBLE AND NON-FUSIBLE SWITCHES

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

1. Square D; a brand of Schneider Electric.
2. Siemens
3. Eaton
4. GE is not an approved manufacturer.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Mechanical type, suitable for number, size, and conductor material.
7. Service-Rated Switches: Labeled for use as service equipment.
8. Accessory Control Power Voltage: As required.

2.2 MOLDED-CASE CIRCUIT BREAKERS

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

1. Square D; a brand of Schneider Electric.
2. Siemens
3. Eaton

4. GE is not an approved manufacturer.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: For frame sizes 250 amp and below, inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits and adjustable magnetic trip setting.

D. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. 400 amp frame and above.
2. Instantaneous trip.
3. Long- and short-time pickup levels.
4. Long- and short-time time adjustments.

E. Current-Limiting Circuit Breakers: Frame sizes 600 amp and below.

F. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
4. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

2.3 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.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
6. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7 or Type 9.

PART 3 - EXECUTION

3.1 INSTALLATION

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

3.2 FIELD QUALITY CONTROL

A. 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.

B. 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.

C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

D. 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.

3.3 ADJUSTING

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

B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study". Provide mission critical breakers or breakers with additional trip features as required for code required coordination.

END OF SECTION 26 2816

SECTION 26 5100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Interior lighting fixtures and accessories

B. Exit lights

C. LEDs

D. Drivers

E. Emergency lighting relays

1.2 REFERENCES

A. NEPA 101 - Code for Safety to Life from Fire in Buildings and Structures

B. NEMA WD1 - General-Purpose Wiring Devices

C. UL 844 - Electric Lighting Fixtures for Use in hazardous (classified) Locations

D. UL 924 - Emergency Lighting and Power Equipment

E. IESNA - Lighting Handbook

F. NEMA WD 1 - General Color Requirements for Wiring devices

G. NFPA 70 - National Electrical Code

H. IECC 2015 - International Energy Conservation Code

1.3 DESIGN CRITERIA

A. Lighting level design shall be per IESNA (Illuminating Engineering Society of North America) recommendation.

1.4 SUBMITTALS

A. Provide submittals in accordance with and in addition to Section 26 0000, Basic Electrical Requirements, and Division 1 for submittal requirement.

B. Submit manufacturer's data on interior lighting fixtures in booklet form, with separate sheet for each fixture, assembled by luminaire "type" in alphabetical order, with the proposed fixture and accessories clearly labeled.

C. Submit dimensioned drawings and performance data including complete photometric test data for each luminaire, candlepower distribution curves in two or more planes, candlepower chart zero to 90 degrees, lumen output zonal summary chart, average and maximum brightness data, and coefficients of utilization for zonal cavity calculations, spacing to mounting height ratio,

efficiency and visual comfort probability. Also provide luminaire weights, mounting data, and accessory information for each luminaire type.

D. Submit point-by-point calculations for all interior spaces (two separate calculations).

1. Normal + emergency
2. Emergency

E. LEDs: Catalog cuts showing voltages, colors, approximate hours life, approximate initial lumens, and lumen maintenance curve.

F. Drivers: Catalog cuts showing type, wiring diagram, nominal watts, input voltage, starting current, input watts, sound rating, power factor and low temperature characteristics.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver lighting fixtures individually wrapped in factory-fabricated fiberboard type containers.

B. Handle lighting fixtures carefully to prevent breakage, denting and scoring the fixture finish. Do not install damaged lighting fixtures.

C. Store lighting fixtures in a clean, dry space and protected from the weather.

PART 2 - PRODUCTS

2.1 GENERAL

A. Lighting fixtures and accessories shall comply with the design and function requirements of the project. Design characteristics shall be as noted in manufacturer's submittal data.

B. Provide lighting fixtures of the size, type and rating as scheduled, complete with, but not limited to LEDs, reflectors, drivers, and wiring.

2.2 INTERIOR LIGHTING FIXTURES

A. Lenses shall be UV stabilized, injection-molded, clear, 0.150-inch minimum thickness virgin acrylic. Provide a minimum of 8 hold-down lens retaining clips for troffers utilizing framed diffuser lenses.

B. Lighting fixture door frames shall be flush steel hinged and equipped with rotary-action cam latches.

C. Lighting fixture housing shall be minimum 22-gauge, cold-rolled steel with pre-punched knockouts and access plate for electrical connections. End plates shall be minimum 20-gauge with pre-punched hanger holes. Driver mounts shall be separated for heat dissipation.

D. Reflector Finishes

1. Painted Finishes: Provide electro-statically applied dry polyester white powder coat finish with minimum reflectance of 88 percent on all light reflecting surfaces.

2. Specular/Semispecular Finishes: Provide Alzak-type anodized finish on aluminum louvers and reflectors as specified in Luminaire Schedule as shown on the drawings. Minimum reflectivity shall be:

   a. Specular: 80 percent
   b. Semi-specular: 75 percent

E. UL Listing

1. All Luminaries and components shall be UL tested, listed, and labeled.
2. Luminaries installed in damp or wet locations shall be UL listed and labeled as suitable for damp or wet locations.
3. Recessed luminaries installed in fire rated ceilings and using a fire rated protective cover shall be thermally protected for this application and shall be approved for the installation in a fire-rated ceiling.

2.3 LEDS

A. All LED luminaires shall be UL Listed and be furnished complete with LEDs and Power supplies at locations indicated on the drawings. Each fixture shall bear the UL Label, and shall comply with Code Requirements.

B. Luminaires shall meet the US Department of Energy's Energy Star performance criteria.

C. LED luminaires shall be designed with heat sinking adequate such that the junction temperature of the LEDs in maintained to meet the rated life as published by the LED manufacturer. Luminaire manufacturer shall provide validation documentation. Heat sinking shall not become compromised with time, lack of maintenance, and/or vibration resistance so that the heat-sink does not become detached from the LED PCB.

D. The LED luminaires shall have a complete 5 year warranty from date of installation

E. The LED luminaires shall be UL, or ETL listed and be furnished complete with LEDs and power supplies.

F. LED power supplies shall operate LEDs within the current limit specification of the manufacturer

G. Shall operate from 60Hz or 50Hz input source and have input power factor above 90% and a minimum efficiency of 70-% at full rated load of the driver.

H. Shall have short circuit and overload protection.

I. Shall have a minimum starting temperature of 0°F and a maximum case temperature rating of at least 70°C.

J. Power supply output shall be regulated to +/-5% across published load range.

K. Shall have a Class A sound rating.

L. Shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47CFR part 15, non-consumer (Class A) for EMI/RFI.

M. Shall have a 5 year warranty from date of manufacturer against defects in material or workmanship, including a replacement, for operation at or below the maximum case temperature specification.

N. Manufacturer shall have a 15 year history of producing power supplies for the North American market.

O. Dimmable power supplies shall be controlled by a (DC 0-10V Device/AC forward-phase control device/AC reverse phase control device) and shall be capable of operating, flicker-free, from 100-1% dimming range.

1. Dimmable power supplies shall allow the light output to be maintained at the lowest control setting (prior to off) without dropping out.
2. Shall be compatible with lighting control systems procured on the project.

P. All LEDs shall have a color temperature as noted on drawings with CRI ≥80. Confirm color temperature at time of preparing submittals.

Q. L70 rated life shall be a minimum of 50,000 hours.

R. All LED modules, unless noted otherwise, shall be provided by the light fixture manufacturer and integral to the luminaire.

S. LED modules/arrays shall be replaceable in the field. If luminaires are still under warranty, the Owner shall be compensated for the labor to do replacement work or the manufacturer shall send a factory representative to the site to do the work.

T. Replacement modules should have the ability to be “tuned” to match the output of remaining adjacent luminaires in the event that some time has passed and there has been light loss.

PART 3 - EXECUTION

3.1 INSPECTION

A. Prior to order of lighting fixture, check the building electrical system requirements, architectural finishes, and the type of ceilings that lighting fixture will be installed. Any discrepancies of compatibility pertaining trim, frames, color, mounting, driver, voltage and etc. shall be brought to the attention of A/E by written notice. Do not proceed with procurement until discrepancies are resolved in a satisfactory manner.

B. Installer shall examine the areas and conditions that light fixtures are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF LIGHTING FIXTURES

A. Install light fixtures in accordance with the manufacturer's written instructions, the applicable requirements of NEC, and national and local codes, standards, and regulations.

B. Install luminaries at locations as shown on the Drawings; install aligned, aimed, and leveled. Install fixtures in accordance with manufacturer's installation instructions complete with mounting accessories, trim and support materials. Fasten fixtures securely to structural support members of the building; solid pendant fixtures shall be plumb.

C. Coordinate with other crafts to avoid conflicts between luminaires, supports, fittings and mechanical equipment.

D. Surface Mounted Fixtures:

1. Fixtures shall be supported from structure at four points near each corner of fixtures.

E. Recessed Fixtures:

1. Handle specular/semi-specular louvers and down light cones using only new clean white cotton or silk gloves. Do not touch louvers or cones with bare hands. Leave luminaries clean and free of any visible dust, debris, or fingerprints with all LEDs operational at time of acceptance of work.
2. All recessed fixtures shall be supported from building structure above ceiling with galvanized steel wire at not less than 4 points near corners of fixture. Size of wire shall be capable of supporting weight of fixtures.
3. Recessed luminaries trims shall fit snugly to the mounting surface and shall not exhibit light leaks or gaps. Provide feed-through junction boxes or provide separate junction boxes. All components shall be accessible through the ceiling opening.
4. Connect recessed luminaries to junction box with flexible steel conduit and fixture wire.

F. Lighting Fixtures Adjustment

1. Adjust to illuminate intended areas as directed.

G. Immediately before final observation, clean all fixtures, inside and out, including plastics and glassware, and adjust all trim to properly fit adjacent surface, replace broken or damaged parts, and test all fixtures for electrical as well as mechanical operation.

H. Protect installed fixtures from damage during the remainder of the construction period.

I. Upon completion of installation of interior lighting fixtures, and after circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

END OF SECTION 26 5100

SECTION 27 0500 -COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Uniform General Conditions, Supplementary General Conditions and Division 1 General Requirements apply to this Section.

B. Section includes: Description of project, definitions, references, contractor qualifications, supervision, equipment and materials, minimum requirements, workmanship, warranty, coordination drawings, storage and protection of materials, cutting and patching, concealment, rough-in, and submittals.

C. Each section following, including this is an integrated part of a whole. No section shall be issued alone. Parts 1 and 2 of each section may contain descriptions of general information and approved materials that are typically used industry-wide, but are not specifically part of this project. Part 3 - Execution of each section together with the drawings identifies the installation procedures for components that are included in this project. A brief synopsis of the work included in this project also follows below in Section 1.3.

D. The work covered by the communications specifications shall include the furnishing of all materials, labor, transportation, tools, permits, fees, utilities, and incidentals necessary for the complete installation of all communications work required in the contract documents and specified herein. The intent of the contract documents is to provide an installation complete in every respect. In the event that additional details or special construction may be required for the work indicated or specified in this section or work specified in other sections, it shall be the responsibility of the Contractor to provide all material and labor in order to make the installation complete and operative.

E. All phases of work shall be sequenced under Division 1 and the Contractor shall be responsible for the coordination and proper relation of his work to the building structure and to the work of other trades. Prior to the start of installation, contractor shall provide a detailed set of plans showing the coordination of pathways and termination equipment with Mechanical, Plumbing and Electrical drawings. Voice and Data Communications systems shall be independent of any other systems.

1.2 RELATED SECTIONS

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

B. Related Division 27 Sections include:
1. 27 05 00 Common Work Results
2. 27 05 28 Pathways for Communications Systems
3. 27 05 53 Identification for Communications Systems
4. 27 15 00 Communications Horizontal Cabling
5. 27 16 00 Patch Cords, Station Cords, Cross-Connect Wire
6. 27 40 00 Audio Visual System

1.3 REFERENCES

A. Codes and Standards (Latest issue and addenda)
1. ADA Standards for Accessible Design 28 CFR Part 36
2. U.S. Department of Labor Occupational Safety Health Administration (OSHA)
3. UNTHSC Telecommunications and Infrastructure Requirements
4. BICSI TDM 11th Edition
5. National Electric Code (NEC), Latest Issue
6. ANSI/TIA568-C.1 - Commercial Building Telecommunications Cabling Standard
7. ANSI/TIA568-C.2 - Commercial Building Telecommunications Cabling Standard
8. ANSI/TIA568-C.3 - Optical Fiber Cabling Components Standard
9. ANSI/TIA569-C - Commercial Building Standard for Telecommunications Pathways and Spaces
10. ANSI/TIA 606-B - Administration Standard for Commercial Telecommunications Infrastructures, June 21, 2002
11. ANSI J-STD-607-A, Commercial Building. Grounding/Bounding Requirements- Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications, 2002
12. ANSI/TIA758-B - Customer-owned Outside Plant Telecommunications Infrastructure Standard, May 2005
13. International Standards Organization/International Electrotechnical Commission (ISO/IEC) IS 11801, 2000
14. Underwriters Laboratories (UL) Cable Certification and Follow Up Program
15. National Electrical Manufacturers Association (NEMA)
16. American Society for Testing Materials (ASTM)
17. American National Standards Institute (ANSI), ANSI T1.404 (DS3) and CATV Applications
18. Institute of Electrical And Electronics Engineers (IEEE), IEEE 802.4 Broadband Applications and 802.7 Broadband Specifications Standard
19. Federal Communications Commission (FCC), FCC Part 15 and FCC Part 76
20. National Cable Television Association (NCTA), NCTA-02.

B. Acronyms and Abbreviations
1. ADA Americans with Disabilities Act
2. AKA also known as
3. ANSI American National Standards Institute
4. AP access provider
5. ASTM American Society for Testing and Materials
6. AWG American Wire Gauge
7. BICSI Building Industry Consulting Services International
8. CATV community antenna television
9. CO-OSP customer owned outside plant
10. EF entrance facility
11. EIA Electronic Industries Alliance
12. EMI electromagnetic interference
13. FCC Federal Communications Commission
14. HVAC heating, ventilation, and air conditioning
15. IEEE The Institute of Electrical and Electronics Engineers
16. ITS Information Technology System
17. ISO International Organization for Standardization
18. LAN local area network
19. Mb/s megabits per second
20. MC main cross-connect AKA Main Distribution Frame (MDF)
21. MDF main distribution frame AKA main cross-connect (MC)

22.	NEMA	National Electrical Manufacturers Association
23.	NESC	National Electrical Safety Code
24.	NFPA	National Fire Protection Association
25.	OFOI	Owner Furnished Owner Installed
26.	RCDD	Registered Communications Distribution Designer
27.	SCS	Structured Cabling System
28.	TBB	telecommunications bonding backbone
29.	TR	telecommunications room AKA Intermediate Distribution Frame (IDF)
30.	TGB	telecommunications grounding busbar
31.	TMGB	telecommunications main grounding busbar
32.	TIA	Telecommunications Industry Association
33.	UL	Underwriters Laboratories
34.	UTP	unshielded twisted-pair
35.	WA	work area
36.	WAP	wireless access points
37.	X	cross-connect

1.4 PROPOSAL SUBMITTALS

A. See Section 01-30-00 - Administrative Requirements, for submittal procedures.

B. Follow Division 1 and this section. All submittals shall be reviewed and stamped by the Contractor's project RCDD.

C. Submit a resume and copy of Building Industry Consulting Services International (BICSI) Registered Communication Distribution Designer (RCDD) certificate for Contractor's project RCDD.

D. A list of technical product education (training) completed by the Contractor's project personnel.

E. All members of the installation team must be certified by the Manufacturer as having completed the necessary training to complete their part of the installation. Submit resumes of the entire team and completed training courses and copies of BICSI Installer certificates TE300, training course IN100 and IN200.

F. Cable tester manufacturer or a third party certification for copper and fiber cable test technicians.

G. Price Quotation Information -
1. Itemized Unit Pricing for Labor and Material;
2. Itemized Add/Deduct Unit Pricing for Labor and Material for Pre- Cutover (200' average length) ONE (1) CAT 6 Drop;
3. Itemized Add/Deduct Unit Pricing for Labor and Material for Post-Cutover (200' average length) ONE (1) CAT 6 Drop;
4. Itemized Add/Deduct Unit Pricing for Labor and Material for Pre- Cutover (200' average length) TWO (2) CAT 6 Drop;
5. Itemized Add/Deduct Unit Pricing for Labor and Material for Post-Cutover (200' average length) TWO (2) CAT 6 Drop;
6. Itemized Add/Deduct Unit Pricing for Labor and Material for Pre- Cutover (200' average length) FOUR (4) CAT 6 Drop;
7. Itemized Add/Deduct Unit Pricing for Labor and Material for Post-Cutover (200' average length) FOUR (4) CAT 6 Drop;

E. The Contractor shall review paragraph 1.3 of this Section; Codes and Standards - Latest issue and addendums and state understanding and compliance or exception.

F. Product Data: For each type of product indicated below. Product data to include, but not limited to, materials, finishes, approvals, load ratings, and dimensional information.
   1. Submittals shall include the manufacturers cut sheets for the following:
      a. Equipment enclosures and/or racks;
      b. Fiber optic and balanced twisted pair cable;
      c. Patch cords and cross connect media;
      d. Connectors and termination hardware;
      e. Protection hardware;
      f. Fire stopping materials;
      g. Test equipment to be used for fiber and balanced twisted pair channels;
      h. Cable tray and cable support hardware.

G. Product Data Manufactures literature sheets for all materials and equipment, including a copy of the proposed warranty, recommended preventative maintenance and spare part inventory recommendations. Literature containing more than one device shall be clearly marked to delineate item(s) included in the work. Clearly indicate color or special finishes.

H. Manufacturer and Contractor statement of RoHS: Restriction of Certain Hazardous Substances Compliance.

I. Design and Installation Certificates: Signed by local cable manufacturer's representative certifying that design is acceptable with cable manufacturer's Design Engineer(s) and Contractor is authorized by manufacturer to install registered (warranty) cabling system.

1.5 DESCRIPTION OF PROJECT

A. Main Distribution Frame (MDF) – Located on Level 1 of the Facility.

B. Pathways - Conduits will be installed by the electrical contractor. One (1) 1” EMT conduits will be placed from each communications device outlet into the ceiling spaces and will terminate within 6” above the nearest cable tray where practical. The conduit will be attached to the underside of the roof structure above the ceiling and the cable tray and will include a bushing-type coupler at the connection point. All conduit stub-ups will be terminated above into accessible ceiling spaces. Cabling, not in conduit or cable tray placed above the ceiling in the Health Professionals Building 1 will be supported on 48” maximum centers using J-hooks (see Section 27 05 28).

C. Horizontal cabling – Typical Data Outlet will consist of two (2) Data Cables. All horizontal cabling shall be plenum-rated.

D. Riser/Backbone/Tie Cabling - Existing.

E. Relay Racks – Existing.

1.6 SUBMITTALS FOR PROJECT RECORD

A. Follow Division 1 and this Section.
   1. Drawings: As-built documentation must be submitted five (5) business days prior to obtaining approval for cutover to any portion of the new cable plant system. Furnish

for review and comments, 4 complete sets of E size (30 by 42) and 4 complete sets of C size as-built drawings along with 4 CDs containing all electronic AutoCAD 2000 or newer (DWG) files.

2. Final approved Shop Drawings: Include plan and elevation of TRs, cable pathway details, and cable locations and cable ID .
3. 4 sets of cable inventory data must be submitted for all copper and fiber, termination hardware (prior to cutover to new cable plant if applicable.) Submit data in binders and electronically on CDs in Microsoft Excel format, listing products furnished, including:
   a. Manufacturer's name and part numbers.
   b. Cable numbers utilizing the Owner's cable numbering standard.
   c. Location and riser assignments.
4. Manufacturer Certificates: Within 10 days of completion of the project, Contractor shall deliver letter signed by local Structured Cabling Components representatives and Contractor's RCDD stating that installed cabling system complies with all requirements specified in manufacturer's installation guidelines and that there were no accidents, improper installation, mishandling, misuse, damage while in transit, unauthorized alteration, unauthorized repair, failure to follow instructions, or misuse with the structured cabling system that could adversely impact warranty.
5. Test Reports: 4 sets of hard copies with 4 copies on CD in compliance with related Test Result Documentation.
6. Submitted test results and other submittals that are non-compliant will be reviewed and returned to the Contractor with comments.
7. Re-submitted test results and other submittals that are non-compliant will be reviewed and returned to the Contractor with comments.
8. Manufacturer's warranty to the Owner. This shall include, but is not limited to: Owner's name and project name and address. (Within three weeks of substantial completion).
9. Within 10 days of completion of the project, Contractor shall deliver letter signed by local SCS Manufacturers representative and Contractor's RCDD stating that installed cabling system complies with all requirements specified in installation guidelines and that there were no accidents, improper installation, mishandling, misuse, damage while in transit, unauthorized alteration, unauthorized repair, failure to follow instructions, or misuse with the structured cabling system that could adversely impact warranty.
10. Within 30 days of completion of a project, the communications contractor and/or the manufacturer's local representative will provide owner The Structured Cabling Performance Warranty signed by the manufacturer. The warranty shall list the owner and name of the Facility including location as the holder of the warranty.

1.7 DEFINITIONS

A. MER - Main Equipment Room: The main room, which typically contains the PBX, MDF and main Data Communications equipment.

B. TR - Telecommunications Room: Any additional room, which contains switches, hubs, patch panels and cross-connects away from a central location to serve areas out of distance from the MER.

C. TO - Telecommunications Outlet: Point of connectivity for voice, data or video on the wall or in the floor. Refer to Telecommunications Drawings and Symbol sheet(s) for quantities and types of media at each outlet.

D. MDF - Main Distribution Frame: A termination frame for unshielded twisted pair cable, usually providing a connection field for PBX telephone ports and feeder/riser cables to TR's. The MDF is normally located in the MER.

E. IDF - Intermediate Distribution Frame: A termination frame for unshielded twisted pair cabling providing a connection field for horizontal wiring from the workstation and feeder/riser cables extended from the MER.

F. PBX - Private Branch Exchange: Privately owned voice communications switch.

G. STUBBED OUTLET - A flush device box, 4-11/16” x 4-11/16” x 2-1/8” deep, with a single-gang extension ring installed behind sheet-rock walls or within concrete block walls. There shall be two (2) conduits a minimum of 1” installed to each device box (See drawing T3.03.05). The device box is centered at 18” a.f.f., and the conduit(s) rise to a point above the suspended ceiling or continues to an accessible ceiling for cable installation. The electrical contractor provides this work.

H. PROJECT MANAGER - An individual who manages the logistic requirements of projects such as personnel, material and schedules. This individual may be responsible for multiple projects.

I. SUPERVISOR - An individual who is responsible for a specific project and is on site 95 of the workday. This individual manages personnel assigned to the project, assures that materials are ordered, received and installed in a timely manner and, assures overall quality on the project. This individual must be a Registered Communications Distribution Designer in good standing with BICSI. Successful completion of the BICSI IST100 training course in addition to TE300 is required.

J. LEAD TECHNICIAN - An individual who is in charge of up to a maximum of 4 technicians. This individual is responsible for timely project completion and quality assurance. Successful completion of the BICSI TE300 training course and all its prerequisites is required.

K. TECHNICIAN, LEVEL II (Installer, Level 2) - An individual who possesses the training and skills necessary to qualify for and has successfully passed the requirements of the BICSI IN200 training course. This individual is responsible for his or her own work plus the work of not more than one (1) level 1 installer.

L. TECHNICIAN, LEVEL I (Installer, Level 1) - An individual who possesses the training and skills necessary to qualify for and has successfully passed the requirements of the BICSI IN100 training course.

1.8 CONTRACTOR QUALIFICATIONS

A. General Qualifications
   1. Untrained, undocumented, or otherwise unqualified personnel are not allowed to perform any portion of the communications infrastructure installation.
   2. All personnel must be permanent employees of the telecommunications contractor, or approved sub-contractors.

B. Voice/Data
   1. Contractor shall have been in telecommunications business continually for at least the past 5 years.

2. A minimum of five (5) representative educational facilities projects must be submitted as references to include the school's name, address, architect or Engineer, cost of the project and the contact person at the school district to include phone number.
3. Telecommunications contractor shall own and possess at least one copy of ANSI/TIA Telecommunications Building Wiring Standards, latest issue. Available from Global Engineering Documents, telephone (800) 624-3974, internet address www.global.ihs.com.
4. Telecommunications contractor shall own and possess at least one copy of BICSI Telecommunications Distribution Methods Manual, latest issue, available from BICSI (Building Industry Consulting Services International) telephone (800) 242-7405, internet address www.bicsi.org.
5. Telecommunications contractor shall possess current certifications from CommScope/Systimax
6. All project managers, supervisors, lead technicians, and technicians for the telecommunications contractor shall each possess individual certification(s) for the installation and testing of CommScope/Systimax voice/data and fiber optic cabling products.
7. Supervisor(s) shall possess BICSI certificates of completion for training courses IN101 and TE350.
8. Strongly Recommended: Lead Technicians shall possess BICSI certificates of completion for the training course TE350.
9. Strongly Recommended: Technicians shall possess BICSI certificates of completion for the training courses IN225/IN250 or IN101 for Installer Level 2 or Installer Level 1.

C. Audio/Video
1. Five (5) years' experience in the installation of broadband distribution systems, including splicing, termination, and testing of copper coaxial cable.
2. Five (5) installed systems, comparable to the Owner's installation, where broadband distribution systems are installed and the systems have been in continuous satisfactory operation for at least one (1) year. The Contractor shall submit as proof, supporting documents and the names, addresses and telephone numbers of the operating personnel who can be contacted regarding the installed systems.
3. A minimum of five (5) representative educational facilities projects must be submitted as references to include the school's name, address, architect or Engineer, cost of the project and the contact person at the school district to include phone number.
4. Installers must have been trained and experienced in the specific splicing, terminating and testing equipment to be used in the installation. Contractor shall possess any and all relevant certifications required by the manufacturer prior to installation of the manufacturer's specific products. Contractor shall provide a list of their technical support staff together with their work experience, training history and manufacturer's certification.
5. Qualified Contractors shall submit proof of all certifications and experience detail with bid response.

1.9 SUPERVISION

A. All work performed under Division 27 shall be continuously supervised at the project site by a Registered Communications Distribution Designer (RCDD) in good standing with Building Industry Consulting Service International (BICSI).

B. The Project Manager shall be the main point of contact for the project between the Owner and the Owner's assignee.

C. The contractor's Project Manager shall attend a pre-installation meeting with the Owner and design team prior to working on the project.

D. The site supervisor shall be assigned to the project site for 95 of the work week and shall be responsible for the management of Lead Technicians.

E. The Lead Technician shall be responsible for the direct supervision of not more than four (4) total Technicians, either Level II or Level 1.

F. A Technician, Level II shall be directly responsible for not more than one (1) Technician, Level 1.

1.10 EQUIPMENT AND MATERIALS MINIMUM REQUIREMENTS

A. All wiring, materials, and equipment must be listed and labeled by a nationally recognized testing laboratory.

B. Original Equipment Manufacturer (OEM) documentation must be provided to the Owner's Telecommunications Technical Representative, who certifies performance characteristics that meet TIA standards.

C. The Contractor shall structure and equip the cable and wire system to minimize vulnerability to single points of failure.

D. All parts shall be made of corrosion resistant materials, such as plastic, anodized aluminum, or brass.

E. All materials used in the installation shall be resistant to fungus growth and moisture deterioration.

F. An inert dielectric material shall separate dissimilar metals that are apt to corrode through electrolysis under the environmental operating conditions specified.

G. The Contractor shall ensure that the wire and cable allow detection and diagnosis of problems to achieve high reliability and availability.

H. The wiring, materials, and equipment furnished for this request shall be essentially the standard product of the Manufacturer.

I. Firestop all rated wall penetrations according to code requirements and industry standards.

1.11 WORKMANSHIP

A. All work shall be performed in a neat, workmanlike manner.

B. Cable trunks (bundles) shall be routed along or perpendicular to building lines.

C. Cable trunks shall be placed above installation-convenient pathways such as hallways.

1.12 WARRANTY

A. The Contractor and Manufacturers shall provide a ONE (1) YEAR guarantee for all work under the Telecommunications Trade. However, such guarantees shall be in addition to and not in lieu of all other liabilities, which the Manufacturer and Contractor may have by law or by other provisions of the Contract Documents. In any case, such guarantees and warranties shall commence when the Owner accepts the telecommunications system, as determined by the Engineer, and shall remain in effect for a period of ONE (1) YEAR thereafter.

B. All materials, items of equipment and workmanship furnished under each Section shall carry a ONE (1) YEAR warranty against all defects in material and workmanship. Any fault under any Contract, due to defective or improper material, equipment, workmanship or design which may develop shall be made good, forthwith, by and at the expense of the Contractor for the work under his Contract, including all other damage done to areas, materials and other systems resulting from this failure.

C. The Contractor shall guarantee that all elements of the system, which are to be provided under his Contract, are of sufficient capacity to meet the specified performance requirements as set forth herein or as indicated.

D. Upon receipt of notice from the Owner of failure of any part of any systems or equipment during the guarantee period, the Contractor for his respective work, as applicable, shall replace the affected part or parts.

E. An additional extended warranty is required for work on this project. The additions and/or extensions to the standard year guarantee previously described are to be provided in writing, by the Manufacturers. The warranty is to cover all parts and labor as specified below:
   1. a certified Systimax 25-year performance certification for:
      a. Category 6, horizontal and backbone copper cable and associated labor.
      b. Category 6, patch panels, blocks and associated labor.
      c. Category 6, data workstation outlets and associated labor.

F. Furnish, before the final payment is made, a written guarantee covering the above requirements.

G. Additional/extended warranty listed above is Non-negotiable, and cannot be amended through the submittal process.

1.13 COORDINATION DRAWINGS

A. It shall be the responsibility of the Contractor to consult the Architectural and Engineering Drawings and Details, thoroughly familiarizing himself with the type and quality of construction to be provided on this project.

B. The Telecommunications Drawings are diagrammatic in character and cannot show every connection in detail or every line or conduit in its exact location. These details are subject to the requirements of local ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate with all other trades in order to avoid interference between the various phases of work.

C. The approximate location of Telecommunications items is indicated on the Telecommunications Drawings. These drawings are not intended to give complete and exact

details in regard to location of outlets, apparatus, etc. Exact locations are to be determined by actual measurements at the job site and will in all cases be subject to the approval of the Architect. The Architect reserves the right to make any reasonable changes in the location indicated without additional cost.

1.14 STORAGE AND PROTECTION OF MATERIALS

A. Wiring, materials, and equipment shall be delivered and stored in a clean, dry space.

B. All materials shall be properly packaged in factory-fabricated containers and protected from damaging fumes, construction debris, and traffic until job completion.

C. Refer to Division 1 for additional information.

1.15 CUTTING AND PATCHING

A. Where it becomes necessary to cut through any wall, floor or ceiling to install any work under this Section of the Contract, or to repair any defects that may appear up to the expiration of the guarantee period, such cutting shall be done under the supervision of the Architect/Engineer by the Contractor. The Contractor shall not be permitted to cut or modify any structural members without the written permission of the Architect/Engineer.

B. Patching of all openings cut by the Contractor, or repairing of any damage to the work of other trades caused by cutting or by the failure of any part of the work installed under this Contract, shall be performed by the appropriate trade but shall be paid for by the Contractor.

C. Openings cut through concrete and masonry shall be made with masonry saws and/or core drills and at such locations acceptable to the Architect/Engineer. Impact-type equipment shall not be used except where specifically acceptable to the Architect/Engineer.

D. All openings shall be restored to “as-new” condition under the appropriate Specification Section for the materials involved, and shall match remaining surrounding materials and/or finishes.

E. Coring through slabs after concrete placement will require X-ray to verify rebar location prior to coring. Contractor shall bear all costs associated with coring, including but not limited to coring and X-ray inspection. Core drill shall not cut any rebar.

F. Refer to Division 1 for additional information.

1.16 CONCEALMENT

A. No telecommunications cable or cable tray may be installed where physical access is not attainable.

B. If cable and/or cable tray must pass through areas obstructed by sheet-rocked ceilings and/or fire-rated walls, or exceeds 20' over a solid sheet-rocked ceiling area, then access panels must be installed.

C. The Contractor shall determine whether access panels are required, by investigating the architectural drawings for this Contract. The Contractor shall also bear the cost of installation

of any access panels.

1.17 ROUGH-IN

A. “Rough-in” shall be defined as incomplete installation of cable or equipment.

B. Where cable is to be roughed-in, the following conditions shall be met:
   1. Cables shall be run within active cabling bundles and dressed-out as same.
   2. Where cables are routed into stub-outs, at least 18” of cable shall be left coiled within the device box. Device box shall have an appropriate blank cover plate installed.
   3. Where no stubbed-out pathways are provided, leave roughed-in cables coiled near the center of the growth area with enough slack to reach the floor plus anyplace in the area and a minimum of 15' for service loop.

Cables that are not to be terminated at patch panels in an MTR or TR shall be left coiled in the ceiling of the MTR or TR with enough slack to reach the floor plus across the MTR or TR to the opposite wall.

1.18 DOCUMENTATION

A. Documentation shall be provided in the form of as-built drawings, cable test records and O M Manuals.

B. Provide one set of 30”X42” Laminated Floor and Ceiling Data Plans showing outlet locations and labels. Mount on wall in TR. Coordinate final mounting location with UNTHSC Telecom.

B. Refer to Division 1 for Submittals Procedures

C. Refer to Division 1 for Shop Drawings, Product Data, and Samples

1.19 SUBMITTALS

A. Refer Division 1 requirements for submission of Shop Drawings, Product Data, Samples and Colors

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Substitutions: See Section 01-60-00 - Product Requirements.

B. Special Note: UNTHSC is a CommScope/Systimax specific location and has requested that the Systimax 25 year Warranty be extended to this installation. This requires that:
   1. The installer of the telecommunications infrastructure be a certified Systimax installer.
   2. The jack inserts, patch panels and accessories must be manufactured by Systimax.
   3. The Category 6A cable must be manufactured by Systimax.
   4. The project shall be registered for warranty and test data submitted for acceptance by Systimax.

C. Special Note: UNTHSC is a Systimax specific location for fiber optic infrastructure and has requested that the Systimax 25 year solutions warranty be extended to this installation. This requires that:
   1. The installer of the fiber infrastructure be a certified Systimax Installer.
   2. The connectors patch panels and accessories must be manufactured by a certified Systimax.
   3. The fiber optic cable must be manufactured by a certified Systimax.
   4. The project shall be registered for warranty and test data submitted for acceptance by a certified Systimax.

PART 3 EXECUTION

3.1 CABLE CONTRACTORS

A. Cable Contractor Qualifications
   1. The Cable Contractor shall have a workers' compensation experience modification rating (EMR) of less than 1.0.
   2. The full time on-site supervisor shall be certified by the Manufacturer of the products being installed.
   3. The Cable Contractor shall have installed similar systems in at least one similar project in the year prior to this bid and be regularly engaged in the business of installation of the types of systems specified in this document. The Cable Contractor shall provide the names and locations of project contacts and numbers, total square footage, total number of cables/drops, types of media, etc.
   4. The Cable Contractor shall have a minimum of one (1) full time employee on staff that is a BICSI RCDD with experience in similar projects to review and approve the design and construction plans and inspect work and report status on a weekly basis.
   5. The Cable Contractor's personnel shall have a complete working knowledge of low voltage cabling applications such as, but not limited to data, voice, video and audiovisual network systems.
   6. Untrained or otherwise unqualified personnel are not allowed to perform any portion of the communications infrastructure installation.
   7. The Cable Contractor's personnel must be permanent employees of the Cable Contractor, or approved sub-contractors.
   8. The Cable Contractor shall review paragraph 1.5 B Codes and Standards - Latest issue and addendums (of this Section) and state compliance or exception to any code or standard.
   9. The Cable Contractor shall have been in telecommunications cabling business continually for at least 4 years.
   10. Eighty per cent (80%) of Cable Contractors' personnel shall have a minimum of 3 years experience in the installation of the types of systems, equipment, and cables specified in this document.
   11. Fifty per cent (50%) of Cable Contractors' personnel shall be certified by specified manufacturer(s) for Telecommunication cabling installations and maintenance of listed product.

3.2 SUBMITTALS

A. Provide a copy of the supervising Registered Communications Distribution Designer's current certificate.

B. Provide a copy of the proposed manufacturer's extended warranty.

C. Provide copies of resumes for each technician, lead technician, supervisor and project

manager. Each resume shall be accompanied by each individual's training certificates.

D. Provide proof of ownership of the ANSI/TIA-568 standards, latest issue.

E. Provide proof of ownership of the Telecommunications Standards and Methods Manuals, eleventh edition.

F. Submit proposed layouts of Television Broadband Distribution System equipment and cable plant, including equipment rack layouts, system schematics and riser diagrams. All equipment, along with expected signal levels and equipment signal level values must be shown.

G. Submit records of Category 6A Cable Certification tests at time of substantial completion.

H. Submit records of fiber optic Power Meter and OTDR (Tier Two) Cable Certification tests at time of substantial completion.

3.3 RECORD DOCUMENTS

A. Maintain Project Record documents on a weekly basis.

B. Refer to Section 017800 Closeout Submittals for dispensation of all record documentation.

C. Refer to Section 27 05 53 Identification for Telecommunications Systems for details on Closeout Submittals required for warranty certification.

END OF SECTION

SECTION 27 0528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This Section specifies the requirements for the Pathways for Communications Systems installation for the University of North Texas Health Science Center.
B. Included in this section are the minimum composition requirements and installation methods for the following:
   1. EMT Conduits and Back boxes
   2. J-hook System
   3. Fire Rated Devices

1.2 SUMMARY

A. Communication Pathways are defined to include, but are not limited to cable tray, innerduct, conduit, pull boxes, sleeves, supports, accessories, associated hardware and fire stopping materials. Final design and specifications for conduits shall be made by the Electrical Engineer of Record.
B. The primary horizontal cable support system will be cable tray, installed as shown in the drawings. Wall penetrations shall transition to properly sized and fire stopped sleeves, then back to tray as indicated on the drawings.
C. Outlets having up to four cables require a double gang box with a single gang reducer connected to accessible ceiling with one (1) 1” conduit with pull string and insulating bushing. Cabling will transition from conduit stub-up to tray via cable hooks or similar.
D. Outlets having more than four cables require a double gang box with a single gang reducer connected to accessible ceiling via two (2) 1” conduits with pull string and insulating bushing. Cabling will transition from conduit stub-up to tray via cable hooks or similar.
E. Pathway in the vivarium area is to be conduit to cable tray. With conduits sealed per requirements listed in Division 26.
F. Conduit runs may not be longer than 100ft or have more than two 90-degree bends without the use of a properly sized junction box. Insulated throat compression fittings must be used for communications conduit runs, with termination points having plastic or grounding bushings installed.
G. Riser sleeve in ER/TR’s must be properly installed with bushings and fire stop.
H. Cables shall be neatly dressed along common paths with Velcro tie wraps with voice cables separated from data cables. Maximum number of cables per bundle shall not exceed manufacturer specifications.
I. Layout cable pathway runs in advance to determine space requirement along pathways, and to ensure non-interference from other trade installations.
J. Do not support communication pathway from or lay on ceiling suspension system or use electrical, plumbing, or other pipes for support. Communication pathway supports shall be permanently anchored to building structure or joist. Provide attachment hardware and anchors designed for the structure to which attached, and that are suitably sized to carry the weight of the pathway and cables to be supported. Confirm with architect and/or construction manager on installation procedures for cable support system prior to implementation.
K. Work furnished and installed by Electrical Contractor as specified in this Section and as shown in E and T drawings includes:
   1. Cable Tray in hallways.
   2. The conduits and back boxes for the work area telecommunications outlets.

3. The floor box and poke through hardware.
4. Fire stopping of conduit cable pathway.
5. Telecommunications Bonding Backbone.

L. Work furnished and installed by the Cable Contractor as specified in this section and as shown in E, T, TY, and TA drawings includes:
1. The overhead cable runway system (ladder rack) within the new MDF/IDF.
2. All J-hook pathway.
3. Bonding and grounding of overhead cable runway system (ladder rack), racks and cabinets within the MDF/IDFs.
4. Fire stopping of conduit sleeves.

PART 2 PRODUCTS

2.1 GENERAL

A. Where conduit, pull boxes, and other raceway sizes are not specifically shown on contract drawings, all communication pathways shall be sized in accordance with the requirements of BICSI and the NEC. No conduit shall be less than 1 .
B. Conduits must be designed and installed in the most direct route possible from the telecommunications Room to the work area.
C. All conduit ends shall have plastic bushings installed before the cable is pulled into the conduit.
D. Conduits will not be run next to hot water lines, steam pipes, or other utilities that may present a safety hazard or cause a degradation of system performance.
E. Conduits entering the Telecommunications Room should be designed and located allowing for the most flexibility in the routing and racking of cables.
F. Conduits or conduit sleeves entering through the floor of the Telecommunications Room shall terminate four (4) inches above the finished floor.
G. All metallic telecommunications conduits entering the Telecommunications Room, Equipment Room, or Entrance Facility shall be bonded together, and bonded to the Telecommunications Main Grounding Busbar with a 6 AWG ground cable.
H. All in-use and spare conduits entering the Telecommunications Room, Equipment Room, or Entrance Facility shall be sealed to prevent the intrusion of water, gasses, and rodents throughout the construction project. Within five days of releasing the conduit for the installation of cable, the conduit installation contractor shall prove all conduits to be clean and dry.
I. All conduits and cables that penetrate fire rated walls or floors must be fire stopped.
J. All OSP conduits and innerduct, used and spare, shall be plugged with watertight plugs at both ends to prevent the intrusion of water, gasses, and rodents throughout the construction project.
K. All OSP conduits shall have pull lines rated at a minimum of 90 kg (200 lb) pulling tension installed. The pull lines must be re-pulled each time an additional cable is installed.
L. Prior to releasing the conduit for the installation of cables, all OSP conduits must be cleaned with a brush pulled through the conduit at least two times in the same direction and swabbed with clean rags until the rag comes out of the conduit clean and dry.
M. All OSP conduits must be tested with a mandrel to prove compliance with the sweep radius requirements throughout the conduit run.
N. Within five days of releasing the conduit for the installation of cable, the conduit installation contractor shall prove all conduits to be clean and dry.

2.2 CONDUITS AND FITTINGS

A. For each wire way system indicated, provide a complete assembly of conduit, tubing or duct with fittings including, but not necessarily limited to, connectors, nipples, couplings, locknuts, bushings, expansion fittings, other components and accessories as needed to form a complete system of the same type indicated.
B. Minimum conduit size for Telecommunications Outlets shall be 1 (one) inch.

2.3 WALL AND CEILING OUTLET BOXES

A. Galvanized steel interior outlet wiring boxes of the type, shape and size, including depth of box, to suit each respective location and installation; constructed with stamped knockouts in back and sides, and with threaded holes with screws for securing box covers or wiring devices.
B. Outlet box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, compatible with outlet boxes, compatible with outlet boxes being used and meeting requirements of individual situations.
C. Provide double gang backbox with single gang trim ring for all in wall or in ceiling data outlets with four or fewer data outlets.

2.4 PULL AND JUNCTION BOXES

A. Boxes shall be galvanized sheet metal conforming to ANSI/NEMA OS 1 with screw-on cover and welded seams, stainless steel nuts, bolts, screws and washers.
B. Boxes larger than 12 inches in any dimension shall be panel board code gauze galvanized steel with hinged cover.
C. Boxes shall be sized in accordance with NEC.

2.5 J-HOOKS, SUPPORTS AND ACCESSORIES

A. Subject to compliance with these specifications, cable runway shall be as manufactured by Chatsworth Products, Inc., or equivalent. Cable runway (ladder rack) is required within the MDF and IDFs to provide a suitable pathway to route all cabling into and out of termination equipment, mounted in equipment racks or on backboards attached to walls, and pathway spaces beyond the MDF and IDF's.
B. Runway: Provide UL classified cable runway and components. Such products are to be UL classified as to its suitability as an equipment-grounding conductor. Cable runway and components are to have rounded edges and smooth surfaces in compliance with applicable standards, and with the following additional construction features:
    1. Dimension: The cross sectional area of the side rail shall be greater than 0.20 square inches. The height of the side rail must remain at 1-1/2 inches.
    2. Material and Finish: All cable runway and components shall be made of tubular steel and finished with Telco-gray paint or black over zinc plating.
    3. Construction: Cable runway is a prefabricated metal structure consisting of two longitudinal side rails connected by individual transverse members. Cable runway shall be constructed of 1-1/2" x 3/8" x .065" rectangular steel tubing. Cross members shall be a single continuous rectangular tube ½" x 1' x .065" with radiused corners. Cross members shall be welded to stringers at 9" intervals with ends finished to protect installers and cables.
    4. Cable runway width shall be 12 inches except as otherwise shown on the Telecommunications Drawings
    5. Cross members shall be spaced every 9 inches.

6. Straight sections shall be supplied in 9 foot 8-1/2 inch lengths.

C. UL Classified Runway Butt-Splice Kit: Consists of 4 splice plates, U-shaped. Overall, 5” by 5/8” by 11/16” thick. Provided with 7/16” by 3/8” cutout for insertion of trimmed head bolt. Bolt measures 3/8” diameter by 2-1/2” long provided with hex nut and lock washer.

D. UL Classified Runway Junction Splice Kit: L-shaped splice angles. Overall, 2” x 2” by 1-1/2”, 3/16” thick. Secured to cable runway by 3/8” diameter by 1-1/2” hex bolts, nuts and lock washers.

E. UL Classified 90 Degree Runway Splice Kit: Outside Clamp - Overall, 5-3/4” x ¾” by 5/8”, minimum 0.10 thick. Provided with 7/16” by 7/16” cutout for insertion of trimmed head bolt. Bolt measures 3/8” diameter by 3-1/4” long. Provided with hex nut and lock washer. Inside Edge Clamp - Overall, 2-9/16” x 15/16” x 5/8”, minimum 0.10 thick. Provided with 7/16” x 7/16” cutout for insertion of trimmed head bolt.

F. UL Classified 45 Degree Runway Splice Kit: Outside Clamp - Overall, 4-7/16” x 5/8” x ¾”, minimum 0.10” thick. Provided with 7/16” x 7/16” cutout for insertion of trimmed head bolt. Bolt measures 3/8” diameter by 2-11/16” long provided with hex nut and lock washer. Inside Edge Clamp - Overall, 2-9/16” x 15/16” x 5/8” minimum 0.10” thick. Provided with 7/16” x 7/16” cutout for insertion of trimmed head bolts.

G. UL Classified Swivel Splice Kit: All fittings shall have a minimum wall thickness of 0.10”. All kits provided with round head square neck bolts, lock washers and hex nuts.

H. Straight Swivel - Eight bracket ends overall, 3-7/16” x 3-1/4”. Provided with recessed area measuring 1-1/2” wide x 3/16” deep, which accepts side rail.

I. Perpendicular Swivel - Four bracket ends overall, 3-7/16” x 3-1/4”. Provided with recessed area measuring 1-1/2” wide x 3/16” deep, which accepts side rail. Bracket support 3-7/16” x 1”. Provided with 90 degree flange measuring 1” high x ¾” wide. Plate clamp measures 3-7/16” x 1”. Lip measures 1-1/2” x 3/8” high to inside of lip.

J. Vertical Swivel - Four bracket ends provided. Overall, 3-7/16” x 3-1/4”. Lip measures 1-1/2” x 3/16” high to inside of lip. Bracket clamp measures 3-7/16” x 1”. Plate clamp measures 3-7/16” x 1”. Lip measures 1-1/2” x 3/8” high to inside of lip.

K. Acceptable Components:
1. 12” Universal Runway - Chatsworth PN 10250-112 or equivalent
2. 12” Cable Runway E-Bend - Chatsworth PN 10822-112 or equivalent
3. 12” Cable Runway Outside Radius 90° Bend - Chatsworth PN 10723-112 or equivalent
4. 12” Cable Runway Inside Radius 90° Bend - Chatsworth PN 10724-112 or equivalent
5. 12” Cable Runway Radius Drop, Cross Member - Chatsworth PN 12100-112 or equivalent
6. U.L. Classified Butt Splice Kit - Chatsworth PN 16301-001 or equivalent
7. U.L. Classified Junction Splice Kit - Chatsworth PN 16302-001 or equivalent.
8. Rack to Runway Mounting Plate - Chatsworth PN 10595-112 or equivalent.
9. Triangular Support Bracket, Aluminum - Chatsworth PN 11312-118 or equivalent.
10. 12” Runway Wall Angle Support Kit - Chatsworth PN 11421-112.
11. Cable Runway Foot Kit - Chatsworth PN 11309-001
12. Cable Runway Grounding Kit - Chatsworth PN 12061-001
13. 12” Cable Runway End Closing Kit - Chatsworth PN 11700-112

2.6 FIRE RATED WIRING DEVICES

A. Wiring devices:
1. Cables passing through fire-rated floors or walls shall pass through fire-rated wiring devices which contain an intumescent insert material that adjusts automatically to cable additions or subtractions.
2. The device shall have an F Rating equal to the rating of the barrier in which the device is installed.

3. Wiring devices shall be capable of allowing a 0 to 100-percent visual fill of cables.
4. Wire devices shall be of a sufficient size to accommodate the quantity and size of electrical wires and data cables required.
5. Wire devices to be provided with steel wall plates allowing for single or multiple devices to be ganged together.
6. Acceptable Manufacturers:
   a. Specified Technologies Inc.
      1) E -PATH Fire Rated Pathway
      2) 3M

PART 3 EXECUTION

3.1 SUMMARY

A. Final design and specifications for the Communications Systems conduits shall be made by the Electrical Engineer and Architect of Record.
B. Conduits shall be reamed to eliminate sharp edges. Metallic conduit shall be terminated with an insulated bushing. Refer to ANSI/TIA-606 B and Section 27 05 53 for administration of the pathway system.
C. The inside of the wire way shall be free of burrs, sharp edges or projections that can damage cable insulation. When a wire way passes through a partition or wall, it shall be an unbroken length. Installation of telecommunications cables shall not exceed the fill requirements. Openings in fire-rated walls, floors and ceilings shall be properly fire stopped. Barriers between power and telecommunications cables shall be installed per electrical code. Wire ways shall not be used as walkways or ladders unless specifically designed and installed for that purpose.
D. Supports should be located where practicable so that connections between sections of the wireway fall between the support point and the quarter section of the span. The support centers shall be in accordance with the load and span for the applicable class as specified in the electrical code. A support should be placed within 600 mm (2 ft) on each side of any connection to a fitting. Wire ways shall be supported on 1500 mm (5 ft) centers unless designed for greater lengths.
E. A minimum of 12 in. access headroom shall be provided and maintained above a cable pathway. Care shall be taken to ensure that other building components e.g., air conditioning ducts do not restrict access to cable or wire ways.

3.2 MINIMUM CLEARANCES

A. Communication Pathway minimum clearances from:
   1. Minimum of 1 foot parallel, 3 inches crossover from power cables and conduits.
   2. Minimum of 6 inches above ceiling tiles.
   3. Minimum of 24 inches Hot Flues, Steam pipes, Hot water pipes and other hot surfaces.
   4. Minimum of 3 feet separation from electrical panel boards.
   5. Minimum of 12-inches from fluorescent fixtures.
   6. Minimum of 6 feet separation from electrical motors and transformers.
   7. Minimum of 2-inches from exposed all-thread rods.

3.3 FIRE STOPPING

A. Provide fire resistant materials to restore fire ratings to all wall, floor, or ceiling penetrations used in the distribution and installation for communications cabling system. Coordinate fire stopping procedures and materials with General Contractor and Electrical Contractor.

B. Solutions and shop drawings/submittals for fire stop materials and systems shall be presented to the General Contractor for written approval of materials prior to purchase and installation.
C. Materials shall be installed per manufacturer instructions, be UL listed for intended use, and meet NEC codes for fire stopping measures.
D. The material chosen shall be distinctively colored to be clearly distinguishable from other materials, adhere to itself, and remain resilient and pliable to allow for the removal and/or addition of communication cables without the necessity of drilling holes in the material.
E. The fire stopping material shall maintain/establish the fire rated integrity of the wall/barrier that has been penetrated.
F. Cable Contractor shall laminate and permanently affix to the MDF wall, adjacent to chases, the following information:
1. Name of manufacturer of fire stop system.
2. Part model numbers of system and all components.
3. Phone numbers of manufacturer's corporate headquarters in U.S. and local distributor's name and phone number.

END OF SECTION

SECTION 27 0553 - IDENTIFICATION OF COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Work covered by this Section shall consist of furnishing labor, equipment, supplies, materials, and testing unless otherwise specified, and in performing the following operations recognized as necessary for the labeling of the telecommunications infrastructure as described on the Drawings and/or required by these specifications.
B. Labeling format is to be submitted to and approved by Owner prior to implementation.

1.2 RELATED SECTIONS

A. 27 0500 Common Work Results
B. 27 0528 Pathways for Communications Systems
C. 27 0553 Identification for Communications Systems
D. 27 1100 Communications Equipment Room Fittings
E. 27 1500 Communications Horizontal Cabling
F. 27 1600 Patch Cords, Station Cords, Cross-Connect Wire

1.3 QUALITY ASSURANCE

A. Identification and administration work specified herein shall comply with the applicable requirements of:
   1. ANSI/TIA - 606-B Administration Standards.
   2. ANSI/TIA – 569-C Pathway and Spaces
   3. ANSI/TIA - 568-C Telecommunications Cabling Standard.
   4. BICSI Telecommunications Distribution Methods Manual.
   5. UL 969.

1.4 TELECOMMUNICATIONS ADMINISTRATION

A. Administration of the telecommunications infrastructure includes documentation of cables, termination hardware, patching and cross-connection facilities, conduits, other cable pathways, Telecommunications Rooms, and other telecommunications spaces.
B. UNTHSC maintains a campus wide numbering scheme for voice and data outlets and patch panels.
C. Telecommunications Infrastructure Records must be maintained in a computer spreadsheet, or in a computer database. Paper records are encouraged, but are optional. A cable record is prepared for each backbone cable. The record will show the cable name, and must describe the origin point and destination point of the cable. The cable record will record what services and/or connections are assigned to each cable pair or strand. An equipment record is prepared for services distributed from a certain piece of equipment, such as a router, or a system such as the telephone system PBX.
D. UNTHSC requires the installer to keep accurate, up-to-date Installation or Construction Drawings. At a minimum, the Installation Drawings shall show pathway locations and routing, configuration of telecommunications spaces including backboard and equipment rack configurations, and wiring details including identifier assignments.

E. UNTHSC requires the installer to provide a complete and accurate set of as-built drawings. The as-built drawings shall record the identifiers for major infrastructure components including; the pathways, spaces, and wiring portions of the infrastructure which may each have separate drawings if warranted by the complexity of the installation, or the scale of the drawings.

PART 2 PRODUCTS

2.1 LABELS

A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.
B. Shall be preprinted or computer printed type. Hand written labels are not acceptable.
C. Where insert type labels are used provide clear plastic cover over label.
D. Outside plant labels shall be totally waterproof even when submerged.
E. Approved Manufacturer:
   1. Panduit
   2. Brady Corporation
   3. Equivalent
F. Equipment Room Copper, Fiber, and Coax Backbone Cable Labels
   1. Panduit Part LS7-75NL-1 or Brady WML-1231-292
G. Equipment Room Copper, Fiber, and Coax Horizontal Cable Labels
   2. Panduit Part LS7-75NL-1 or Brady WML-317-292
H. Work Area Copper, Fiber, and Coax Riser Cable Labels
   1. Panduit Part LS7-75NL-1 or Brady WML-317-292
I. Patch Panel Labels
   1. Panduit Part LS7-38-1 or Brady CL-111-619

PART 3 - EXECUTION

3.1 IDENTIFICATION LABELING

A. The size, color, and contrast of all labels should be selected to ensure that the identifiers are easily read. Labels should be visible during the installation of and normal maintenance of the infrastructure.

B. Labels should be resistant to the environmental conditions at the point of installation (such as moisture, heat, or ultraviolet light), and should have a design life equal to or greater than that of the labeled component.

C. All labels shall be printed or generated by a mechanical device.

3.2 TELECOMMUNICATION IDENTIFIERS

A. All voice and data outlets and patch panels shall be clearly marked using permanent means. Voice and data outlets shall use the following system of numbering and labeling. Each cable shall be labeled with the MDF or IDF room number, Rack Number, Patch Panel ID and patch panel port number as well as the following:

1. OUTLET AND PATCH PANEL
   a. DATA: Actual IDF/TR Room Number, Rack Number (1-3), Patch Panel ID (A-E) and Patch Panel Port Number (01-48). Example: IDF123-1-A-01

2. When more than one TC is needed per floor, the room number of the TR shall be

added to the numbering scheme.

3. Outlet numbers shall be marked by permanent means on each cable at the outlet and at the TC.

END OF SECTION

SECTION 27 1500 - COMMUNICATIONS HORI ONTAL CABLING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
B. Specification Section 27 0500, Common Work Results for Communications, apply to this Section.

1.2 SUMMARY

A. This Section specifies the requirements for the Communications Horizontal Cabling for the University of Texas Health Science Center in Fort Worth, Texas.
B. All voice and data horizontal cables shall consist of plenum rated, Category 6, 4 pair UTP copper terminated in the ER and TR's. The voice/data cables shall terminate on 48 port RJ-45 T568B, The maximum horizontal distance shall be 295 feet.
C. All information outlets will be flush-type mounted into conduits and boxes. Typical outlets will be used in the office spaces and lab spaces. These outlets shall consist of 2 data cable unless otherwise specified. Each port in the data patch panel shall have 8 conductors configured to RJ45 (ISDN) standard pin-out T568B.
D. Outlet configurations. Single-gang mounting plate with modular openings which might contain one or more the following devices
    1. Data Jack(s) - 8-pin modular, Category 6, un-keyed, blue, pinned to T568B standards (fully terminated).
    2. Blank Inserts – to be inserted in unused openings.
E. Contractor must keep updated redline drawings and provide as-built documentation in both print and electronic formats.
F. Cabling maybe installed in J-hooks above accessible ceilings. Conduit or solid bottom tray is required in all open ceiling areas.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

A. Systimax

2.2 UTP COPPER CABLE

A. Systimax Category 6, Plenum Rated CMP – 2071B
B. Cables Colored by use:
    1. Green – Security Cameras and Access Control Panels
    2. Yellow – Wireless Access Points
    3. Blue – Workstations and other connections
    4. Purple – AV Cameras

2.3 PATCH PANELS

A. Systimax 24 port Category 6 flat patch panels - 360-IPR-1100-E-GS3-1U-24
B. Systimax 48 port Category 6 flat patch panels - 360-IPR-1100-E-GS3-2U-48

2.4 COPPER CONNECTORS

A. Systimax - Category 6, modular jack inserts - blue.

2.5 WALL PLATES

A. Unused ports shall have blank inserts installed.
B. Color shall be White.
C. Faceplates shall have two separate labeling areas.
D. Label areas shall be covered with a clear plastic insert.
E. Label areas shall accept 9mm height labels

PART 3 - EXECUTION

3.1 GENERAL

A. Follow manufacturer's installation guidelines.
B. All data and voice cabling and terminations and termination hardware shall be ANSI/TIA wiring configuration T568B
C. The length of each individual run of horizontal cable from the administration subsystem (Telecommunications Room) to the Telecommunication Outlet shall not exceed 295 ft.
D. The 4 pair UTP cable shall be Underwriter's Laboratories (UL) listed type CMP.
E. Pay strict attention to the manufacturer's guidelines on bend radii and maximum pulling tension during installation. Notice that the recommended minimum bend radius for a cable during installation is typically greater than the recommended bend radius after the cable is installed. This is to minimize tension and deformation as the cables pass around corners during installation. The maximum pull-force guideline for 4-pair horizontal balanced twisted pair cables is 110 N (25 lbf).
F. UTP Cabling:
    1. Provide a minimum of 3-foot service loop (for re-termination) for horizontal cables. Locate service loop where horizontal cable run transitions to cable tray. Place at least 12” of service loop in outlet box.
    2. The horizontal distance is the cable length from the mechanical termination of the media at the horizontal cross-connect in the telecommunications room to the telecommunications outlet/connector in the work area. The maximum horizontal distance shall be 295 ft, independent of media type. The length of the cross-connect jumpers and patch cords in the cross-connect facilities, including horizontal cross-connects, jumpers, and patch cords that connect horizontal cabling with equipment or backbone cabling, should not exceed 5 m (16 ft) in length. For each horizontal channel, the total length allowed for cords in the work area plus patch cords or jumpers plus equipment cables or cords in the telecommunications room shall not exceed 10 m (33 ft).
    3. Cable and components shall be visually inspected for proper installation. Cable stress, such as that caused by tension in suspended cable runs and tightly cinched bundles, shall be minimized. Plenum rated Velcro ties used to bundle cables should be applied loosely to allow the Velcro tie to slide around the cable bundle. The vector ties should not be cinched so tightly as to deform the cable sheath. Cable placement should not deform the cable sheath.
    4. Minimum bend radius: The minimum bend radius for cable will vary depending on the condition of the cable during installation (tensile load) and after installation when the cable is at rest (no-load).
    5. The minimum bend radius, under no-load conditions, for 4-pair unshielded twisted-pair

(UTP) cable shall be four times the cable diameter.
6. Copper cable splicing or bridge tapping is unacceptable.
7. Cables should be terminated with connecting hardware of the same category or higher. To maintain the cable geometry, remove the cable sheath only as much as necessary to terminate the cable pairs on the connecting hardware. The connecting hardware manufacturer's instructions for cable sheath strip-back shall be followed. When terminating Category 6 and higher cables, the cable pair twists shall be maintained to within 13 mm (0.5 in) from the point of termination. For best performance when terminating cable on connecting hardware, the cable pair twists should be maintained as close as possible to the point of termination.
8. The Cable Contractor shall install 4-pair Category 6 plenum rated UTP cables from the appropriate ER or TR to each outlet location as indicated on the telecommunications drawings

3.2 SITE QUALITY CONTROL

A. Site Testing and Inspection Agency qualifications:
1. Every cabling link in the installation shall be tested in accordance with the field test specifications defined in ANSI/TIA-568-C.2-1 “Transmission Performance Specifications for 4-pair Category 6 Cabling”. This document will be referred to as the “TIA Cat 6 Standard.”
2. The installed twisted-pair horizontal links shall be tested from the patch panel in the telecommunications room to the telecommunication wall outlet in the work area against the “Permanent Link” performance limits specification as defined in the TIA CAT 6 Standard.
3. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate, as proof thereof shall execute the tests. Appropriate training programs include but are not limited to installation certification programs provided by BICSI or the ACP (Association of Cabling Professionals).
4. The test equipment shall comply with the accuracy requirements for level III field testers as defined in the TIA CAT 6 Document. The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy plus adapter contribution) are specified in Table C.2 of Annex B of the TIA CAT 6 Standard. (Table B.3 in this TIA document specifies the accuracy requirements for the Channel configuration.)
5. The test plug shall fall within the values specified in E.3.2.2 Modular test plug NEXT loss requirements of the TIA CAT 6 Standard.
6. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.
7. The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy, preference is given to a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The Cable Contractor shall provide proof that the interface has been calibrated within the period recommended by the vendor. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.
8. One hundred percent of the installed cabling links must be tested and must pass the requirements of the standards in this section. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation in accordance with the Test Result Documentation as listed below.

B. Site Testing, Inspection and Acceptance
   1. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests. Any Fail or Fail result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter must Pass or Pass .
   2. A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter. The test result of a parameter shall be marked with an asterisk ( ) when the result is closer to the test limit than the accuracy of the field tester. The field tester manufacturer must provide documentation as an aid to interpret results marked with asterisks.
   3. A representative of the design team shall be invited to witness field testing. The representative shall be notified of the start date of the testing phase five business days before testing commences.
   4. At the conclusion of field-testing, at a time scheduled by the owner's representative, the owner's representative will select a random sample (up to 10) of the installed links in each wiring closet. The Cable Contractor, under supervision of the owner's representative, shall test these randomly selected links and the results are to be stored in accordance with the prescriptions in Test Result Documentation as listed below.
   5. The results obtained shall be compared to the data originally provided by the Cable Contractor. If any (one or more) of the sample test reports displays a fail or fail result, the Cable Contractor shall resolve any conditions causing the failed test and under supervision of the owner’s representative shall repeat 100% of the testing and the cost shall be borne by the Cable Contractor.

C. Performance Test Parameters
   1. The test parameters for CAT 6 are defined in TIA CAT 6 standard, which refers to the ANSI/TIA-568-C.2 standard. The test of each link shall contain all of the following parameters as detailed below. In order to pass the test all measurements (at each frequency in the range from 1 MHz through 250 MHz) must meet or exceed the limit value determined in the above-mentioned standard.
      a. Wire Map
      b. Length
      c. Insertion Loss (Attenuation)
      d. NEXT Loss
      e. PSNEXT Loss
      f. ELFEXT Loss, pair-to-pair
      g. PSELFEXT Loss
      h. Return Loss
      i. ACR (Attenuation to crosstalk ratio)
      j. PSACR
      k. Propagation Delay
      l. Delay Skew as defined in ANSI/TIA-568-C.1; Section 11.2.4.11

D. Test Result Documentation
   1. The test results information for each link shall be recorded in the memory of the field tester upon completion of the test.
   2. The test results records saved by the tester shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of these test records. A guarantee must be made that the measurement results are transferred to the PC unaltered, i.e., “as saved in the tester” at the end of each test and that these results cannot be modified at a later time. Superior protection in this regard is offered by testers that transfer the numeric measurement data from the tester to the PC in a non-printable format.

3. The database for the completed job shall be stored and delivered on CD-ROM including the software tools required to view, inspect, and print any selection of test reports.
4. A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information:
   a. The identification of the link in accordance with the naming convention defined in the overall system documentation.
   b. The overall Pass/Fail evaluation of the link-under-test including the NEXT Headroom (overall worst case) number.
   c. The date and time the test results were saved in the memory of the tester.
5. General Information to be provided in the electronic data base with the test results information for each link:
   a. The identification of the customer site as specified by the end-user.
   b. The identification of the link in accordance with the naming convention defined in the overall system documentation.
   c. The overall Pass/Fail evaluation of the link-under-test.
   d. The name of the standard selected to execute the stored test results.
   e. The cable type and the value of NVP used for length calculations.
   f. The date and time the test results were saved in the memory of the tester.
   g. The brand name, model and serial number of the tester.
   h. The identification of the tester interface.
   i. The revision of the tester software and the revision of the test standards database in the tester.
   j. The test results information must contain information on each of the required test parameters.
6. The detailed test results data to be provided in the electronic database for each tested link must contain the following information:
   a. For each of the frequency-dependent test parameters, the value measured at every frequency during the test is stored. In this case, the PC-resident database program must be able to process the stored results to display and print a color graph of the measured parameters. The PC-resident software must also provide a summary numeric format in which some critical information is provided numerically as defined by the summary results (minimum numeric test results documentation) as outlined above for each of the test parameters.
      1) Length: Identify the wire-pair with the shortest electrical length, the value of the length rounded to the nearest 0.1 m (1ft) and the test limit value.
      2) Propagation delay: Identify the pair with the shortest propagation delay, the value measured in nanoseconds (ns) and the test limit value.
      3) Delay Skew: Identify the pair with the largest value for delay skew, the value calculated in nanoseconds (ns) and the test limit value.
      4) Attenuation: Minimum test results for the worst pair.
      5) Return Loss: Minimum test results for the worst pair as measured from each end of the link.
      6) NEXT, ELFEXT, ACR: Minimum test results documentation as explained in Section I.B for the worst pair combination as measured from each end of the link.
      7) PSNEXT, PSELFEXT, and PSACR: Minimum test results documentation for the worst pair as measured from each end of the link.

E. As-built drawings
1. Provide three (3) copies of E and three (3) copies of C size prints along with CADD files in .dwg or .dgn formats showing floor plans with room numbers and actual outlet locations and labeling. The deliverable is required within 5 business days of final cable testing.
2. Red Line Drawings: Contract must kept one (1) E size set of floor plans on site during work hours with installation progress marked and outlet labels noted. Contractor may be asked to produce these drawings for examination during construction meetings or field inspections.

END OF SECTION

SECTION 27 1600 - COMMUNICATIONS CONNECTING CORDS, DEVICES ADAPTERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Uniform General Conditions, Supplementary General Conditions and Division 1 - General Requirements apply to this Section.
B. Section includes: Materials minimum requirements, workmanship, warranty, coordination drawings, storage and protection of materials and submittals.
C. Special Note: UNTHSC is a Systimax specific location and has requested that the Systimax 25 year Warranty be extended to this installation. This requires:
   1. The installer of the telecommunications infrastructure to be a certified Systimax installer.
   2. The Category 6A Patch Cables are manufactured by Systimax.
   3. The project shall be registered for warranty and test data submitted for acceptance by Systimax.

1.2 RELATED SECTIONS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
B. Specification Section 27 05 00, Common Work Results for Communications, apply to this Section.

1.3 REFERENCES

A. Codes and Standards (Latest issue and addenda)
   1. ADA Standards for Accessible Design 28 CFR Part 36
   2. U.S. Department of Labor Occupational Safety Health Administration (OSHA)
   3. UNTHSC Telecommunications and Infrastructure Requirements
   4. BICSI TDM 14th Edition
   5. National Electric Code (NEC), Latest Issue
   6. ANSI/TIA-568-C.1 - Commercial Building Telecommunications Cabling Standard
   7. ANSI/TIA-568-C.2 - Commercial Building Telecommunications Cabling Standard
   8. ANSI/TIA-568-C.3 - Optical Fiber Cabling Components Standard
   9. ANSI/TIA-569-C - Commercial Building Standard for Telecommunications Pathways and Spaces
   10. ANSI/TIA-606-B - Administration Standard for Commercial Telecommunications Infrastructures, June 21, 2002
   11. ANSI J-STD-607-A, Commercial Building. Grounding/Bounding Requirements- Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications, 2002
   12. ANSI/TIA758-B - Customer-owned Outside Plant Telecommunications Infrastructure Standard, May 2005
   13. International Standards Organization/International Electrotechnical Commission (ISO/IEC) IS 11801, 2000
   14. Underwriters Laboratories (UL) Cable Certification and Follow Up Program
   15. National Electrical Manufacturers Association (NEMA)
   16. American Society for Testing Materials (ASTM)

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

1.5 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. All materials, items of equipment and workmanship furnished under each Section shall carry a ONE (1) YEAR warranty against all defects in material and workmanship. Any fault under any Contract, due to defective or improper material, equipment, workmanship or design which may develop shall be made good, forthwith, by and at the expense of the Contractor for the work under his Contract, including all other damage done to areas, materials and other systems resulting from this failure.

C. The Contractor shall guarantee that all elements of the system, which are to be provided under his Contract, are of sufficient capacity to meet the specified performance requirements as set forth herein or as indicated.

D. Upon receipt of notice from the Owner of failure of any part of any systems or equipment during the guarantee period, the Contractor for his respective work, as applicable, shall replace the affected part or parts.

E. An additional extended warranty is required for work on this project. The additions and/or extensions to the standard year guarantee previously described are to be provided in writing, by the Manufacturers. The warranty is to cover all parts and labor as specified below:

F. Systemax 25-year performance certification for:
1. Category 6, cable and associated labor.
2. Category 6, patch panels and associated labor.
3. Category 6, data workstation outlets and associated labor.

G. Furnish, before the final payment is made, a written guarantee covering the above requirements.

H. Additional/extended warranty listed above is Non-negotiable, and cannot be amended through the submittal process

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Substitutions: See Section 01 6000 - Product Requirements.

B. UNTHSC is standardized on Systimax cable system.

2.2 COPPER PATCH CABLES

A. Category 6 copper patch cables shall be provided, one for each “wired for” data circuit as listed in Section 27 1500 or as required otherwise by this Contract.

B. One copper patch cable terminated with RJ-45 connectors shall be provided, one for each “wired for” voice circuit as listed in Section 27 1500 or as required otherwise by this Contract.

C. Copper patch cables shall be of the same Category and manufacturer as the cable listed in Section 27 1500 as necessary to meet the requirements of the extended manufacturer's warranty listed in Section 27 0500.

D. Copper patch cables shall be of variable lengths to form neat and workmanlike groups within the cable management.

2.3 FIBER OPTIC PATCH CABLES

A. Fiber optic patch cables shall connect the backbone fiber from the fiber patch panel to the building switch in Section 27 1300.
B. Fiber optic patch cables shall be terminated with LC connectors as directed under the provisions of Section 27 1300.

PART 3 EXECUTION

3.1 COPPER PATCH CABLES

A. Provide two (2) patch cables for each “wired for” voice/data circuit.
B. Lengths shall be 50 1’ and 50% 15’
C. Cables Colored by use:
1. Green – Security Cameras and Access Control Panels
2. Yellow – Wireless Access Points
3. Blue – Workstations and other connections
4. Purple – AV Cameras

3.2 FIBER OPTIC PATCH CABLES

A. Provide duplex fiber optic patch cables for each strand of fiber optic cable installed.
B. Lengths shall be 50 1m, 40 3m and 10 5m

END OF SECTION

SECTION 27 4100 - AUDIOVISUAL SYSTEMS

PART 1 GENERAL

1.1 DEFINITIONS

A. Owner: The University of North Texas Health Science Center (UNTHSC)
B. Project: Gibson Library Renovation – Level 3 Provost Suite
C. Consultant: 4b Technology Group
D. Contractor: Contractor or subcontractor providing and installing the audiovisual system
E. GC: General Contractor
F. OFE: Owner Furnished Equipment
G. OFOI: Owner Furnished Owner Installed
H. OFCI: Owner Furnished Contractor Installed
I. CFCI: Contractor Furnished Contractor Installed

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

A. Section includes furnishing, installing, testing, and documenting the audiovisual system for digital signage systems along with executive office, huddle room, team room and community/living room locations in the Owner's Project.
B. General elements of the work will consist of (but are not limited to) the following:
    1. Procuring all permits and licenses required by local governing bodies for complete and functional audiovisual system installation.
    2. Attending pre-construction/pre-submittal meetings with Owner and Consultant to review design package for the audiovisual system.
    3. Providing continuous on-site supervision of installation technicians.
        a. On-site supervision will include daily oversight of work, updating worksite progress drawings to reflect changes and installations details, preparing weekly progress reports, and attending on-site coordination meetings as directed by the Owner and Consultant
    4. Providing equipment, labor, materials, tools, appliances, and transportation required for a complete and functional audiovisual system as described within the design specifications and drawings.
    5. Providing all miscellaneous hardware including (but not limited to) cable management devices, termination cabinets, cable labeling materials, fasteners, hangers, and brackets required for complete and functional audiovisual system installation.
    6. Providing all required audiovisual system software and licenses to the Owner.
    7. Coordinating with all trades and Owner representatives as required to facilitate the installation of control systems equipment including (but not limited to) door hardware, fire alarms, blinds, shades, HVAC, and electrical divisions.
    8. Coordinating and documenting receipt of Owner furnished equipment.
    9. Protecting new facilities finishes and equipment.
    10. Maintaining construction materials and refuse within the area of work on-site.
    11. Cleaning the work area on-site at the end of each day and disposing of waste in designated refuse bins or containers.

12. Coordinating network settings, configurations, and requirements in conformance to owner standards (i.e. isolated AV network, AV VLAN, etc.) to ensure proper function of the audiovisual system equipment.

C. The work described in these specifications and drawings have been provided to meet certain performance requirements.
   1. Some information such as exact equipment models, layout, wire routing, conduit pathway, power requirements, etc. has been omitted.
   2. The audiovisual system is designed to efficiently support the Owner's various facilities and activity areas in a manner which can be reasonably and proficiently managed by the staff.
   3. Contractor is responsible for translating these specifications and drawings into a complete design package containing all the necessary elements to deliver a complete turnkey installation including (but not limited to) all materials, labor, warranties, shipping and permits.
      a. In the event of any conflicts between design specifications and drawings, the Contractor will provide written notification to Consultant of any such occurrences before purchasing any equipment or materials and performing any installation services.
         i. The Consultant will notify the Contractor of any actions required to resolve these conflicts which may include (but not be limited to) design changes, equipment, materials and/or installation changes.
         ii. In any event, Contractor will not supersede specifications and standards from the latest NFPA and NEC publications.

D. In all cases, the Contractor is solely responsible for the performance of the audiovisual system and the delivery of complete system documentation for each part of the Project.

1.4 ROOM TYPE FUNCTIONAL NARRATIVES

A. Office
   1. This office space will support presentation and web conferencing applications.
      a. A flat panel display will be wall mounted at the conference table location.
      b. A wireless presentation gateway will be the display's primary video input source with an HDMI wall plate for secondary device connections.
         1) The system will auto-switch between the primary wireless source and the secondary wall plate source when auxiliary devices are connected at that location. The system will auto-switch back to the primary wireless source when auxiliary devices are disconnected from the wall plate location.
      c. A USB wall plate will connect to a USB conferencing bar at the display.
         1) The USB conferencing bar will provide image and audio capture of local meeting participants along with sound reinforcement of remote meeting participants and wired or wireless presentation sources.
      d. A wall mounted, button panel interface will provide the following AV system controls:
         1) Display on/off
         2) Conferencing bar volume up/down/mute

1.5 PROGRAMMING

A. Coordinate and provide programming review meeting(s) with Owner to address and advise on control system capabilities (per room type) based on Project drawings and specifications.
B. Deliver control system and digital signal processor programming source code configuration files (both compiled and uncompiled per room type) to the Owner as a requirement for final acceptance of the audiovisual system.
C. Provide programming labor to cover audiovisual system functional control changes and modifications requested by the Owner within the warranty period beginning after the final acceptance date.
D. Refer to 1.8 – SUBMITTALS later in this document for additional requirements.

1.6 BID RESPONSE

A. Provide a bid response document with line-item pricing that is formatted and organized to identify unique room types, locations, and/or general systems along with the total installation cost associated for each.
B. Line-item pricing per room type, location, or general system will include (but is not limited to) equipment, accessories, software, hardware, subscriptions, licenses, labor types, general, administrative, and miscellaneous costs required for installation of a functional audiovisual system.
   1. The provided equipment list should contain line-item manufacturer, model, quantity, unit cost and extended cost information for each component in that specific room type, location, or general system.
   2. Installation labor per room type, location, or general system should be presented separately from the associated equipment list with line-item pricing.
   3. General, administrative, and miscellaneous equipment or labor costs including (but not limited to) design, drawing production, programming, project management, shipping, handling, and training per room type, location or general system should also be presented separately with line-item pricing for each category.
   4. Please see the following example for Bid Response Pricing Data submittal package formatting guidance:

ample id esponse ricing ata

oom Type	**anufacturer**	**odel**	**ty.**	**nit ost**	**t. ost**
Huddle Room	Product	A	1	1.00	1.00
	Product	B	2	1.00	2.00
	Contractor	Install Labor	1 hr.	1.00	1.00
	Contractor	Programming	2 hr.	1.00	2.00
	Contractor	Project Management	3 hr.	1.00	3.00
	Contractor	Training	1 hr.	1.00	1.00
	Contractor	Shipping	N/A	1.00	1.00
	Contractor	Miscellaneous	N/A	1.00	1.00
				TOT	**.**
Conference Room	Product	A	1	1.00	1.00
	Product	B	2	1.00	2.00
	Product	C	1	1.00	1.00
	Contractor	Install Labor	2 hr.	1.00	2.00
	Contractor	Programming	3 hr.	1.00	3.00
	Contractor	Project Management	4 hr.	1.00	4.00
	Contractor	Training	2 hr.	1.00	2.00
	Contractor	Shipping	N/A	2.00	2.00
	Contractor	Miscellaneous	N/A	2.00	2.00
				TOT	**.**
				TOT	**.**

1.7 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Contractor will have a minimum of five years' experience installing, programming, and commissioning audiovisual systems of a comparable size and scope.
   2. Contractor's project installation team will feature at least one individual with an active

Certified Technology Specialist – Installer (CTS-I) designation to supervise and approve all on-site work.

3. Contractor's project installation team will feature a dedicated Project Manager whose responsibilities include (but are not limited to) the oversight of system programming, operations and maintenance manual preparation, training coordination, testing protocols, testing documentation, document deliverables, and labor scheduling.
4. Contractor's project installation team members must demonstrate knowledge and compliance with all AVIXA, TIA, UL, and NEC methods, standards, and codes.
5. Contractor's project installation team must be certified by industry groups and/or equipment manufacturers relevant to this project's scope of work and bill of materials as having completed the training necessary to perform their specific installation task(s).
6. Owner's representative(s) may make such investigations (as deemed necessary) to determine that the Contractor is responsive, responsible, and qualified to execute the work outlined by the Contract.
   a. In this regard, the Contractor will furnish to the Owner such information as requested for this purpose.
   b. Information and data may include (but not necessarily be limited to) the date of organization and/or incorporation, number of years engaged in this business under present firm's name, a list of major equipment owned by the company, a list of principal personnel who will be involved in the execution of this contract along with the experience and qualifications of each person.
7. Contractor will be an authorized manufacturer's representative for all products which they install.
8. Contractor will have in-house engineering and project management staff with capabilities to satisfy the requirements of the Project and located no more than one hundred miles away from the Owner's site.
9. Contractor will have a consistent presence (or subcontractor organization) located no more than one hundred miles away from the Owner's site that can provide maintenance and services for the for the audiovisual system during the required (or optional extended) warranty period.
10. Contractor will be capable of providing emergency maintenance and service twenty-four hours per day, seven days per week.

B. The Contractor will provide all materials, equipment, and installation in compliance with the latest applicable standards from ANSI, ASTM, AVIXA, FCC, IEEE, NCTA, NEC, NEMA, NFPA, REA, TIA/EIA, and UL including (but not limited to):
   1. American National Standards Institute (ANSI)
   2. ANSI T1.404 (DS3) and CATV Applications
   3. American Society for Testing and Materials (ASTM)
   4. American with Disabilities Act (ADA)
   5. EIA/TIA-569 Standard, Commercial Building Standard for Telecommunications Pathways and Spaces
   6. EIA/TIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications
   7. National Cable Television Association (NCTA)
   8. NCTA-02 NCTA Recommended Practices for Measurements on Cable Television Systems
   9. National Electrical Code (NEC) (latest revision and pertinent addendums)
   10. Article 250, Grounding
   11. Article 300, Part A. Wiring Method
   12. Article 310, Conductors for General Wiring
   13. Article 800, Communication Systems
   14. National Fire Protection Association (NFPA) Publications (latest revisions and pertinent addendums)
   15. Underwriters Laboratories (UL)

16. NECA 1 Good Workmanship in Electrical Contracting

C. Electrical Components, Devices and Accessories:
   1. Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use.

1.8 SUBMITTALS

A. Contractor's CTS-I supervisor will review, approve, and sign off on all submittal documents.
B. Provide evidence of compliance with specifications described in 1.7 - QUALITY ASSURANCE as requested by the Owner and/or Consultant.
C. Partial submittals will not be acceptable without prior approval in writing from the Consultant.
D. Until the Consultant approves the full submittals, the Contractor will not commence any work, nor will the Contractor order any equipment related to the audiovisual system.
E. Approval of submittals does not relieve the Contractor from any contract-required responsibilities.
F. Product Data
   1. Provide cut sheets for each component within in a unique room type, room location, and/or general system and include notes on the cut sheet identifying specific models, color finishes, accessories, or relevant selection details (when multiple options are shown in any category) for that equipment.
   2. Organize cut sheets into a single .pdf package with an index on the first page which specifies the following information:
      a. Room type, room location, and/or general system name
      b. Equipment manufacturer and model name of each component within that room type, room location, and/or general system
      c. Color option availability of each equipment component
      d. Color selection specification of each component per room type, room location and/or general system name (where applicable)
      e. Page number location within the submittal package for the first cut sheet of each component.
   3. When custom equipment (podium, lectern, in-room rack, etc.) is specified for the Project that features multiple selection options (finishes, accessories, logos, etc.), the Contractor will provide a completed version of the manufacturer's configuration document and/or a copy of the manufacturer's unique quote featuring all customized selections within the Product Data submittal package.
      a. Coordination meeting(s) between the Contractor and Architect may be required to review and advise on custom equipment configuration options based on Project drawings and specifications.
   4. The following example shows the minimum information required for review of Contractor's Product Data submittal package:

ample nde

Room Type	Color Option	Color Selection	Page
Huddle Room			
- Product A	✓	White	2
- Product B	x	N/A	3
Conference Room			
- Product A	✓	Black	2
- Product B	x	N/A	3
- Product C	✓	Custom	4

Page 1

ample roduct ata

Product A

Cut Sheet

Page 2

ample roduct ata

Product B

Cut Sheet

Page 3

ample roduct ata

Product C

Custom Configuration Document
or Manufacturer's Custom Quote

Page 4

G. Programming
   1. Provide screenshots, templates, and functional examples of all graphic user interface design which will be displayed on audiovisual system control equipment including (but not limited to) touch panels, button panels, and web or desktop applications for sign off and approval by the Owner.
      a. Contractor must obtain written approval from Owner for all graphic user interface design and functionality (per room type) prior to deployment of audiovisual system programming.
      b. Without written approval, Owner reserves the right to reject graphic user interface design and/or functionality and require specific updates to satisfy their programming requirements.

H. Shop Drawings
   1. Contractor's on-site supervisor will review, approve, and sign off on all shop drawings, coordination drawings and as-built drawings.
   2. The contract design documents (including but not limited to floor plans, reflected ceiling plans, wiring schematics, elevations, details, or section drawings) will not be accepted as submittals and do not relieve the Contractor from the obligation to produce and provide their own shop drawings.
   3. Shop drawings to include the following:
      a. Drawing legend sheet identifying and describing all symbols used on the Contractor's documents
      b. Floor plans and reflected ceiling plans showing all audiovisual system equipment with wiring pathways represented

c. Dimensioned elevations and sections showing wall, ceiling and/or surface mounted audiovisual system equipment
d. Details showing mounting and installation specifications for audiovisual system equipment.
e. Schematic block diagrams for each audiovisual room type featuring equipment manufacturer and model information with connector level details for all system components including (but not limited to) audio, video, control, and power signals
f. Elevations for all equipment racks including (but not limited to) ceiling enclosures, wall enclosures, lecterns, and teaching consoles
g. Cable runs with tags for type, gauge, quantities, and cable identifiers
h. System riser diagram indicating all field devices, riser paths and room designations as required.
i. Fabrication shop drawing(s) showing component layout and location of custom configured equipment (cable cubby, podium, lectern, etc.) for approval by the Owner.

I. Samples
1. As requested, provide samples to the Owner and/or Architect for audiovisual system equipment color and texture finish coordination.

J. Resubmitting
1. If any submittal documents are rejected by the Consultant, the Contractor will be responsible for making the required corrections or changes identified by the Consultant's stamp instructions and attached comments.
a. Contractor will clearly identify corrections or changes on resubmitted documentation by clouding areas which have been updated.
b. Consultant will only review clouded areas of correction or change within resubmitted documentation.
2. Contractor will be responsible for project delays caused by rejected submittals.
3. If both the Contractor's original submittals and resubmittals are each rejected, then the Consultant will be compensated for the additional services required to review the third (and any subsequent) Contractor submittal documents.
a. The amount of such compensation will be incorporated via change order and withheld from the Contractor application for payment.

1.9 ENVIRONMENTAL CONDITIONS

A. Audiovisual system components will be rated for the environments where they are proposed to be installed.
B. Manufacturer environmental (temperature, humidity, etc.) ratings and requirements will be followed exactly to ensure reliable equipment operation and maintain warranty coverage.
C. Contractor will be responsible for verifying that the environmental conditions of the proposed audiovisual system equipment installation location does not exceed the minimum/maximum ratings and requirements of the specified audiovisual system components.
D. The following are environmental control requirements for interior equipment spaces as described in the BICSI Telecommunications Distribution Methods Manual (TDMM), 13th Edition:
1. Temperature: ≈18 °C to ≈27 °C (≈64 °C to ≈81 °F)
2. Relative humidity: 60
3. Heat dissipation: ≈ 751 to ≈5016 BTU (220 to 1470 watt-hours) per cabinet

1.10 PROJECT COORDINATION PLAN

A. Contractor will submit a project plan to the General Contractor detailing the steps and associated timeframe to meet the Project's schedule requirements. Project plan should include benchmarks for items such as regular project meetings, equipment ordering, delivery, installations, configuration, calibration, testing, burn-in, training, substantial completion

notification, final testing, and final acceptance.

B. Contractor assumes responsibility for coordinating with building trades or other parties that may be identified by the General Contractor to ensure functional delivery of the audiovisual system.
C. Contractor will coordinate size and location of conduit systems, back boxes, and provisions for electrical power to specified audiovisual system equipment.
D. Contractor will obtain written permission from the General Contractor prior to routing and/or installing cable, equipment, or service through the facility.
E. Contractor will prepare the installation schedule to coordinate sequencing, dependencies, and priorities of the audiovisual system installation including work by other trades.

PART 2 PRODUCT

2.1 APPROVED MANUFACTURERS ALTERNATES

A. The following product specifications (along with those detailed on the project drawings) are presented as a basis of design in order to set minimum levels of acceptable equipment performance and functionality standard.
B. Contractor may make equipment substitutions for alternate manufacturers and/or models so long as they meet or exceed the performance and functional standard set forth in the basis of design.
C. Should Contractor make substitutions for alternate manufacturers and/or models, Contractor must provide to Consultant the following:
    1. A comprehensive list documenting the originally specified equipment and the make/model of equipment which is being proposed as an alternate.
    2. Notation on the Product Data submittal package identifying which equipment therein is an alternate and what originally specified equipment it is being substituted for.

2.2 CABLE

A. Where applicable, Provide white cable for all audiovisual horizontal cabling.
    1. Refer to Telecom specification to avoid cable color conflict.
B. 70 Volt Speaker Cable
    1. Minimum 16 AWG, twisted, stranded CL2/CL2P unless otherwise noted schematically.
C. Low Impedance Speaker Cable
    1. Minimum 12 AWG, twisted, stranded CL2/CL2P unless otherwise noted schematically.
D. Microphone Level Cable
    1. Minimum 22 AWG, with 22 AWG drain wire, shielded, twisted, stranded CL2/CL2P unless otherwise noted schematically.
E. Line Level Cable
    1. Minimum 22 AWG, with 22 AWG drain wire, shielded, twisted, stranded CL2/CL2P unless otherwise noted schematically.
F. Low Voltage Control Cable
    1. Minimum 18 AWG twisted, stranded CL2/CL2P unless otherwise noted schematically.
G. Category cable
    1. Cat6A UTP for isolated audiovisual networks.
    2. For cables connected to the Owner’s network, refer to Telecom specifications.
H. HDBaseT/Crestron DM/Extron XTP – Manufacturer’s recommendation for maximum available resolution, frame rate, color sampling, color depth and distance of connected hardware.
I. Minimum acceptable audiovisual system systems wiring performance standards will be as follows:
    1. Speaker cable - Per ANSI WC57 standard test.
    2. CAT6 - Per ANSI/TIA/EIA-568-8.1 standard test.

3. Fiber optic cable - Per ANSI/TIA/EIA-568-B standard test.
4. RS 232 - Per ANSI/ WC66 standard test.
5. Line level shielded audio cable - Per ANSI WC66 standard test.
6. Microphone level shielded audio cable - Per ANSI WC66 standard test.
7. Video coaxial cable - Per ANSI/TIA/EIA–TSB-67standard test.
8. Multi-conductor control cable - Per ANSI WC57 standard test.

2.3 AUDIOVISUAL PATHWAY

A. Install j-hooks or saddlebags four to five feet apart. Avoid uniform spacing to minimize problems with signal degradation.
B. Support j-hooks or saddlebags from decking or building structure using methods approved by the manufacturer.
C. Cable count will not exceed manufacturer’s recommended maximum. Add separate parallel j-hook pathway when cable count requires it.

2.4 AUDIOVISUAL PATCH CABLES

A. Provide audiovisual patch cables for all audiovisual plates and interconnectivity locations.
B. Minimum 6’ patch cables for device interconnect cabling.
C. Minimum 12’ patch cables for user interface connection.
D. Approved manufacturers:
   1. Extron
   2. Crestron
   3. Cables To Go (Premium)
   4. Or approved equal

PART 3 EXECUTION

3.1 GENERAL

A. The Contractor will be responsible for providing all wire and cable as required for complete and functional audiovisual system operation.
B. All cables must be continuous runs from the device location to the ultimate point of termination. Mid-run cable splices or couplers are not acceptable.
C. Make cable connections with solderless devices that are mechanically and electrically secure in accordance with manufacturer's recommendations.
D. Installation techniques which may degrade the mechanical and communications characteristics of audiovisual system cables are *not* acceptable.
E. The Contractor will not place audiovisual system wiring in the same conduit or raceway with wire for electrical power distribution.
F. Wiring Method
   1. Cable distribution will be accomplished using cable trays, j-hooks, cable runways, conduit raceways, ducts, core holes, extended columns, false half-columns, and plenums.
   2. Install cables in raceways in all locations as indicated in the design specifications and drawings excluding (but not limited to) accessible indoor ceiling spaces and hollow gypsum-board partitions.
   3. Conceal all raceways and associated wiring as indicated in the design specifications and drawings excluding (but not limited to) unfinished spaces
   4. Horizontal cable segments will be supported by distribution rings when cables enter and exit cable trays.
   5. Cables will be supported by cable runways and distribution rings when they converge at equipment room locations

6. All cable placements will be based on design specifications and drawings.

G. Wiring within Enclosures:
   1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bend radius.
      a. Provide and use lacing bars and distribution spools where necessary to accomplish the above requirements.

H. Splices, Taps and Terminations
   1. For power and control wiring, use numbered terminal strips in junction, pull boxes, outlet boxes, terminal cabinets, and equipment enclosures.
   2. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.
      a. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

I. Grounding Bonding
   1. The Division 26 contractor will be responsible for providing the required grounding means for all audiovisual system equipment per the NFPA 70, National Electrical Code (latest adopted edition), additional applicable codes, laws, or regulations from federal, state, and local AHJs, the direction from the licensed electrical engineer of record for the Project, and from the audiovisual manufacturer’s recommendations.
   2. Contractor will be responsible for ensuring ground continuity by properly bonding all appropriate audiovisual cabling, closures, cabinets, service boxes and framework to the main building grounding electrode system.
      a. All bonding connections will consist of minimum 12 AWG copper wire and will be bonded to the approved main electrical ground for the building.
      b. Contractor will coordinate with electrical engineer of record for the Project to ensure the proper grounding and bonding is completed for the audiovisual system.

3.2 CONSTRUCTION MEETINGS

A. The Consultant and/or Owner will hold regular construction meetings to review the installation schedule. It is mandatory that the Contractor's Project Manager attend each meeting.

3.3 SITE INSPECTION

A. Continuously verify that the site conditions agree with the Contract Documents and the audiovisual system design. Notify Owner's representative immediately of conditions that effect the performance of the installed system.
B. Identify and coordinate any required work that is not specified in the Contract Documents.
C. Identify and coordinate any special environmental conditions for equipment installation that is not specified in the Contract Documents.

3.4 COORDINATION

A. Verify adequate conduit, back boxes and power have been provided for the audiovisual system installation.

   1. Notify General Contractor immediately of discrepancies and/or deficiencies identified in any of these categories.

3.5 IDENTIFICATION, LABELING AND DOCUMENTATION

A. Equipment Identifications
   1. The Contractor will label all termination devices, panels, enclosures, and equipment rooms.

2. The Contractor will mark each unit with permanently attached markings that will not impair the equipment or present a hazard to maintenance personnel.

B. Cable Labeling
1. Place wire identification numbers ¼” on each end of all conductors and or connectors by using sleeve-type heat shrinkable markers.
2. Install markers to be readable from left to right or top to bottom.
3. Wire numbers will be computer printed (Brady TLS2200 with Permasleeve cable marking labels or equivalent). Hand-written labels are not acceptable.
4. Mark all spare conductors.

C. Project Documentation
1. The Contractor will establish and maintain complete system documentation including (but not limited to) the following:
   a. Floor plan and reflected ceiling drawings that indicate device locations, conduit locations, junction box locations and wire routing pathways
   b. Mounting details for all equipment and hardware
   c. Functional block diagrams for each room type with cable type identification
   d. Rack elevations
2. Contractor to maintain a progress set of design documents which will be updated daily to reflect the current condition of the work and made available for review by the Consultant and Owner upon request.
3. If audiovisual system changes occur prior to acceptance testing which alters the previously furnished documentation, the Contractor will formally update and reissue the relevant documentation to the Consultant and Owner.
4. Consultant and Owner may review all documentation for accuracy and completeness and may reject substandard submittals.

3.6 FIELD QUALITY CONTROL

A. Inspection
1. Verify that units and controls are installed, connected, and labeled in accordance with the design specifications and drawings.
2. Verify that interconnecting wires and terminals are identified in accordance with the design specifications and drawings.

B. Pre-testing
1. Verify that audiovisual system components function in compliance with the design specifications and drawings with equipment, wiring and control functionality adjustments made, as necessary.

C. Test Schedule
1. Provide a minimum of ten days' notice of test schedule to Owner.
   a. Contractor will schedule testing with the Owner after normal and functional audiovisual system operation has been observed for a period no less than fourteen days after pre-testing.

D. Operational Tests
1. Perform operational system tests for each room type to verify that audiovisual system complies with design specifications and drawings.
2. Include all modes of system operation during testing procedures.
3. Evaluate each component for proper operation in all functional modes.
4. Record test results for each room type and piece of equipment.
5. Remove and replace malfunctioning items and retest as specified above.

E. Re-test:
1. Correct deficiencies identified or observed during the testing process and re-test until specified requirements are met.

3.7 SPEAKER SYSTEM CONFIGURATION

A. Equalize speaker systems flat from 80 Hz to 2 KHz.
B. Program speaker systems with a high pass filter at 60Hz with 12dB per octave roll-off and a low pass filter 15 KHz with 12 dB per octave roll-off.
C. The Contractor will provide calibration of speaker systems using sound analyzing software/hardware (SmaartLive, TEF SoundLab, Meyer's SIM or equivalent), a suitable calibration microphone, and a trained operator capable of making (or recommending) appropriate system adjustments including (but not limited to) delay timing, cabinet aim and equalization.
D. Use a minimum of three measurement locations in the speaker systems intended coverage area to calibrate the system response.
E. The Contractor will coordinate speaker testing and calibration with the expectation that this work will take a minimum of one hour per room type.
    1. The Contractor will be responsible for coordinating with the Owner to ensure that the working environment will be quiet room during speaker testing and calibration times.
F. Contractor to record all speaker system measurements, settings, and adjustment for inclusion in the operations and maintenance manuals.

3.8 TRAINING

A. Contractor will provide competent instruction personnel to train the Owner's general, operations, facilities, maintenance and/or technical support staff on topics including (but not limited to) location, operation and troubleshooting of the installed systems.
B. Contractor to produce a custom, quick reference guide per room type with the most inexperienced audiovisual system user as the intended audience.
    1. Provide one laminated hard copy for each room location as part of the final documentation package.
    2. Provide one digital copy of the quick reference guide for each room type as part of the final documentation package.
C. Contractor will develop separate training plans with "general users" (low audiovisual technology comprehension) and "power users" (high audiovisual technology comprehension) as the intended audience.
    1. "General user" training will minimally consist of:
        a. Two independent sessions, each one-hour in duration per room type.
        b. Printed reference material for each attending trainee (written in plain language) addressing normal day-to-day operations, selectable control system features, and basic system block diagrams.
        c. Review of the quick reference guide per room type.
        d. Demonstration of control system functionality per room type.
        e. Question and answer session.
    2. "Power user" training will minimally consist of:
        a. Two independent sessions, each one-hour in duration per room type.
        b. Detailed explanation of audiovisual system components and functionality per room type empowering trainees to analyze potential malfunctions, troubleshoot issues and recommend modifications or additions.
        c. Printed reference material for each attending trainee (written in plain language) addressing technical operation, adjustment, and programming, system features, system block diagrams, and as-built drawings.
        d. Review of the quick reference guide per room type.
        e. Demonstration of control system functionality per room type.
        f. Question and answer session.
D. Training sessions to be scheduled in coordinated with the Owner after approval of formal training plans and occurring no more than six months after substantial completion.
    1. Complete operations and maintenance manuals and preliminary as-built drawings will be delivered to the Owner one week prior to the first scheduled training session.

3.9 WARRANTY

A. The Contractor will warrant the system for parts and labor for one year.
   1. Warranty commences at the time of substantial project completion acceptance by Owner.
   2. Nothing will be construed to limit this obligation to a shorter period.
B. Warranty service will be rendered on-site at the request of Owner to repair or replace any defective materials, equipment and/or workmanship without cost to the Owner unless the Owner has previously given the Contractor a written acceptance of such condition.
   1. The Owner will give prompt notice of the defect(s) either verbally or in writing to Contractor.
C. Once every six months following the of date of substantial completion, the Contractor will provide on-site maintenance to make adjustments which suit actual occupied conditions and optimize performance of the installed equipment including (but not limited to):
   1. Inspecting of all components for proper operation and installation
   2. Cleaning of equipment that features an air intake, filter, or fan
   3. Checking and testing cable connections/terminations
   4. Analyzing control system presets and graphic user interface design based on feedback from Owner
   5. Recommend changes to the audiovisual system to improve Owner's utilization of the system
D. Contractor will coordinate with the Owner to schedule the performance of required six-month on-site maintenance and include confirmation of that scheduling coordination as part of the Project close out documentation.
E. Contractor will coordinate with the Owner on scheduling service technicians (who will check in and check out with Owner at the beginning and end of each visit) to perform maintenance/warranty work.
F. Within two business days after the completion of the on-site maintenance/warranty service, the Contractor will provide the Owner a written report including (but not limited to) work performed, equipment repaired or replaced, and recommended audiovisual system updates or modifications.
G. In the event of an equipment failure which cannot be repaired on-site, the Contractor will make a reasonable effort to provide the Owner with temporary equipment to maintain audiovisual system functionality.
H. General Repair or Replacement Service
   1. Repair or replacement service during the warranty period will be performed five days a week and during Contractor’s normal business hours with a four-hour response time.
   2. If the Contractor cannot restore system operation during the warranty period within two business days of the system failure, the Owner reserves the right to require the Contractor to provide on-site manufacturer's service technicians at no additional cost.
I. Emergency Repair or Replacement Service
   1. Provide the Owner optional repair or replacement service pricing for emergency level work to be performed seven days a week and twenty hours a day with a one-hour response time as part of the Bid Response package.
J. Extended Audiovisual System Support
   1. Provide the Owner optional extended service agreement pricing, terms, and conditions to support and maintain the audiovisual system during years two through five after the final acceptance date as part of the Bid Response package.

3.10 SUBSTANTIAL COMPLETION

A. Work must meet the following requirements to qualify for the Owner's consideration of Substantial Completion:
   1. All audiovisual system devices will be completely installed, powered, online and operational.

2. All sub-system interfaces must be complete and operational.
3. Initial training schedule submitted.
4. Owner may utilize the system for its designed intent.

B. Contractor will provide a list of remaining work items and approximate completion date(s).
C. Contractor will certify in writing that all remaining work is minor in nature and will be completed in less than thirty days.

3.11 TESTING REQUIREMENTS

A. Audio Performance
   1. Harmonic Distortion
      a. Measure the total harmonic distortion of the audio system. The distortion level should not exceed industry best practices, result in an audible hiss, or create audible noise at any system gain level.
   2. Signal-to-Noise
      a. Measure the signal-to-noise ratio of the audio system. The noise level should not exceed industry best practices, result in an audible hiss, or create audible noise at any system gain level.
   3. Frequency Response
      a. Measure the system's frequency response for speech sound reinforcement, which should be determined during design. Also measure frequency response for program sound amplification.
   4. Speaker Polarity
      a. Program loudspeakers in the same system should produce consistent polarity for a mono input signal in all channels. Speech reinforcement systems should be polarized so that positive acoustic pressure on a microphone will result in positive acoustic pressure at all loudspeakers.
   5. Multiple Sources
      a. Calibrate audio system inputs so that there is zero or minimal difference between any input signal level.
   6. Conferencing Systems
      a. When working on a conferencing system, adjust the microphone input gain to demonstrate that a standard talker, positioned at each talker position in the room, produces a dBu level of zero at the output bus of the digital signal processor. Verify signal levels for both transmitting and receiving normal speech.
   7. Amplifier Loads
      a. Make sure no power amplifier exceeds its rated load. Record the impedance (and at what frequency) for each loudspeaker line of each power amp. If available, 63, 250, and 1,000 Hz are recommended.

B. Video Performance
   1. NTSC Signal Gain
      a. For NTSC sources, you should demonstrate that a consistent, 1-volt, peak-to-peak test signal at each source produces a 1-volt, peak-to-peak to each destination. Verify at each destination using NTSC bars, peak white, and five-step multiburst.
   2. Projected Displays
      a. Verify that projected displays are focused, centered, and evenly illuminated. Using a light meter, make sure a projected image has uniform brightness across the whole image, and measure the contrast ratio with ambient lighting in normal operating mode.
   3. Multiple Resolutions
      a. The video system should be able to display stable, properly scaled images with no artifacts when switching among, at minimum, 720p, 1080i, and 1080p sources, plus all sources in the performance criteria.

C. The Contractor will perform sample tests in the presence of the Consultant and Owner.
   1. All testing will comply with EIA/TIA Standards and that of the equipment manufacturers.

2. Performing the testing procedures specified herein assures that the communications cabling and system electronics meets the specified performance characteristics.
3. If testing indicates that the performance characteristics are not met, the test will be considered “failed” and any other test that may be affected by the modification and/or repair will be re-run and verified.

D. The Contractor will provide testing equipment to certify 100 operational condition of all audiovisual system cabling, components, and programming.
E. The Contractor will prepare and submit all test procedures, forms and results to the Owner and Consultant.
   1. The test procedures will have Owner and Consultant approval before the testing begins.

3.12 SYSTEM CHECK-OUT AND VERIFICATION

A. Verify continuity of cabling between field devices and controllers.
B. Commission all devices from field to front end.
C. Contractor supplied As-Built Drawings will show conduit routing.
D. Review all As-Built documentation and Operation and Maintenance manuals with Owner.
   1. Revise and reissue as required.
E. Provide As-Built/Record Drawing documentation in PDF and AutoCAD formats.
F. Demonstrate proper sequences of operation for all devices.

3.13 FINAL ACCEPTANCE OF SYSTEMS

A. Each area of construction submitted as “complete” will meet the following criteria under testing:
   1. System must meet all specifications as described in these instructions.
   2. Operational prints, manuals, signal logs and As-Built prints must be furnished.
   3. Visual testing and signal verification will be conducted at random locations to determine that equipment performs satisfactorily.
B. Specifications set forth for construction of the system have been produced to ensure system compatibility and performance.
   1. Compliance to these specifications will be determined during periodic observances of construction.
   2. Repeated failure to comply with the specifications will be considered before the acceptance phase of the Project commences.
C. Within ten days receipt of the final acceptance notice, the Owner's representatives will schedule and perform the final inspection.
   1. Declaration that the Project is “complete” will be achieved when the work is found acceptable under the contract documents and that the contract has been fully performed.

END OF SECTION 27 4100

SECTION 28 0500 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 – GENERAL

1.1 RELATED SECTIONS

A. 28 0500 Electronic Safety and Security

B. 28 1300 Access Control

C. 28 2300 Video Surveillance

1.2 DESCRIPTION

A. This Section, Requirements for Electronic Safety and Security Installations, applies to all sections of Division 28.

B. Furnish and install electronic safety and security cabling, systems, equipment and accessories in accordance with the specifications and drawings. Capacities, and ratings, of cable and other items and arrangements for the specified items are shown on drawings.

1.3 REFERENCE STANDARDS

A. Adherence to, and compliance with, the codes and standards referenced, and the UNTHSC, unique requirements and design solutions is mandatory. Requests to deviate from the industry standards and design solutions prescribed in these guidelines may be submitted, on a case-by-case basis, in accordance with the instructions in the Policy and Procedures section of these guidelines. No deviation from the requirements of the National Electrical Code (NEC) will be allowed.

1.4 CODES, STANDARDS, REFERENCES, AND APPLICABILITY

A. National Electrical Code, NFPA 70.
   1. The National Fire Protection Association has acted as the sponsor of the National Electrical Code (NEC) since 1911. The original Code was developed in 1897 as a result of the united efforts of various insurance, electrical, architectural, and allied interests. The purpose of the NEC is the practical safeguarding of persons and property from hazards arising from the use of electricity. The NEC provides the minimum code requirements for electrical safety. In security distribution design, the NEC must be used in concert with the ANSI/EIA/TIA standards identified below, which are intended to insure the performance of the security infrastructure.

B. TIA Standards
   1. The Telecommunications Industry Association (TIA) engineering standards and publications are designed to serve the public interest through eliminating misunderstandings between manufacturers and purchasers. The standards facilitate interchangeability and improvement of products, and assist the purchaser in selecting and obtaining the proper product for his or her particular need.

C. Cabling Standard, ANSI/TIA-568-C (SERIES)
   1. The ANSI/TIA-568-C (series) is the Commercial Building Cabling Standard. This standard defines a generic security wiring system for commercial buildings that will support a multi-product, multi-vendor environment. It also provides direction for the design of security cabling products for commercial enterprise.
      a. The purpose of the standard is to enable planning and installation of building wiring with little knowledge of the security products that subsequently will be installed. Installation of wiring systems during building construction or renovation is significantly less expensive and less disruptive than after the building is occupied. ANSI/TIA-568-C establishes performance and technical criteria for various wiring system configurations for

interfacing and connecting their respective elements.

D. Pathways and Spaces, ANSI/TIA-569-C (SERIES).
1. The ANSI/TIA-569-C (series) is the Commercial Building Standard for Pathways and Spaces. This standard will be followed at the UNTHSC and recognizes three fundamental concepts:
a. Buildings are dynamic. Over the life of a building, or campus, remodeling is more the rule than the exception. The standard recognizes that changes will take place.
b. Building security systems and media are dynamic. Over the life of a building, or campus, both security equipment and cabling change dramatically. The standard recognizes this fact by being as independent as possible from specific vendor equipment and media.
c. Security is more than just locks and cameras. Security also encompasses many building systems including environmental controls, fire alarms and emergency paging.
d. In order to have a building, or campus, successfully designed, constructed, and provisioned for security, it is imperative that the security design be incorporated during the preliminary architectural design phase. To accomplish this, the architect must work closely with the designated Security IT staff members.

E. Grounding and Bonding, ANSI-J-STD-607-B (SERIES)
1. The ANSI/TIA-607-B (series) (also known as ANSI J-STD-607-B) is the Commercial Building Grounding and Bonding Requirements for Security. The National Electrical Code (NEC) provides grounding, bonding, and electrical protection requirements to ensure life safety. Modern security systems require an effective grounding infrastructure to insure optimum performance of the wide variety of electronic security systems that may be used throughout the life of a building. The grounding and bonding requirements of this standard are additional technical requirements for security that are beyond the scope of the NEC. These standards are intended to work in concert with the cabling topology specified in ANSI/TIA-568-C, and installed in the pathways and spaces designed in accordance with ANSI/TIA-569-C.

F. Americans With Disabilities ACT (ADA)
1. The Americans with Disabilities Act defines accessible design considerations such as spacing between equipment, room layouts mounting heights and device and communications requirements applicable to Electronic Safety and Security designs and installations. It also contains regulations concerning alarms and signage.

G. Occupational Safety Health Administration (OSHA)
1. Through the Occupational Safety and Health Administration the federal government enforces the safety aspects of codes and standards that apply to employee working conditions. Guidelines for good practice when installing electronic safety and security systems are defined in the following documents:
a. 29CFR1910, Title 29, Labor-Part 1910 OSHA Standards.
1) 29CFR1926, Tit6le 29, Labor-Part 1926 Safety Health Regulations for Construction.
2) Individual states may have their own occupational safety divisions. Most states or localities accept certification of electrical products by a national testing laboratory as evidence that products and materials are safe for use in that jurisdiction.

H. Underwriters Laboratories Inc. (UL)
1. In the United States the Authority Having Jurisdiction (AHJ) typically requires UL testing and certification on electrical equipment. Some of the applicable standards are as shown below:
a. UL 294 (1999) Standard for Access Control System Units. UL 639 (1997) Standard for Intrusion-Detection Units.

I. BICSI Electronic Safety Security Design Reference Manual
1. The Building Industry Consulting Service International, Inc. (BICSI) is an information technology association whose mission is to provide state-of-the-art information technology and security knowledge to the industry, resulting in good service to the end user. BICSI develops and publishes the Electronic Safety and Security Design Reference Manual (ESSDRM). The

ESSDRM is not a code or standard. The ESSDRM is an extensive volume of information on the various aspects of security systems and security distribution.

a. The ESSDRM provides discussions and examples of various engineering methods and design solutions that can be selected and employed in order to meet the requirements of the NFPA and ANSI/TIA standards. Designers and installers are encouraged to use the ESSDRM as an engineering tool, within the constraints of the requirements of the UNHSC Security Infrastructure Standards.

1.5 MINIMUM REQUIREMENTS

A. References to industry and trade association standards and codes are minimum installation requirement standards.

B. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

C. Access control systems shall be designed and installed to not interfere with egress requirements for life safety nor interfere with intrusion or fire alarm systems.

D. All access controlled handicap entrances shall be fully integrated into the building access control system ensuring that while providing access to the disabled, that proper access control is maintained in both the unsecured and secured modes. Access control systems shall be installed to comply with Americans with Disabilities Act and UNHSC policies.

E. All access control installations shall using housings and mountings which maintain or minimize disruption to architectural sensibilities or themes of the buildings and campus.

F. All access control installations shall using housings and mounting designed to provide sufficient protection against tampering and vandalism. Torx center pin security fasteners shall be used on all devices installed in public areas.

G. All equipment and components to support access control system shall be installed to manufacturer’s specifications. Installation of components and hardware shall be in place prior to connection to the access control system.

H. Installations of control access system equipment hardware shall comply with requirements found in UNHSC Construction Standards.

I. All access control systems shall be configured to provide a Fail Secure with mechanical manual egress from the secure side in the event of a loss of power, loss of network communications, or system failure.

J. All access control equipped doors locking hardware shall include keyed locking mechanisms accessible from the unsecured side to allow keyed manual operation of the door.

K. All access control equipped doors shall be keyed to a key system designated for access controlled doorways.

L. All access control equipped doors shall be equipped with door position monitors and request to exit devices to allow for configuration of door condition alarms.

M. All access controlled system equipment, including controllers and power supplies, shall be located in accessible and secure rooms; with Telecommunication/ IDF rooms being preferred.

N. Electric power supplies and power converters for the access system equipment and hardware shall be connected in the Telecommunications/IDF room. Power supplies located at the access equipped door should be avoided.

O. Electrical service to access control power supplies shall be on dedicated circuits. Where practicable, electric power for the access system should be provided through the building emergency power supply.

P. All access control equipment power supplies shall be equipped with battery back up to allow operation if electrical service and emergency generated power is lost.

Q. As a minimum, provide conduit from all access devices, hardware, and equipment to ceiling location to allow for convenient access to raceways for cabling.

R. All new construction installation of access control systems shall be hardwired. In renovation or retro-fit installations hardwired installations are preferred; wireless systems may be considered with the approval of Access Services, and Project Manager, and building owner.

S. Wiring Connection Requirements: All low voltage control, monitor, power, and other cables shall be connected using sealed crimp type lugs, no wire nuts will be allowed.

T. Monitor Contacts: Door monitoring contacts, and wiring and conduits there to, shall be concealed and invisible when the door is closed. Externally applied door monitoring contacts, externally applied conduit or wire mold, and wire without conduit must be approved by Access Services, Project Manager, and building owner.

U. Request to Exit Switches: Request to exit (RX) switches should be mechanically hardware based devices. Passive infrared (PIR) or sonic detectors must not be used.

PART 2 PRODUCTS

2.1 GENERAL

A. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.

B. Product Qualification:
1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
2. The University reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.

C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.7 MANUFACTURED PRODUCTS

A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.

B. When more than one unit of the same class of equipment is required; such units shall be the product of a single manufacturer.

C. Equipment Assemblies and Components:
1. Components of an assembled unit need not be products of the same manufacturer.
2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
3. Components shall be compatible with each other and with the total assembly for the intended service.
4. Constituent parts which are similar shall be the product of a single manufacturer.

D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.

E. When Factory Testing Is Specified:
1. The Owner shall have the option of witnessing factory tests. The contractor shall notify UNHSC through the Construction Manager a minimum of 15 working days prior to the manufacturers making the factory tests.

2. Four copies of certified test reports containing all test data shall be furnished to the Resident Engineer prior to final inspection and not more than 90 days after completion of the tests.
3. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including expenses of the University.

1.8 EQUIPMENT REQUIREMENTS

A. Where variations from the contract requirements are requested in accordance with Section 00 7200, GENERAL CONDITIONS and Section 01 3323, Shop Drawings, Product Data, And Samples, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

1.9 EQUIPMENT PROTECTION

A. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain:
1. During installation, enclosures, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of foreign matter; and be vacuum cleaned both inside and outside before testing and operating and repainting if required.
2. Damaged equipment shall be, as determined by the Resident Engineer, placed in first class operating condition or be returned to the source of supply for repair or replacement.
3. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
4. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

PART 3 - EXECUTION

3.1 WORK PERFORMANCE

A. Job site safety and worker safety is the responsibility of the contractor.

B. For work on existing buildings, arrange, phase and perform work to assure electronic safety and security service for other buildings at all times. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 0000, GENERAL REQUIREMENTS.

C. The contractor’s Project Manager shall attend a pre-installation meeting with the Owner and design team prior to working on the project.

D. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 0000, GENERAL REQUIREMENTS.

E. Coordinate location of equipment and conduit with other trades to minimize interferences. See Section 00 7200, GENERAL CONDITIONS.

3.2 EQUIPMENT INSTALLATION AND REQUIREMENTS

A. Equipment location shall be as close as practical to locations shown on the drawings.

B. Inaccessible Equipment:
1. Where the University determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the University.
2. Conveniently accessible is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

3.03 EQUIPMENT IDENTIFICATION

A. Install an identification sign, which clearly indicates information required for use and maintenance of equipment.

B. Nameplates shall be laminated black phenolic resin with a white core with engraved lettering, a minimum of 6 mm (1/4 inch) high. Secure nameplates with screws. Nameplates that are furnished by manufacturer as a standard catalog item, or where other method of identification is herein specified, are exceptions.

3.4 SUBMITTALS

A. Submit in accordance with Section 01 3323, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. The Universities approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site.

C. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the University to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.

D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
1. Mark the submittals, SUBMITTED UNDER SECTION .
2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
3. Submit each section separately.

E. The submittals shall include the following:
1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
2. Elementary and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
3. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.

F. Manuals: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
1. Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections. Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.
2. Inscribe the following identification on the cover: the words MAINTENANCE AND OPERATION MANUAL, the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.
3. Provide a Table of Contents and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
4. The manuals shall include:
   a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
   b. A control sequence describing start-up, operation, and shutdown.

c. Description of the function of each principal item of equipment.
d. Installation and maintenance instructions.
e. Safety precautions.
f. Diagrams and illustrations.
g. Testing methods.
h. Performance data.
i. Pictorial exploded parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
j. Appendix; list qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.

G. Approvals will be based on complete submission of manuals together with shop drawings.

H. After approval and prior to installation, furnish the Resident Engineer with one sample of each of the following:
1. A 300 mm (12 inch) length of each type and size of wire and cable along with the tag from the coils of reels from which the samples were taken.
2. Each type of conduit and pathway coupling, bushing and termination fitting.
3. Conduit hangers, clamps and supports.
4. Duct sealing compound.

3.5 SINGULAR NUMBER

A. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., the switch), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

3.6 TRAINING

A. Training shall be provided in accordance with Article, INSTRUCTIONS, of Section 01 0000, GENERAL REQUIREMENTS.

B. Training shall be provided for the particular equipment or system as required in each associated specification.

C. A training schedule shall be developed and submitted by the contractor and approved by the Resident Engineer at least 30 days prior to the planned training.

END OF SECTION

SECTION 28 1300 - ACCESS CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Security access devices.

B. Access control panel.

1.2 RELATED SECTIONS

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

B. Specification Section 28 0500, Electronic Safety and Security Work Results, apply to this Section.

C. Section 08 7100 - Door Hardware.

D. Section 14 2010 - Passenger Elevators.

1.3 REFERENCES

A. NFPA 70 - National Electrical Code; National Fire Protection Association.

1.4 ACCESS CONTROL

A. All access control and intrusion detection components shall be the most current model or version available and shall be compatible and interoperable with other installed systems such as digital video management, fire alarm, and building environmental control systems. The system shall be an IP based open architecture type system that facilitates monitoring from numerous workstations throughout the system. The system shall provide interface with client workstations with the police dispatch center.

B. The Access Control system consists of sub-systems such as Access Control and Intrusion Detection servers, workstations and software, data gathering panels, LAN interface cards, card readers, door position sensors and request to exit devices. The system shall allow for controlled entrances to be programmed to lock and unlock on a predetermined schedule. The security integrator shall coordinate with campus personnel to ascertain the desired door scheduling and program the system to meet the schedule. Each time an entry is made with a valid credential the system shall record and store that information on the server to provide an audit trail of when a door was opened (date and time), who's credential was presented for access (users name and card number). The system shall also record and store the date and time of each alarm occurrence of a door being opened without presentation of a valid credential or when a door remains open for longer than a preset time programmed in the software. This information shall be continuously displayed on server and workstation monitors and shall be recallable and printable from these stations. It is the responsibility of the security integrator to verify proper operation of devices and systems prior to final acceptance.

1. The card readers shall be proximity readers and be programmable from a server or workstation equipped with the security software. Card readers shall work such that upon presentation of a valid ACID keycard, the unique card data shall be transmitted to an associated control panel where the data is compared to an authorized user database and access is approved or rejected accordingly. A valid authorization will activate operation of the electric lock and shunt the door status switch. The alarm shunt will not affect supervision of the detection circuit.

1.5 SYSTEM DESCRIPTION

A. Security Access System: Control access to building using encoded cards:
   1. Selected Exterior Doors: Control access into building.
   2. Selected Building Areas: Control access into restricted areas.
   3. As an Alternate: Provide event-based tie-in to camera-view call ups.

1.6 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Provide system wiring diagram showing each device and wiring connection required.

C. Product Data: Provide electrical characteristics and connection requirements.

D. Test Reports: Indicate satisfactory completion of required tests and inspections.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

F. Project Record Documents: Record actual locations of access authorization equipment.

G. Operation Data: Operating instructions.

H. Maintenance Data: Maintenance and repair procedures.

1.7 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.

C. Installer Qualifications: Company specializing in installing the products specified in this section with minimum three years documented experience.

D. Products: Furnish products listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and indicated.

1.8 MAINTENANCE SERVICE

A. Furnish service and maintenance of security access system for one year from Date of Substantial Completion.

1.9 EXTRA MATERIALS

A. Provide 50 spare capacity on AMAG door modules, input boards, output boards and the required board enclosures.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Security Access System:
   1. AMAG

2.2 COMPONENTS

A. Security Access Control Panel:

1. Product: AMAG Symmetry M2150 Series -
2. Substitutions: Not allowed.

B. Encoded Card Readers:
1. Exterior Doors - Product: HID Corp. R40 i-Class Reader (Wiegand)
2. Handicap Equipped Entrances: HID Corp. R90 Long Range i-Class Reader (Wiegand)
3. Interior Doors - Product: HID Corp. R40 i-Class Reader (Wiegand)
4. Handicap Equipped Interior Doors: HID Corp. R90 Long Range i-Class Reader (Wiegand)
5. Parking Vehicle Entrances: HID Corp. R40 Long Range i-Class Reader (Wiegand)
6. Elevator Doors - Product: HID Corp. R40 i-Class Reader (Wiegand)

C. PIR Exit Devices:
1. Not used.

D. Exit Buttons:
1. Product: RCI or approved alternative
2. Substitutions: See Section 01 6000 - Product Requirements.

E. Door Modules:
1. Product: AMAG M2150 8DC, M2150 4DC
2. Substitutions: See Section 01 6000 - Product Requirements.

F. Input Boards:
1. Product: AMAG AC24/4
2. Substitutions: See Section 01 6000 - Product Requirements.

G. Output Boards:
1. Product: AMAG OC4/24
2. Substitutions: See Section 01 6000 - Product Requirements.

H. Power Supplies:
1. Product: Altronix AL600ACMCB220 Power Supply
2. Securitron AQD series Power Supply
3. No other substitutions allowed

I. Electric Panic Device Doors:
1. Product: Von Duprin PS914 with 900-2RS option board. Must include battery back-up with appropriate option board for specified panic devices.
2. Substitutions: See Section 01 6000 - Product Requirements.

J. Card Access and Cable:
1. Product: Belden B658AFS.
2. Substitutions: See Section 01 6000 - Product Requirements.

K. Input Supervision:
1. Product: GRI 6644 or approved alternate
2. Substitutions: See Section 01 6000 - Product Requirements

L. Delayed Egress Door “Monitor” Cable:

1. 6 conductor 18 gauge plenum rated cabling

2. 2 conductor 12 gauge plenum rated cabling

M. Door Position Switch:
1. GRI 180 Series or approved alternate

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Use 20 AWG minimum size conductors for detection and signal circuit conductors. Install wiring in conduit.

C. Make conduit and wiring connections to door hardware devices furnished and installed under Section 08 7100.

D. Provide supervision for each input. Locate end of line resistors at the device to provide supervision for the entire cable connection.

3.2 DEVICE POSITIONING

A. Card readers shall be installed at an ADA compliant height of 40 above grade. The door position sensors shall be concealed, flush mounted units, mounted in top of the door frame approximately 4 to 6 inches from the opening edge of the door.

3. 3 TEST PROCEDURES

A. Field Test Reports: Upon completion and testing of the installed system, test reports shall be submitted in booklet form and electronic media showing all field tests performed on, and adjustments made to each/any component and all field tests performed to prove compliance with the specified performance criteria. Indicate and interpret test results in written form and verbally to owner/4b Technology for compliance with performance requirements at a pre-scheduled meeting.

1. Specific test and verification requirements by demonstration or test are as follows. Owner reserves the right to witness any and all tests.
    a. Following factory assembly and delivery, the security subcontractor shall individually test each component and sensor and verify the proper functioning of each component within a particular sub-system.
    b. Following installation, individually test each component and sensor and verify the proper functioning of each component within a particular sub-system. Similarly test each sub-system until all detection zones, alarm assessment components, alarm reporting and display, and access control functions have been verified. Prior to final functional and operational tests of the system correct any deficiencies. After sub-system verification is complete, test the entire system to assure that all elements are compatible and function properly as a complete system.
    c. Upon completion of the above outlined tests conduct a formal test to be known as the “System Operational Test”, in which all components and sub-systems of the security system are demonstrated to operate together as a system. This test is to be performed over a continuous seventy-two (72) hour period. A formal test plan and test procedures for each portion of the test shall be prepared by the security subcontractor and submitted to the Owner/Architect for approval. The subcontractor must demonstrate that the security system components and sub-systems meet specification requirements in the “As-Installed” operating environment during the “System Operational Test”. While no formal environmental testing is required, temperature, humidity and other environmental parameters should be measured and recorded. Include this data in the test report document for the “System Operational Test.

3.4 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with Section 01 4000.

3.5 MANUFACTURER'S FIELD SERVICES

A. Include services of technician to supervise installation, adjustments, final connections, system testing, and to train UNTHSC personnel.

3.6 DEMONSTRATION

A. Demonstrate normal and abnormal modes of operation, and required response to each.

B. Provide 8 hours of instruction each for two persons.
   1. Conduct instruction at project site with manufacturer's representative.

END OF SECTION

SECTION 28 2300 - VIDEO SURVEILLANCE

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Cameras.

B. Control equipment.

C. Cable and accessories.

1.2 RELATED SECTIONS

A. Section 28 1600 - Intrusion Detection.

B. Section 28 1300 - Access Control.

1.3 REFERENCES

A. NFPA 70 - National Electrical Code; National Fire Protection Association.

B. Video surveillance systems shall be installed in compliance with Federal Law, State Law, Texas State Construction Standards, and UNTHSC policies.

1.4 SYSTEM DESCRIPTION

A. The video surveillance system is an Internet Protocol (IP) camera based system that runs off of signal and low voltage power generated by a Power over Ethernet (PoE) data network switch and using signals transmitted over Local and Wide Area Network cable.

B. UNTHSC currently uses the Strand video surveillance system.

C. All video surveillance or documentation systems shall be recorded and stored using the current Strand video documentation system and administered by the University Security Department.

D. All video camera systems, equipment, and accessories shall be fully compatible and integrated with the current UNTHSC video surveillance system.

E. All additional accessories or supporting hardware shall be fully compatible with and able to integrate with existing campus systems.

PART 2 PRODUCTS

2.1 COMPONENTS

A. Indoor Dome Camera: Axis Communications P3265-V or Owner approved equal

1. All indoor dome cameras to be installed with Axis TP3202 recessed mount

B. Interior 360 Camera: Axis Communications M3058-PLVE

1. All indoor 360 cameras to be installed with Axis TM3208 recessed mount

C. Exterior Dome Camera: Axis Communications P3265-LVE or Owner approved equal

D. Camera Licenses: Strand (OFOI)

E. Network Video Recorder: Strand NVR (Existing)

2.2 ACCESSORIES

A. Main Video Cable: Category 6

1. Product: As determined by Section 27 15 00.

B. Cabinet: Free-standing equipment rack (Provided by Communications Installer).
1. Size: As indicated.

PART 3 EXECUTION

3.1 COORDINATION

A. Cable Contractor shall fully cooperate and coordinate with Owner as required to ensure proper integration and connectivity between systems.

B. As a minimum, provide conduit for all video surveillance wiring and/or infrastructure exposed to the public view.

C. All video surveillance system equipment, including encoders and power supplies, shall be located in Telecommunication/ IDF rooms.

D. All video surveillance installations shall provide adequate housings and environmental controls to insure proper operation of camera determined by environmental conditions and building usage. Provide protection from accidental and intentional damage or tampering. Torx with center pin security fasteners shall be used for devices in public areas.

E. All equipment and components to support video surveillance system shall be installed to manufacturer's specifications. Installation of components and hardware shall be in place prior to connection to the video surveillance system.

F. Where practical the electric power for the video surveillance system equipment and hardware shall be connected through the building emergency power system or provided with appropriate battery back up systems.

G. Exterior mounted cameras shall be appropriately protected from lightning strikes.

H. Data cable runs shall be limit to no more than 290 ft from the camera device and switch. During design and installation close attention should be paid to the distance of cabling runs for video surveillance.

I. Camera installations requiring cable runs longer than 290 ft shall use coaxial cable to transmit video signal to a digital encoder located in the telecommunications/IDF closets.

J. Hardwired solutions for transmission of video surveillance data are preferred. All wireless transmission of video surveillance data requires prior written approval by UNTHSC

K. Wireless data links to video surveillance system shall be configured point to point and dedicated to the transmission of video. When practicable wireless data transmission should be encrypted or protected to prevent unintentional and intentional interception or disruption of the data transmission.

L. All data transmissions between cameras and recording servers or devices shall be encrypted or made on secure network pathways to ensure data cannot be intercepted or manipulated.

M. The final building video surveillance system shall be approved by the Security Department Supervisor,

END OF SECTION

SECTION 28 3107 - EXTENSION OF EXISTING FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

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

B. Provide all labor, materials, supervision, tools, services, equipment and incidentals necessary for complete and operational systems as specified under this division and as shown on the Contract Drawings. This section expands and supplements the requirements of Division 01.

C. Refer to Section 260510 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.

1.2 SCOPE

A. The work covered by this section of the specifications includes the furnishing of all design, labor, equipment, materials, programming, testing and performances of all operations in connection with the extension of the existing Notifier addressable fire alarm system as shown on the drawings, as specified herein, and as required by City of Fort Worth Fire Department, and the Texas Department of Licensing and Regulation Texas Accessibility Standards.

B. The complete installation shall conform to the applicable section of NFPA-72A, NFPA 71, local code requirements and National Electrical Code Article 760.

C. The work covered by this section of the specifications shall be coordinated with the related work as specified elsewhere under the project specifications.

1.3 QUALITY ASSURANCE

A. Each and all items of the fire alarm system shall be listed as a product of Notifier by Honeywell under the appropriate category by Underwriter's Laboratories, Inc. (UL), and shall bear the UL label. All control equipment shall be listed under UL Category 1076 as a single control unit. Partial listing shall NOT be acceptable.

B. Qualifications of the Installer

1. The installing contractor shall specialize in the design and installation of fire alarm systems. The firm shall have a minimum of three years of verifiable commercial fire alarm system design and installation experience.

2. State License. The firm shall be registered as a fire alarm contractor Alarm Certificate of Registration (ACR) with the Texas State Board of Insurance Underwriters (TDI) and have in its employ, a Fire Alarm Planning Superintendent (APS), licensed by the Texas State Board of Insurance Underwriters (TDI); and Fire Alarm Technician(s) (FAL), licensed by the Texas State Board of Insurance Underwriters (TDI). The firm shall also be an authorized NOTIFIER® authorized distributor.

3. Installer Qualifications: Installer(s) must be Fire Alarm Technician (FAL), licensed by the Texas State Board of Insurance Underwriters (TDI), and be a certified NOTIFIER® equipment technician.

4. Insurance: The installing firm shall carry liability insurance in the amount and manner specified by the Texas State Board of Insurance Underwriters (TDI) to install fire alarm systems.

5. All fire alarm panel, ONYXWorks® and their associated programming shall be done by a NOTIFIER® certified technician.

6. Before commencing work, the installing contractor shall submit data showing that the contractor has successfully installed fire alarm systems of the same type and design as specified, or that they have a firm contractual agreement with a state licensing subcontractor having the above required manufacturer's training and experience. The contractor shall include the names and locations of at least two installations where the contractor, or the subcontractor above, has installed such systems. Specify the type and design for each system and furnish documentation that the systems have performed satisfactorily for the preceding 18 months.

C. Provide the Owner's Representative with:

1. Manufacturer's certificate showing materials meet or exceed the minimum requirements as specified.

2. A copy of installing company's license to sell and install fire alarm systems in the State of Texas.

3. A copy of job superintendent's license to supervise installation of fire alarm systems in the State of Texas.

4. Shop drawings and wiring diagrams with equipment counts and locations shall be submitted to the local authority for approval and signature prior to submitting to Engineer through proper channels. The shop drawings must be approved by the Engineer prior to commencing work. Room names must be shown on shop drawings.

1.4 GENERAL

A. Furnish and install a modification to the existing fire alarm system as described herein and as shown on the plans; to be wired, connected and left in first class operating condition. The system shall include all required hardware, raceways, wiring and software to accomplish the requirements of this specification.

1.5 REFERENCE STANDARDS

A. The publications listed below form a part of this publication to the extent referenced. The publications are referenced in the text by the basic designation only. The latest version of each listed publication shall be used as a guide unless the authority having jurisdiction has adoped an earlier version

1. Texas Department of Insurance (TDI) State Fire Marshal's Office;

2. National Fire Protection Association (NFPA):

a. NFPA 72 Standard for the Installation, Maintenance and use of Protective Signaling Systems;

b. NFPA 13 Standard for the Installation of Sprinkler Systems;

c. NFPA 70 National Electrical Code;

d. NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems;

e. NFPA 101 - Life Safety Code.

3. Texas Insurance Code Chapter 6002, Fire Detection and Alarm Device Installation;

4. 28 TAC §§ 34.600 The Fire Alarm Rules;

5. Underwriter's Laboratories, Inc. (UL);

6. Texas Accessibility Standards (TAS);

7. UNTHSC Specifications.

1.6 SUBMITTALS

A. The contracting firm shall submit copies of its Texas Department of Insurance (TDI) Fire Alarm Contractor Registration (ACR), Fire Alarm Planning Superintendent License (APS) and the required TDI's Liability Insurance Certificate, signed by a Texas Insurance Agent.

B. The contractor shall include the following information in the equipment submittal;

1. Power calculations.

a. Battery capacity calculations. Batteries shall be sized at least 150% of the calculated requirement.

b. Supervisory power requirements for all equipment.

c. Alarm power requirements for all equipment.

d. Power supply rating justification showing power requirements for each of the system power supplies. Power supplies shall be sized to furnish the total connected load in a worst case condition.

e. Justification showing power requirements of the system amplifiers.

f. Voltage drop calculations for wiring runs demonstrating worst case condition.

2. Complete manufacutrer's catalog data including supervisory power usage, alarm power usage, physical dimensions, finish and mounting requirements.

3. Data describing more than one type of item shall be clearly marked to indicate the type the contractor intends to provide for options not crossed out in submittal material will be furnished for the project. All submittal material shall be complete. Partial submittals will not be evaluated and will be rejected without comment.

4. Submit panel configuration and interconnection of modules and all other data as required to make an informed judgment regarding product coverage and performance. At a minimum, data shall be submitted on the following:

    a. Master system CPU including all fire detection, voice/audio and visual evacuation alarm control modules, and supervised power amplifiers with the required back up modules.

    b. Circuit interface panels including all modules.

    c. Power supplies, batteries, and battery chargers.

    d. Pre-amplifiers, amplifiers, tone generators, master microphone and master telephone.

    e. Equipment enclosures, including dimensions and weights of completed units.

    f. Intelligent addressable manual pull stations, heat detectors, analog smoke detectors, alarm monitoring modules, and supervised control modules.

    g. Annunciator panels.

    h. Audible and visual evacuation signals and devices.

    i. Software and firmware as required to provide a complete functioning system.

    j. Circuiting, including conduit and wire sizes.

    k. All interface and connection with ONYXWorks® remote terminals - UNTHSC and Fire Systems Offices.

C. Complete drawings covering the following shall be submitted by the contractor for the proposed system;

1. Floor plans showing all communicating, initiating, supervisory, indicating appliances, and output control devices; including circuit interface panels, message digitizers, amplifiers, annunciators, video display terminals, color graphic displays, transponders and the main CPU locations. Raceways shall be shown, marked for size, conductor count with type and size, showing the percentage of allowable National Electric Code fill used. Drawings shall indicate ambient sound levels used by the system installer for sound level calculations.

    a. The FAAP, remote power supplies, electronic control boards and batteries shall be installed in rooms or locations where relative humidity is maintained at less than 90% and temperature is maintained between 60° - 80° F.

2. Wiring diagrams showing points of connection and terminals used for all electrical connections to the system devices and panels.

D. A complete proposed system database including a description of all logic strings, control by event programming and point identification labels on a CD ROM and in a formatted printed form, as required for offsite editing, uploading and downloading shall be submitted for evaluation by the owner. A programming manual shall accompany the submitted program and shall be adequate to allow understanding, operation and editing by the system owner.

E. For use in system test, a complete operation and maintenance manual with two sets of proposed installation drawings shall be submitted.

1. The following information shall be inscribed on the cover:

a. "OPERATION AND MAINTENANCE MANUAL"

b. Building Name and address

c. The name of the fire alarm firm/contractor, Alarm Planning Superintendent and alarm system manufacturer.

2. The manual shall be legible and easily read with a full size copy of record drawings folded and contained in pockets. Included shall be installation instruction, maintenance documentation.

F. Upon completion of the installation, record drawings shall be submitted on each system before final acceptance of the work. In addition to the records drawings masters shall be high quality for legibility and reproduction and on high density CD ROM in an AutoCAD DXF format.

PART 2 - PRODUCTS

2.1 FIRE ALARM SYSTEM AND REMOTE POWER SUPPLIESS

A. System Operation: Refer to UNT System Design and Construction Standards for system operation requirements.

2.2 REMOTE CIRCUIT INTERFACE PANELS

A. Remote circuit interface panels shall consist of an enclosure, a remote power supply, digital communications circuitry, mother boards, batteries and hardware, modules and circuitry described for inclusion in the fire alarm control panel as required to function as specified.

1. Circuit interface panels, when required, include conventional zone module, analog loop drivers, indicating appliance circuits, output circuitry to perform actions, speaker supervisory and distribution circuits. All fire detection, alarm and indicating devices supported by the circuit interface panel shall function as a self-standing system in the failsafe mode upon loss of the central fire alarm control panel processing, communications or the communications wiring between them.

2. Smoke detectors shall alarm at their programmed sensitivity settings and shall not revert to a common default setting when their operating system segment is in the default mode.

3. Circuit interface panels shall support remote system displays, annuciators and printers. Test procedures shall be capable of initiation at the main fire control panel, any remote LCD annunciator or any remote interface panel equipped with a keypad.

2.3 DETECTOR BASES

A. Detector Bases - Detector bases for public areas shall be low profile, surface or flush mounted on a standard 4" square by 2-1/8" deep box. Bases shall be able to accept photoelectric, ionization or heat detectors.

B. Detector Bases for sleeping/dwelling units shall be sounder bases for all system smoke detectors located in sleeping/dwelling units. Sounders shall produce a low frequency 520 Hertz ± 10% frequency alarm signal that complies with NFPA 72 Section 18.4.5.

2.4 SMOKE DETECTORS - PHOTOELECTRIC

A. Furnish and install intelligent analog photoelectric smoke detectors in accordance with NFPA 72, in all sleeping/dwelling units and public areas and where indicated on the drawings.

1. Manufacturers:

a. Detector shall be campus standard System Sensor, no exception.

2.5 DUCT DETECTORS - PHOTOELECTRIC

A. Furnish and install where indicated on the drawings, intelligent analog smoke detectors.

1. Manufacturers:

a. Detector shall be campus standard System Sensor, no exception.

1) If mounted where the detector is not redily accessible or within normal view, a remote visual indicator and control for testing and re-setting unit shall be installed in close proximity in a readily accessible, viewable location.

2.6 HEAT DETECTORS, INTELLIGENT RATE COMPENSATED

A. Furnish and install where indicated on the drawings, intelligent analog smoke detectors.

1. Manufacturer:

2. Detectors shall be campus standard System Sensor, no exception.

2.7 MANUAL STATIONS, INTELLIGENT

A. Provide double action, intelligent, manual fire alarm "Pull Stations" where shown on the plans. Pull stations shall be:

1. Manufacturer:

a. Pull Stations shall be campus standard NOTIFIER®, no exception, and shall be:

1) red in color;

2) provide a clear indication when activated;

3) labeled "FIRE"

4) equipped with terminal strip and pressure style screw terminals for the connection of field wiring;

5) flush mounted.

2.8 MAGNETIC HOLD OPEN DEVICE

A. Provide 24 VDC magnetic hold open devices where indicated in architectural door hardware specification. Devices shall release upon activation of a fire alarm.

2.9 INTELLIGENT SYSTEM INTERFACE MODULE

A. Furnish and install, for the monitoring of contact type initiation devices and for the control of electrical devices where required, intelligent analog signaling circuit interface module.

B. The module shall be suitable for two wire, two way communications on the intelligent analog signaling circuit. The module shall display a flashing LED for each circuit, in the normal power or standby power condition. The module shall display a steady LED when the alarm state or during control circuit activation.

C. Modules shall incorporate triple technology microprocessor chips including analog, digital and EEROM technologies on the single device.

2.10 EVACUATION SIGNALS

A. Speakers: Shall be of the polarized 24-VSC type. Speaker shall be UL listed for fire alarm voice evacuation use. Speakers shall be designed to be mounted on a wall, ceiling or other suitable rigid surface and shall be capable of being surface, semi-flush, or flush mounted. Speakers shall be multi-tap. Settings shall be 1/16, 1/8, 1/4, 1/2, 1, 2, or 4 watts.

1. Speech Intelligibility: The emergency voice communication system shall be designed to meet a Common Intelligibility: The emergency voice communication system shall be designed to meet a Common Intelligibility Scale (CIS) of not less than 0.70.

B. Strobe Light: Visual notification appliances shall be comprised of a xenon flashtube and be entirely solid state. These devices shall be UL listed and available for ceiling or wall mounting.The unit shall be Texas Accessibility Standards (TAS) compliant with and output no less than 15 candela. The Lexan lens shall be pyramidal in shape to allow better visibility. All strobe lamps and lenses shall be clear. Strobe light vandela ratings shall be shown on the fire alarm plans. Contractor is responsible for providing number of strobes and candela sizing per NFPA 72 based on room size and device location. Units shall be installed 80" above finished floor. All strobes within the same line of site shall be synchronized. Provide multi-tap strobes to allow for a full range of candela settings. Settings shall be 15/75, 30/75, 75 or 110 candela. Circuits for strobes shall allow for capacity to increase strobe intensities one setting for all strobes. Provide spare devices equal to 1% of the toal number of new devices provided for this project.

C. Speaker/Strobe combination: Units shall meet TAS. Audio/Visual units shall provide a common enclosure for the fire alarm audible and visual alarm devices. The housing shall be designed to accommodate either horns, bells, chimes or speakers. The unit shall be complete with a tamper resistant, Lexan lens visible from a 180-degree field of view. Strobe shall be multi-tap type to allow for a full range of candela. Xenon strobe shall provide 4-wire connection to insure properly supervised in/out system connection. Unit shall be complete with all mounting hardware including back box. Audio/visual unit shall be UL listed for its intended purpose. Speaker shall be multi-tap type to allow for different audio settings. Provide spare devices equal to 1% of the total number of new devices provided for this project.

D. The evacuation signal device shall be available in flush, semi-flush, or surface mount versions as required for signal locations shown on the contract documents. Devices shall be mounted using a listed outlet box. Signals shall be available in visual and audio/visual to satisfy all required project applications. Device housing shall be white and without any label.

E. Dual screw barrier type terminal strips shall be provided within the interface terminal box. Terminals shall be provided for each interface output from the fire alarm system and the manual unlock key switch. All terminals shall be labeled to identify their function.

F. The output contacts from the fire alarm system shall be rated for 1A at 120V.

PART 3 - EXECUTION

3.1 DESIGN AND INSTALLATION DRAWINGS

A. Show a general layout of the complete system including equipment arrangement. It shall be the responsibility of the fire alarm contractor to verify dimensions and assure compatibility with all other systems interfacing with the fire alarm system.

1. Identify on the drawings, conduit and conductor sizes and types with number of conductors in each conduit. Provide each conduit and device with a unique identification. For addressable alarm initiation devices, the system identifier shall be the system address for that device. Signals shall be sequentially numbered as the addess of the controlling module.

2. Indicate on the point to point wiring diagrams, interconnecting wiring within the panel between modules, and connecting wiring to the field device terminals.

3. Provide mounting details of FACP and other boxes to building structure, showing fastener type, sizes, material and embedded depth where applicable.

3.2 INSTALLATION

A. All work shall be in compliance with Section 1.3, REFERENCE STANDARDS contained in the UNT System Design and Construction Standards.

B. All work shall be accomplished in a professional and workmanship like mannner.

C. A qualified fire alarm technicial shall supervise the installation, testing and adjustment of the fire alarm equipment.

D. The Fire Alarm contractor is responsible for patching and repairing walls and/or ceilings penetrations made by the fire alarm contractor or his/her designated subcontractor(s) where wiring, conduit or devices are installed or removed. Holes in smoke barrier or fire-resistive construction walls and ceilings shall be properly sealed with approved UL listed materials and/or UL listed fire stop/smoke devices designed for such use or location. The smoke or fire stop material or devices shall be approved by the wiring manufacturer for compatibility with the wiring material it contacts. Whichever method is approved, it shall be installed per the UL listing of the specific product.

E. Contractor shall provide fire watch during all times that existing system coverage is down as a result of renovation work associated with this project.

3.3 CONDUITS

A. All wiring shall be installed in conduit, minimum 3/4" EMT. Plenum rated cable with J-hooks may be used above ceiling.

3.4 ENCLOSURES AND WIRING DEVICES

A. Wiring enclosures and equipment device boxes shall be sized and installed per NFPA 70.

1. All fire alarm J-Boxes and their covers shall be painted red. The cover shall be labeled "FA System" in mimimum 1/2 inch letters with permanent black ink.

3.5 CONDUCTORS

A. All fire alarm systems shall be installed in such a manner that a failure of any single initiating device or single open in an initiating circuit conductor will not interfere with the normal operation of other such devices. All signaling line circuits (SLC) shall be installed such that a single open will not interfere with the operation of any addressable devices (Class A). Outgoing and return SLC conductors shall be installed in accordance with NFPA 72 requirements for Class A circuits and shall have a minimum of four feet separation horizontal and one foot vertical between supply and return circuit conductors. The initiating device circuit (IDC) from a signaling line circuit interface device may be wired Class B, provided the distance from the interface device to the initiating device is ten feet or less. NAC circuits shall be wired Class A.

B. Each conductor shall be identified as shown on the shop drawings with wire markers at every splice and terminal point. Attach permanent wire markers within 2 inches of each wire termination. Marker legends shall be visible.

1. All wiring shall b e supplied and installed in compliance with the requirements of the National Electric Code, NFPA 70, Article 760, and that of the manufacturer.

2. Wiring for analog loop circuits and speaker circuits shall be minimum 18 AWG twisted. Wiring for strobe circuits shall be a minimum 14AWG.

3. Wiring shall be installed without splices or joints. Connections shall be made to the device terminals or equipment terminal strip.

4. Crimp-on type spade lugs shall be used for terminations of stranded conductors to binder screw or stud type terminals. Spacde lugs shall have upset legs and insulation sleeves sized for the conductors.

C. Permanently label or mark each conductor at each end and at all terminals with permanent alphanumeric wire markers.

D. Provide Type CI, 2 hour rated circuit integrity cable for riser wiring and hwerever else reqired per code.

3.6 CERTIFICATE OF COMPLIANCE

A. Complete and submit to the Owner in accordance with NFPA 72.

3.7 FIELD QUALITY CONTROL

A. Testing, General.

1. All intelligent analog devices shall be tersted and logged for correct address and sensitivity using test equipment specifically designed for that purpose. These devices and their bases shall be tagged with adhesive tags located in an area not visible when installed, showing the system address, initials of the intalling technician and date.

2. Wiring runs shall be tested for continuity, short circuit and grounds before system is energized. Resistance, current and voltage readings shall be made as work progresses.

a. A systematic record shall be maintained of all readings using schedules or charts of tests and measurements. Areas shall be provided on the logging form for readings, dates and witnesses.

b. The acceptance inspector shall be notified before the start of the required tests. All items found at variance with the drawings or this specification during testing or inspection by the acceptance inspector, shall be corrected.

c. Test reports shall be delivered to the acceptance inspector as completed.

3. All test equipment, instruments, tools and labor required to conduct the system tests shall be made available by the installing contractor. The following equipment shall be a minimum for conducting the tests:

a. Ladders and scaffolds as required to access all installed equipment.

b. Multimeter for reading voltage, current and resistance.

c. Intelligent device programmer/tester.

d. Laptop computer with programming software for any required program revisions.

e. Two way radios, flashlights, smoke generation devices and supplies.

f. A manufacturer recommended device for measuring air flow through air duct smoke detector sampling assemblies.

g. Decibel meter.

4. In addition to the testing specified to be performed by the installing contractor, the installation shall be subject to test by the acceptance inspector.

5. System wiring: fire alarm circuits shall be tested for continuity, grounds, and short circuits.

B. Acceptance testing.

1. A written accepance test procedure (ATP) for testing the fire alarm system components and installation will be prepared by the Acceptance Inspector in accordance with NFPA 72, and this specification. The contractor shall be responsible for the performance of the ATP, demonstrating the function of the system and verifying the correct operation of all system components, circuits, and programming.

2. A program matrix shall be prepared by the installing contractor referencing each alarm input to every output function affected as a result of an alarm condition on that input. In the case of outputs programmed using more complex logic functions involving "any", "or", "not", "count", "time", and "timer" statements; the complete output equation shall be regerenced in the matrix.

3. A complete listing of all device labels for alpha numeric annunciator displays and logging printers shall be prepared by the installing contractor prior to the ATP.

4. The acceptance inspector shall use the system record drawings in combination with the dcuments specified under Paragraph 3.1 during the testing procedure to verify operation as programmed. In conducting the ATP, the acceptance inspector shall request demonstration of any or all input and output functions. The items tested shall include but not be limited to the following:

a. System wiring shall be tested to demonstrate correct system response and correct subsquent system operation in the event of:

1) Open, shorted and grounded intelligent analog signaling circuit.

2) Open, shorted and grounded netowrk signaling circuit.

3) Open, shorted and grounded conventional zone curcuits.

4) Open, shorted and grounded speaker, telephone circuits.

5) Intelligent device removal.

6) Primary power to battery disconnected.

7) Incorrect device at address.

b. System evacuation alarm indicating appliances shall be demonstrated as follows:

1) All alarm notification appliances actuate as programmed.

2) Audibility and visibility at required levels.

c. System indications shall be demonstrated as follows:

1) Correct message display for each alarm input at the control panel, each remote alphanumeric display and each CRT terminal.

2) Correct annunciator light for each alarm input at each annunciator and color graphic terminal as shown on the drawings.

d. Secondary power capabilities shall be demonstrated as follows:

1) System primary power shall be disconnected for a period of time as specified herin. At the end of that period, an alarm condition shall be created and the system shall perform as specified for a period as specified.

2) System primary power shall be restored for forty-eight hours and system charging current shall be normal trickle charge for a fully charged battery bank.

3) System battery voltages and charging currents shall be checked at the fire alarm control panel using the test codes and displayed on the LCD display.

5. In the event of system failure to perform as specified and programmed during ATP procedure, at the discretion of the acceptance inspector, the test shall be terminated.

a. The installing contractor shall retest the system, correcting all deficiencies and providing test documentation to the acceptance inspector.

b. In the event that software changes are required during the ATP, a utility program shall be furnished by the system manufacturer to compare the edited program with the original. This utility shall yield a printed list of changes and all system functions, inputs and outputs effected by the changes. The items listed by this prgram shall be the minimum acceptable to be re-tested before calling for resumption of the ATP.

c. The acceptance inspector may elect to require the complete ATP to be performed again if, in their opinion, modifications to the system hardware or software warrant complete re-testing.

3.8 DOCUMENTATION

A. System documentation shall be furnished to the owner and shall include but not limited to the following:

1. System record drawings and wiring details including one set of reproducable masters and drawings on CD ROM in a DXF format suitable for use in a CAD drafting program. System operation, installation and maintenance manuals.

2. Written documentation for all logic modules as programmed for system operation with a matrix showing interaction of all input signals with output commands.

3. Documentation of system coltage, current and resistance readings taken during the installation, testing and ATP phases of the system installation.

4. System program showing system functions, controls and labeling of equipment and devices. Also provide a copy of the system files on CD ROM in PDF format.

3.9 TEST EQUIPMENT

A. Refer to Division 01 for General commissioning requirements.

B. The Contractor shall furnish all test equipment as required to program devices and test the system, specifically an intelligent device tester and programmer.

3.10 INTERFACE TERMINAL BOX

A. The fire alarm system contractor shall install the interface terminal box at the main fire alarm control panel in a redily accessible location no more than 8'-0" A.F.F.

B. The fire alarm contractor shall wire from the fire alarm system to the interface terminal box.

C. The security contractor shall wire from the security system to the interface terminal box.

3.11 INTERFACE TERMINAL BOX

A. The fire alarm contractor shall provide all conduit, power and wiring required for the installation of the terminal box, manual unlock switch and interfacing to the fire alarm system. All wiring installations shall meet NFPA 70 and be UL listed for the fire alarm applications.

3.12 WARRANTY AND SERVICES

A. The contractor shall warrant the entire system against mechanical and electrical defects for a period of 18 months. This period shall begin upon completed certification and test of the system.

B. During the warranty period, the fire alarm system subcontractor or manufacturer shall provide at no additional charge the inspection, parts, maintenance, testing and repair to maintain the system in full compliance with the requirements of NFPA 72.

C. A NOTIFIER® trained technician in the enploy of the installing fire alarm contractor shall furnish training to the Owner's employees on operation of the fire alarm system.

1. Training in the receipt, handling and acknowledgement of alarms.

2. Training in the system operation including manual control of output functions from the system control panel.

3. Training in the testing of the system including logging of detector sensitivity, field test of devices and response to common troubles.

4. The total training requirements shall be a minimum of 6 hours but shall be sufficient to cover all items specified.

END OF SECTION 28 3107