Additions & Renovations to

SILVER LAKE ELEMENTARY SCHOOL

Owner:

Appoquinimink School District
118 South Sixth Street
Odessa, DE 19730

Architect:

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Middletown, DE 19709
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Mechanical & Electrical Engineers:

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Claymont, DE 19703
302.798.3515

Structural Engineer:

MacIntosh Engineering
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Wilmington, DE 19806
302.252.9200

Foodservice Consultants

Nyikos Associates, Inc.
18219-A Flower Hill Way
Gaithersburg, MD 20879
240.683.9530

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Project Manual VOLUME 3

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RG GR ARCHITECTS

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SECTION 21 01 70
FIRE SUPPRESSION SPRINKLER AND STANDPIPE SYSTEMS

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. Codes and Standards listed below, apply to work indicated on the drawings and in the specifications.

1. National Fire Protection Association (NFPA)
2. Delaware State Fire Prevention Regulations (DSFPR)
3. American National Standards Institute (ANSI)
4. American Society for Testing Materials (ASTM)
5. National Electrical Manufacturer's Association (NEMA)
6. Underwriters' Laboratories (UL)

1.2 SUMMARY

A. This Section includes fire-suppression sprinklers, piping, and equipment for the following building systems:

1. Wet-pipe fire-suppression sprinkler systems, including piping, valves, specialties and automatic sprinklers.

2. Wet pipe, fire suppression standpipe system, including piping, hose valves, valves, and specialties.

3. Contractor shall provide schedule and location of all fire hose valve cabinets on sprinkler drawings regardless of which trade procures or installs them.

B. Additional work includes, but is not limited to the following:

1. Obtain and pay for all permits, licenses, approvals, reviews, utility shutdowns, water flow testing, pressure tests and acceptance inspections.

2. Pipe sleeves through floors, walls and structural elements of the building, set in coordinated locations. Penetrations created in fire rated walls and floors, shall have their smoke stopping and fire rating integrity restored with the use of fire tested, U.L. listed details, that have prior approval of the local Fire Prevention Bureau.

3. All cutting, coring and patching of general construction as necessary for installation of the work specified.

4. Coordinated working drawings and hydraulic calculations from water flow test data less than one year old; submit and obtain approval by the local Fire Prevention Bureau and Owner's Insurance Underwriter, and State Fire Marshal.

5. Clean-up, on a daily basis, of all debris associated with the installation of this work, as necessary to maintain the premises in a broom swept condition.

6. Testing, adjusting, retesting, re-adjusting as may be required to obtain system acceptance by the local Fire Prevention Bureau, Owner's Insurance Underwriter, State Fire Marshal and Owner's Representative. Fire Protection Contractor shall remain responsible for the fire protection systems until all approvals are obtained.

7. Provide equipment manuals, record drawings, valve tag schedules and personnel instruction, prior to system turnover to the Owner.

8. Provide fire protection on all floors during construction, utilizing temporary standpipes or fire extinguishers, according to the requirements of the authority having jurisdiction.

9. Performance of all work specified in this Section shall be in compliance with the requirements of the Occupational Safety and Health Act and Construction Safety Standards.

C. The work in this Section includes providing all labor, materials, specialty products testing and services for, and reasonably incidental to, the satisfactory completion of the Fire Protection systems, as indicated on the Contract Drawings, in the Specification Sections, and as required by the applicable Codes and Standards.

D. The following related work is specified in other Divisions and Sections of the specification.

1. Electrical power supply to water flow switches, tamper switches.

2. Fire extinguishers and cabinets.

E. Related Sections include the following:

1. Division 26 Section "Fire Alarm Systems" for alarm devices not in this Section.
2. Division 22 Section “General Provisions – Plumbing/Fire Protection
3. Division 10 Section “Fire Protection Specialties” for cabinets and fire extinguishers.
4. Division 7 Section “Fire Stopping”

1.3 DEFINITIONS AND INTERPERTATIONS

A. Specific terminology used in the Design Drawings and Specifications shall have the following meanings;

1. “Piping” includes pipe, fittings, flanges, valves, controls, hangers, supports, vents, drains and other customarily required items required in connection with the transfer of gases and fluids.

2. “Install” includes unloading at the delivery point for the project and performing all tasks necessary to establish a secure mounting and correct operation, for items and assemblies furnished by other trades or the Owner.

3. “Furnish” includes purchase and delivery to the project site, of items and assemblies, complete with every necessary appurtenance.

4. “Provide” shall mean “Furnish and Install”

5. “Concealed” when used in connection with the installation of piping, shall mean hidden from view behind chases, furred spaces, pipe shafts, or above suspended ceilings.

6. “Concealed Spaces of Combustible Construction shall be as defined in NFPA#13, Section 8.15.1.

7. “Contractor” shall mean the Fire Protection contractor and his vendors, fabricators or subcontractors.

8. “Design Drawings” shall mean documents, including drawings and written specifications, prepared by the Architects and Engineers, to obtain building permits and competitive bid proposals from contractors, for construction of the specified fire protection systems.

9. “Working Plans” shall mean documents, including calculations, drawings and material specifications prepared by the fire protection contractor, according to NFPA#13, for obtaining approval from the authority having jurisdiction, Owner’s insurance underwriter, Architect/Engineer and the State Fire Marshal.

10. “NPS” shall mean nominal pipe size, in inches.

11. “CPVC” shall mean Chlorinated polyvinyl chloride plastic.

12. “Owner” shall mean Appoqunimink School District.

13. “Architect” shall mean the Architect of Record as denoted in this package.

14. “Engineer” shall mean the Engineer of Record as denoted in this package.

15. “UL” means Underwriter’s Laboratories

16. “FM” means Factory Mutual.

17. “Sprinkler System” shall mean piping and sprinklers under the individual control of a supervised control valve, with provisions for alarm annunciation, alarm testing and system drainage.

18. “Standpipe” shall mean piping, valves, hose connections, and allied equipment with the hose connections located such that water can be discharged through attached hose and nozzles, for the purpose of extinguishing a fire, thereby protecting a building, structure, its contents, and the occupants.

19. Reference applicable NFPA Standards for additional definitions that shall apply to work under this Section.

B. The use of the Design Drawings and Specifications by the contractor, for Bid Proposal and Working Drawing preparation, shall include the following understandings:

1. The information included in the drawings and specifications is given as a guide only, to indicate general design feasibility and to show an acceptable arrangement of system zones, system types, sprinkler positions, main piping location and equipment layout.

2. The design drawings utilize symbols and diagrams to indicate required work, representing only the sequence of items to be installed, which have no dimensional significance and do not indicate every required item to be provided. The work shall be installed in accordance with the diagrammatic intent expressed on the drawings, in conformity with the dimensions indicated on the final architectural and structural working drawings, and final equipment shop drawings. Information regarding general construction shall be derived only from the Architectural and Structural Design Drawings and Specifications.

3. The drawings and specifications are complementary and are to be utilized together for a complete interpretation of the work intended. The higher capacity or standard shall be provided, where conflicts between the drawings and specifications, or conflicts within themselves, occur.

4. The limitations of the language used on the drawings and specifications shall not be interpreted as meaning that accessories and appurtenances, required for completion of work, are to be excluded. The description of any item, on the drawings or in the specifications or both, requires the installation of all it’s necessary components for approved, satisfactory operation. These drawings do not indicate sprinkler head locations. The Contractor shall reference the architectural reflected ceiling plans. The intent is to establish an architecturally acceptable arrangement of sprinklers with other ceiling elements including lights, diffusers, speakers etc., to be repeated in similar areas. Provide sprinklers according to the NFPA#13 occupancy hazard classification and spacing rules, for unfinished ceiling area.

5. Submission of a bid proposal requires the contractor to review all project documents and visit the construction site, to be thoroughly familiar with all requirements for the project, and identify in his bid, conditions that may affect the efficient and satisfactory performance of the work. Claims for additional

compensation shall be denied if the above procedures are not followed and the disputed conditions may have been identified by the completion of these required tasks.

6. The information shown on the design drawings and written in the specifications shall not be interpreted as to instruct the contractor to not follow the applicable codes or local amendments. Where the information provided is believed not to be in conformance with the code requirements, the contractor shall notify the Architect and Engineer for clarification prior to the submission of his bid proposal.

7. References to providing sprinklers per the NFPA#13 Standard mandates that all building areas shall be provided with complete, full sprinkler protection, unless specific notation is made to the contrary on the drawings or in the specification.

8. References in this Specification to NFPA Standards as design and installation guidance of fire protection systems, invoke all of the Sections, Subsections, Exceptions and Advisory Provisions of the Standard that are applicable to the Project's requirements; they are hereby included in this Specification as if repeated in their entirety, and are referenced to convey the minimum acceptable performance and installation requirements acceptable.

9. All the referenced information and guidance for design noted prior shall also be used and adhered to in the design of the fire suppression standpipe systems. Fire suppression standpipe systems shall be designed and installed in accordance with NFPA 14 and the Delaware State Fire Prevention Regulations.

1.4 SPRINKLER SYSTEM PERFORMANCE REQUIREMENTS

A. Design sprinkler system piping according to the following requirements and obtain approval from authorities having jurisdiction, Owner’s insurance underwriter, Architect, Engineer and Fire Marshal. Refer to Section 1.7 QUALITY ASSURANCE, paragraph I., Working Plans and Hydraulic Calculations, and Section 3.1 PREPARATION WORKING OF PLANS, for additional system performance related design requirements.

B. Design sprinkler system piping according to the following:

1. Include 10 psi cushion pressure as a margin of safety in available water flow and pressure calculations.

2. Include losses from point of connection to city water main, through water-service entrance, backflow preventer, sprinkler system piping, including all valves, fittings and devices.

3. Maximum piping velocity shall be limited to 20 fps.

4. Sprinkler Occupancy Hazard Classifications shall be as follows:

a. Classrooms, Art Rooms, Music Rooms, Multi-Purpose Room: Light Hazard

b. Offices, Corridors, Toilet rooms, Locker rooms, Public Areas, Cafeteria Seating Areas: Light Hazard

c. Building Service Areas, Kitchen, Janitor's Closets, Electrical and Telephone Equipment Rooms and Closets, Mechanical Equipment Rooms: Ordinary Hazard, Gp. 1.

d. General Storage Areas, Stage Loading Docks: Ordinary Hazard, Gp. 1.

e. Combustible construction and Combustible concealed spaces: Light Hazard.

f. All other occupancies and hazards not noted, shall be in accordance with NFPA.

5. Minimum Density for Automatic-Sprinkler Piping Design shall be as follows:

a. Light Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area unless otherwise indicated on drawing data schedule.

b. Ordinary Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area unless otherwise indicated on drawing data schedule.

c. Ordinary Hazard, Group 2 Occupancy: 0.20 over 1,500 sq. ft. area unless otherwise indicated on drawing data schedule.

d. Combustible construction and Combustible concealed spaces: 0.10 gpm over 1500-sq. ft. area unless otherwise indicated on drawing data schedule.

e. Special Occupancy Hazard: As determined by authorities having jurisdiction.

f. For light and ordinary hazard occupancies, where the requirements of NFPA 13 are met, design are reduction for quick response sprinklers may be used.

C. Components and Installation shall be capable of producing piping systems with 175-psig minimum working-pressure rating, unless otherwise indicated.

1.5 STANDPIPE SYSTEM PERFORMANCE REQUIREMENTS

A. Design Class I horizontal fire standpipe system piping according to the following requirements and obtain approval from authorities having jurisdiction, Owner's insurance underwriter, Architect, Engineer, and Fire Marshal. Refer to Section 1.8 QUALITY ASSURANCE, Paragraph I, Working Plans and Hydraulic Calculations, and Section 3.1 PREPARATION WORKING OF PLANS, for additional system requirements related design requirements.

B. Design fire standpipe system piping according to the following:

1. Design shall be in accordance with NFPA 14 and the Delaware State Fire Protection Regulations/International Building Code.

2. Include losses from the fire department connection/the connection to the City water main/the fire pump discharge, including all valves including hose valves, fittings, and devices.

3. Maximum piping velocity shall be limited to 20 fps.

4. Classification: Class I Horizontal, Wet Standpipe, supplied by the fire department at the system fire department connection.

5. Minimum standpipe flow and pressure to be as follows:

a. A flow of 250 gpm at the three most hydraulically remote hose connections of the hydraulically most remote horizontal standpipe.

b. A minimum of 100 psi at the most remote hose valve while flowing system demand.

c. The system shall be hydraulically designed so that the required system pressure does not exceed 175 psi at any point in the system.

C. Components and installation shall be capable of producing piping systems with 175-psig minimum working-pressure rating, unless otherwise indicated.

1.6 SUBMITTALS

A. The contractor shall provide Submittals according to Section 220010, with all required drawings, calculations and product data for complete review of the proposed system installation submitted at the same time. Incomplete submittals shall be returned unreviewed. When resubmittals are required, all changes from the original submittal shall be clearly identified with revision triangles and clouds.

B. Product Data shall be provided for the following:

1. Pipe and fitting materials and methods of joining for sprinkler piping.

2. Pipe hangers and supports.

3. Valves, including specialty valves, accessories, and devices.

4. Alarm devices. Include electrical data.

5. Fire department connections. Include type; number, size, and arrangement of inlets; caps and chains; size and direction of outlet; escutcheon and marking; and finish.

6. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.

7. Fire stopping product materials and U.L. listed installation details for penetrations of fire-rated walls and floors.

8. Fire hose station equipment including hose valves, hose adapters and hose cabinets.

C. Fire-Hydrant Flow Test has been executed for the project on 1/16/2019 and data is recorded on the drawing.

D. Sprinkler and Stnadpipe Piping Drawings: Working plans and hydraulic calculations, shall be prepared according to NFPA #13 and NFPA #14, and submitted to the authorities having jurisdiction, Owner’s insurance agent, Architect, Engineer, and State Fire Marshal for approval.

E. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA #13 and NFPA #14, including the "Contractor's Material and Test Certificate for Aboveground Piping" for each system.

F. Maintenance Data: shall be submitted for each type of sprinkler component and specialty, and included in the maintenance manuals, specified in Division 1.

G. Record Drawings: Refer to Division 1 for requirements. An up to date set of working drawings shall be kept at the site to record minor change in the intended system installation, as as-built conditions. Provide the required copies of final working drawings, corrected to show all as-built conditions, to the Owner, and the Owner’s insurance agent upon completion of the project.

H. System Diagram and Operating Instructions: Provide at the completion of work, a color coded, neatly drawn small scale plan, mounted in a substantial glass enclosed frame, showing the locations of all sprinkler system control valves, auxiliary low point drains and inspector’s test connections. Provide a minimum of two (2) copies of the current edition of NFPA#25, “Standard for the Inspection, Testing, and Maintenance of Water Based Fire Protection Systems”.

I. Guarantee: The contractor shall submit a written guarantee of all materials and workmanship for a period of one (1) year, beginning at the date of final acceptance or beneficial use to the Owner, which includes emergency repair service for sprinkler systems, within four (4) hours, on a twenty-four (24) hour, seven (7) day a week basis, upon request for repair service by the Owner.

1.7 QUALITY ASSURANCE

A. All materials, specialty products, equipment, methods of installation, and the application of materials and products in specific situations, shall be in strict accordance with the applicable requirements of NFPA #13 and NFPA #14, and have the prior approval of the authority having jurisdiction. All materials and equipment shall be U.L. labeled and/or F.M. approved, and installed in accordance with their listings.

B. Installer Qualifications: An experienced installer who has designed and installed fire-suppression systems similar to that indicated for this Project and obtained design approval and inspection approval from authorities having jurisdiction.

C. Manufacturer Qualifications: Firms whose equipment, specialties, and accessories are listed by product name and manufacturer in UL's and/or Fire Marshal's "Fire Protection Equipment Directory" and that comply with other requirements indicated.

D. Sprinkler Components: Listing/approval stamp, label, or other marking by a testing agency acceptable to authorities having jurisdiction.

E. Working Plans and Hydraulic Calculations

1. Design the specified sprinkler systems and standpipe systems utilizing hydraulic calculations and indicate the intended installation of systems accurately on minimum 1/8" scale plans, with ¼" scale details which include the following:

   a. Building section/elevation details, with all necessary elevation data shown.

   b. Riser diagram of system water supply and backflow prevention.

   c. All pipe lengths, diameters, fittings, hangers locations and details, earthquake bracing and restraints, valves and devices with piping details.

   d. A site plan indicating project location, site elevations, north arrow, street intersections, Fire Department access lane(s), location of Fire Department connection(s), and size, material and location of public, and private fire water service mains and their appurtenances. The site plan shall be scaled or indicate dimensions and distances (of mains) and show location of water flow test(s).

   e. Hydraulically most remote design area(s) with hydraulic nodes on plans corresponding to hydraulic calculations.

2. Provide hydraulic calculations utilizing Hazen-Williams formula for determining piping friction losses, to prove the intended design, according to the requirements NFPA#13 and NFPA #14, using "C" values therein, which include the following:

   a. Each type of pipe and joining method to be used, including weight, schedule, wall thickness, exact internal diameters, wall thicknesses and corrosion resistance ratio (CRR), for pipes other than Sch. 40.

   b. The K-factor, orifice diameter, and minimum operating pressure required, for each flowing sprinkler in the hydraulically most remote area(s), according to the worst case requirements of either NFPA#13, NFPA #14, the local Fire Dept., or the appropriate approval/U.L. listing pressure required, to deliver the required minimum water distribution. Flows shall be calculated to the nearest 1/10 gallon.

   c. Piping friction losses calculated to the nearest foot for all pipe lengths over (1) foot; all vertical lengths shall be included to show loss or gain of elevation pressures. Pressures shall be calculated to the nearest 1/100 psi.

d. Pressure losses for dry valves, deluge valves, backflow preventers etc., shall be clearly indicated as a device, and expressed as additional feet of pipe.

e. Velocity in all piping to be 20 feet per second or less. Velocity pressure may be ignored in hydraulic calculations.

f. Provide hydraulic calculations in an "easily reviewable" format, similar to the traditional NFPA#13 presentation, including the name of the hydraulic calculation program used, if applicable. The order of entry shall follow the flow of water from the most remote design sprinkler back to the riser, with flows added and subtracted at the cross main; order entry based upon only a sequential ordering of the node numbers, which could result in jumps from one pipe segment to a disjunct segment, is not "easily reviewable", and therefore is not an acceptable submittal format.

g. All notes in the hydraulic calculations corresponding to the calculated results shall be clearly identified on the plans, including the site plan.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounting steel cabinet and hinged cover, with space spare sprinklers plus sprinkler wrench. Include the minimum number of each type of sprinkler in the project, as required by NFPA #13.

1.9 LEAK DAMAGE

A. The fire protection contractor shall be responsible during the installation and testing of the sprinkler and standpipe system(s), for damage to building, it’s contents, the work of other trades etc., caused by leaks or overflow from equipment, defective valves, disconnected or unplugged pipes, fittings etc., and shall pay for the repair or replacement of work or facilities damaged by such leaks.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Specialty Valves and Devices:

Vicatulic Company
Tyco Fire Suppression & Building Products
Reliable Automatic Sprinkler Co., Inc.
Viking Corp.

2. Water-Flow Indicators and Supervisory Switches:

Tyco Fire Suppression & Building Products
Potter Electric Signal Co.
Reliable Automatic Sprinkler Co., Inc.
Viking Corp.

3. Sprinkler, Drain and Alarm Test Fittings:

   Tyco Fire Suppression & Building Products
   Fire-End and Croker Corp.
   Victaulic Company
   AFG Manufacturing

4. Sprinkler, Branch-Line Test Fittings:

   Elkhart Brass Mfg. Co., Inc.
   Fire-End and Croker Corp.
   Smith Industries, Inc.; Potter-Roemer Div.
   AFG Manufacturing

5. Sprinkler, Inspector's Test Fittings:

   Fire-End and Croker Corp.
   G/J Innovations, Inc.
   Triple R Specialty of Ajax, Inc.
   AFG Manufacturing

6. Fire Department Connections:

   Potter-Roemer
   Elkhart Brass Mfg. Co., Inc.
   Fire-End and Croker Corp.
   Tyco Fire Suppression & Building Products
   Guardian Fire Equipment, Inc.
   Reliable Automatic Sprinkler Co., Inc.

7. Sprinklers:

   Tyco Fire Suppression & Building Products
   Reliable Automatic Sprinkler Co., Inc.
   Viking Corp.
   Victaulic Company

8. Fire Dept. Hose Valves:

   Potter-Roemer
   Elkhart
   Fire-End and Croker Corp.
   Guardian Fire Equipment, Inc.

   Fire Hose Valve Cabinets:

   Potter-Roemer
   Larsen
   Guardian Fire Equipment, Inc.
   Fire-End and Croker Corp.

9. Fire-Protection-Service Valves:

   Tyco Fire Suppression & Building Products
   Central Sprinkler Corp.
   Nibco, Inc.

Stockham Valves & Fittings, Inc.
Victaulic Company

10. Keyed Couplings for Steel Piping: (Grooved Fittings)

    Tyco Fire Suppression & Building Products
    Victaulic Company
    Viking Corp.
    Anvil International Grulok

11. Fire Protection Backflow Prevention Valve Assemblies (including RPZ Type).

    Ames Fire & Waterworks
    Watts Regulator Company
    Apollo Valves (Conbraco)

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials in specific fire protection services. All piping shall be permanently marked continuously along its length by the manufacturer, properly identifying the type of pipe. All fittings shall be stamped or embossed by the manufacturer, indicating the size, pressure rating, and U.L. listing or F.M. approval.

2.3 PIPES AND TUBES

A. Standard-Weight Steel Pipe: ANSI/ASTM A 53, ASTM A 135, or ASTM A 795; Schedule 40 in NPS 6" and smaller, and Schedule 30 in NPS 8" and larger, may be joined with threads or cut-groove couplings and fittings, for pressures up to 300 psi.

B. Schedule 30 Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and equal to or greater than Schedule 30, or ASTM A 795 and ASME B36, 10M, Schedule 30 wrought-steel pipe, may be joined by welding or roll-groove couplings and fittings, for pressures up to 300 psi.

C. Schedule 10 Steel Pipe: ASTM A 135 Schedule 10 in NPS 5" and smaller and NFPA #13 specified wall thickness in NPS 6" to NPS 10", may be joined by welding or roll-groove couplings and fittings, for pressures up to 300 psi.

D. "THINWALL" "XL" AND CPVC piping shall not be permitted on this project.

2.4 PIPE AND TUBE FITTINGS

A. Cast-Iron Threaded Flanges: ASME B16.1.

B. Cast-Iron Threaded Fittings: ASME B16.4.

C. Malleable-Iron Threaded Fittings: ASME B16.3.

D. Steel, Threaded Couplings: ASTM A 865.

E. Steel Welding Fittings: ASTM A 234/A 234M, ASME B16.9, or ASME B16.11.

F. Steel, Grooved-End Fittings: UL-listed and approved, ASTM A 47, malleable iron or ASTM A 536, ductile iron; with dimensions matching steel pipe and ends factory grooved according to AWWA C606.

2.5 JOINING MATERIALS

A. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for pipe-flange gasket materials and welding filler metals.

B. Steel, Keyed Couplings: UL 213 and AWWA C606, for steel-pipe dimensions. Include ASTM A 536, ductile-iron housing, rubber gaskets, and steel bolts and nuts. Include listing for dry-pipe service for couplings for dry piping.

2.6 FIRE-PROTECTION-SERVICE VALVES

A. General: UL listed and approved, with minimum 175-psig nonshock working-pressure rating. Valves for grooved-end piping may be furnished with grooved ends instead of type of ends specified.

B. Gate Valves, NPS 6” and Smaller: UL 262; cast-bronze, threaded ends; solid wedge; OS&Y; and rising stem.

C. Indicating Valves, NPS 3” and Smaller: UL 1091; butterfly or ball-type, bronze body with threaded ends; and integral indicating device.

Indicator: Visual.
Indicator: Electrical 115-V ac, prewired, two-circuit, supervisory switch.

D. (Optional Section) Gate Valves, NPS 4” and Larger: UL 262, iron body, bronze mounted, taper wedge, OS&Y, and rising stem. Include replaceable, bronze, wedge facing rings and flanged ends.

E. Swing Check Valves, NPS 2” and Smaller: UL 312 or MSS SP-80, Class 150; bronze body with bronze disc and threaded ends.

F. Swing Check Valves, NPS 2-1/2” and Larger: UL 312, cast-iron body and bolted cap, with bronze disc or cast-iron disc with bronze-disc ring and flanged ends.

G. Split-Clapper Check Valves, NPS 4” and Larger: UL 312, cast-iron body with rubber seal, bronze-alloy discs, and stainless-steel spring and hinge pin.

2.7 SPRINKLERS

A. Utilize quick-response sprinklers throughout Light and Ordinary Hazard occupancies

B. Automatic Sprinklers: shall have heat-responsive element complying with the following:

UL 199, for applications except residential.
UL 1767, for early suppression, fast-response applications.

C. Sprinkler Types and Categories: Nominal 1/2-inch standard orifice, unless otherwise indicated or required by application.

D. Sprinkler types, features, and options include the following:

Dry upright sprinklers
Dry pendent sprinklers
Horizontal Dry/Sidewall sprinklers
Pendent sprinklers (Flush, recessed and/or concealed)
Quick-response sprinklers
Sidewall sprinklers
Upright sprinklers

E. Sprinkler Finishes: Upright bronze, and “white” painted pendents and sidewalls.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

Ceiling Mounting: White-plated steel, two piece, flat.
Ceiling Mounting: Metal, white finish, two piece, flat.
Sidewall Mounting: White-plated steel, two piece, flat.
Sidewall Mounting: Metal, white finish, two piece, flat.

G. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

H. Sprinkler Water Shields: Shield for protecting sprinkler, heat-sensing operating element from other sprinkler water discharge (pendent and/or upright sprinkler water shield).

2.8 SPECIALTY SPRINKLER FITTINGS

A. Specialty Fittings: UL listed and approved; made of steel, ductile iron, or other materials compatible with piping.

B. Locking-Lug Fittings: UL 213, ductile-iron body with locking-lug ends.

C. Mechanical-T Fittings: UL 213, ductile-iron housing with pressure-responsive gasket, bolts, and threaded or locking-lug outlet.

D. Mechanical-Cross Fittings: UL 213, ductile-iron housing with pressure-responsive gaskets, bolts, and threaded or locking-lug outlets.

E . Drop-Nipple Fittings: UL 1474, with threaded inlet, threaded outlet, and seals; adjustable.

F. Sprinkler, Drain and Alarm Test Fittings: UL-listed, cast- or ductile-iron body; with threaded inlet and outlet, test valve, and orifice and sight glass.

G. Sprinkler, Branch-Line Test Fittings: UL-listed, brass body; with threaded inlet and capped drain outlet and threaded outlet for sprinkler.

H. Sprinkler, Inspector's Test Fittings: UL-listed, cast- or ductile-iron housing; with threaded inlet and drain outlet and sight glass.

2.9 FIRE DEPARTMENT CONNECTIONS

A. Confirm with the local Fire Department for type of connection requirement: Storz or Siamese.

B. Wall, Fire Department Connections: UL 405; cast-brass body with brass, wall, escutcheon plate; brass, lugged caps with gaskets and brass chains; and brass, lugged swivel connections. Include inlets with threads according to NFPA 1963 and matching local fire department sizes and threads, outlet with pipe threads, extension pipe nipples, check devices or clappers for inlets, and escutcheon plate with marking "AUTO SPKR”/“STANDPIPE AND AUTO SPKR”.

Type:	Flush mounting.
Escutcheon Plate:	Rectangular.
Finish:	Polished chrome-plated.

2.10 ALARM DEVICES

A. General: All alarm devices shall be U.L. listed and F.M. approved as sprinkler system attachments. Types utilized shall match piping and equipment connections.

B. Electric-Operated Alarms: Provide 10” outside waterproof vibrating type bell and 6” inside bell, in locations shown on drawings or required by the local Fire Dept.

C. Water-Flow Indicators: UL 346; electrical-supervision, vane-type water-flow detector; with 250-psig pressure rating; and designed for horizontal or vertical installation. Include two single-pole, double-throw, circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.

D. Pressure Switches: UL 753; electrical-supervision-type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts and design that operates on rising pressure and signals water flow.

E. Valve Supervisory Switches: UL 753; electrical; single-pole, double throw; with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

F. Low Temperature Supervisory Switch: UL listed, electrical-supervisory-type, temperature activated, normally open contact, operated at set temperature of 40°F.

2.11 PRESSURE GAGES

A. Pressure Gages: UL 393, 3-1/2- to 4-1/2-inch diameter dial with dial range of 0 to 250 psig.

PART 3 – EXECUTION

3.1 PREPARATION OF WORKING PLANS

A. The contractor shall be responsible for reviewing the Architectural and Structural Design Drawings and verifying with the General Contractor, that substitutions of noncombustible building materials with combustible building materials have not been made that alter the requirements of the sprinkler system shown on the Fire Protection Design Drawings. Report such substitutions to the Architect and Engineer for review, prior to the design of sprinkler systems. Combustible framing or construction is not allowed above ceilings, below floors or in concealed spaces, unless specifically protected by sprinklers.

B. The final arrangement, positions and connections of pipes, drains, valves, sprinklers etc., shall be established by the fire protection contractor’s design, and shall be configured to drain fully, avoiding trapped piping sections and excessive auxiliary drains. Sprinkler systems shall be installed concealed above architectural suspended ceilings where ceilings are provided, unless indicated otherwise.

C. Design the specified fire protection systems from the fire service entry riser, in accordance with the mandatory requirements and all advisory provisions of NFPA#13 and NFPA#14, the requirements of the authority having jurisdiction and the Owner’s insurance agent, utilizing hydraulic calculations, with uniform water distribution over each most remote design area and/or specified demand.

D. Establish each sprinkler position, giving full consideration to the vertical and horizontal obstructions to sprinkler spray pattern development that may be presented by building construction, ductwork, mechanical and electrical equipment, piping, soffits and ceilings constructed with different adjacent elevations, suspended and surface mounted lighting fixtures etc.; coordinate the position and location of sprinklers, piping and system components, referencing the detailed working drawings of all other trades, to avoid installation conflicts.

E. Contractor shall be responsible for planning and providing the required penetrations of fire rated walls, floors and smoke partitions, in such a manner that U.L. listed details that restore their fire rating integrity and that have prior approval of the Delaware State Fire Marshal’s Office where they are utilized.

F. Where practical, uniformly space sprinklers on branchlines; sprinklers shall be spaced in architectural patterns consistent with symmetrical positions of lights, air diffusers, speakers, and other ceiling elements, where sprinklers are shown on architectural reflected ceiling grid plans.

1. Pendent sprinklers in architectural ceilings shall be centered in square ceiling tiles in both directions, and centered in the short dimension of rectangular tiles, with sprinkler positions acceptable at quarter points of the long dimension, +/- 12".

2. Provide sprinkler spacing and locations per NFPA#13 requirements, in areas without suspended ceilings.

G. Wet sprinkler systems may be "tree", "loop" or "grid" type systems, as may be hydraulically advantageous, unless a specific piping arrangement is indicated on the design drawings. System piping arrangement shall be configured above the top of recessed lighting fixtures, within suspended ceilings.

H. Where sprinkler piping within concealed spaces provides protection for occupancies below, sprinklers for protection of concealed spaces may be attached to the same piping system. Hydraulically calculate each set of sprinklers separately and provide pipe sizes for the hydraulically more demanding group.

I. Sprinklers for the protection of attic spaces may be conventional upright or pendent types, or a combination of these types of sprinklers. The position of sprinklers in attics framed of combustible construction, shall establish sprinkler protection into the eaves overhanging the outside of the building.

J. Provide sprinkler protection in combustible framed, horizontal and vertical soffits and wall cavities, with outside finished dimensions greater than 14." Where combustible concealed construction and spaces are permitted to be unsprinklered, meeting one or more of the exceptions of NFPA#13, Section 8.15.1.1, the design area of application shall be increased to a minimum of 3,000 sq.ft., without revising the hydraulic density, per NFPA#13, Section 11.2.3.1.5 and 11.2.3.2.

K. Provide standpipe system hose connections at all locations as required by NFPA #14, the Delaware State Fire Prevention Regulations, the Authority having Jurisdiction and thoughs locations as directed by the Owner, Architects, and/or the Engineer. Provide hose valve cabinets in locations as indicated on the Architectural and Design drawings.

3.2 PIPING APPLICATIONS

A. Flanges, unions, transitions and special fittings shall have pressure ratings the same as or higher than system's static pressure rating for use in aboveground applications, unless otherwise indicated.

B. Piping between Fire Department Connections and Check Valves: Use galvanized, standard-weight steel pipe with grooved ends; steel, grooved-end fittings; steel, keyed couplings; and grooved joints.

C. Underground Service-Entrance Piping: Use ductile-iron, push-on-joint pipe and fittings and restrained joints.

Fire Suppression Bulk Mains and Risers: See Fire Protection Drawings.

D. Wet-Pipe Sprinkler Branch and Standpipe Piping: See Fire Protection Drawings.

1. NPS 2-1/2" and Larger: Standard weight (Schedule 10) steel pipe with roll-grooved ends; steel, grooved-end fittings; and grooved couplings.

2. NPS 2" and Smaller: Standard-weight steel pipe with threaded ends, cast- or malleable-iron threaded fittings, and threaded joints.

3.3 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Fire-Protection-Service Valves: UL listed and approved for applications where required by NFPA#13.

   Shutoff Duty: Use gate and/or butterfly valves.

2. General-Duty Valves: For applications where UL-listed and approved valves are not required by NFPA #13.

   Shutoff Duty: Use gate, ball, or butterfly valves.

3.4 JOINT CONSTRUCTION

A. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for basic piping joint construction. Apply joint compound or tape to male threads only.

B. Steel-Piping, Grooved Joints: Use Schedule 40 steel pipe with cut or roll-grooved ends and Schedule 30 or thinner steel pipe with only roll-grooved ends; steel, grooved-end fittings; and steel, keyed couplings. Assemble joints with couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions. Use gaskets listed for dry-pipe service for dry piping.

C. Locking-Lug-Fitting, Twist-Locked Joints: Follow fitting manufacturer's written instructions.

D. Dissimilar-Piping-Material Joints: Construct joints using adapters or couplings compatible with both piping materials. Use dielectric fittings if both piping materials are metal. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for dielectric fittings.

3.5 WATER-SUPPLY CONNECTION

A. Connect sprinkler piping to the existing 8” flanged outlet connection.

B. Install shutoff valve, backflow preventer, riser check valve assembly, pressure gage, drain, and other accessories indicated at connection. The backflow preventer shall be UL listed for fire protection service. Backflow preventer for this project shall be AMES 3000 “Silver Bullet.”

3.6 PIPING INSTALLATION

A. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for basic piping installation.

B. 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 installation require written approval from authorities having jurisdiction. File copy of written approval with Architect before deviating from approved working plans.

C. Use only approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes. Bushings shall not be used.

D. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections. Not required on grooved connections.

E. Install "Inspector's Test Connections" for each sprinkler system, sized and located according to NFPA #13 requirements. Install main drain test connection at location that will permit full flow discharge for a time sufficient to allow for proper testing of water supplies, without flooding or water damage.

F. Install sprinkler piping to avoid excessive auxiliary drains. Provide auxiliary drains as required for complete drainage of trapped piping sections.

G. Install sprinkler zone control valves, test assemblies, and drain risers adjacent to sprinkler risers when sprinkler branch piping is connected to sprinkler risers.

H. Install ball drip valves to drain piping between fire department connections and check valves. Drain ball drips to floor drain or outside building.

I. Install alarm devices in piping systems.

J. Hangers and Supports: Comply with NFPA #13 for hanger materials and installation. Hangers, hanger rods and attachments must be capable of supporting five (5) times the weight of the water-filled pipe, plus 250 pounds minimum, at each point of hanging. Piping shall be supported from building structure only, and shall not be hung from ductwork, conduit runs or other piping. Install piping straight and true, parallel with building walls, without dips or sags. Piping shall bear evenly on all pipe hangers. Provide complete details of earthquake bracing and flexible couplings consistent with the requirements of the seismic zone of the project location.

K. Install piping with grooved joints according to manufacturer's written instructions. Construct rigid piping joints, unless otherwise indicated.

L. Install pressure gages on system risers and at each sprinkler test connection. 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.

3.7 SPECIALTY SPRINKLER FITTING INSTALLATION

A. Install specialty sprinkler fittings according to manufacturer's written instructions.

3.8 VALVE INSTALLATION

A. Refer to Division 22 Section "Valves" for installing general-duty valves. Install fire-protection specialty valves, trim, fittings, controls, and specialties according to NFPA #13, manufacturer's written instructions, and authorities having jurisdiction.

B. Gate/Butterfly/Valves: Install fire-protection-service valves supervised-open, unless noted otherwise, located to sectionalize system and control sources of water supply, except from fire department connections. All sectional control valves shall be installed in accessible locations.

1. Provide drains at all sectional control valves. Pipe drains to an acceptable location, capable of accepting full flow discharge without flooding or damage. Provide permanent identification signs indicating portion of system controlled by each valve, according to NFPA#13 requirements.

C. Install check valve in each water-supply connection. Install UL listed fire protection backflow preventers instead of check valves in potable-water supply sources.

D. Riser Check Valves: Install valves in vertical position unless noted otherwise, for proper direction of flow.

E. Install standpipe hose valves at all locations as required by NFPA 14, NFPA 101, the Delaware State Fire Prevention Regulations and where indicated on the drawings. Installation shall be in accordance with NFPA 14.

3.9 SPRINKLER APPLICATIONS

A. General: Only new sprinklers shall be installed, according to their listing requirements. Ornamental finishes shall be factory applied only. Position sprinkler deflectors at the same elevation, parallel with ceiling plane.

B. Use sprinklers according to the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Pendent, sprinklers.
3. Wall Mounting: Recessed, Sidewall sprinklers.
4. Spaces Subject to Freezing: Upright; pendent, dry-type; and sidewall, dry-type sprinklers.
5. Special Applications: Use quick-response sprinklers where indicated.
6. Sprinkler Finishes: Use sprinklers with the following finishes:

a. Upright, Pendent, and Sidewall Sprinklers: White-plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

3.10 SPRINKLER INSTALLATION

A. Install sprinklers in patterns indicated. Install sprinklers in suspended ceilings in center of acoustical panels and tiles.

1. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical panels, and quarter points of the long dimension.

B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space,

C. Install approved sprinkler guards at all sprinklers installed below 7’-6”, or where mechanical damage is possible.

D. Install sprinklers in accordance with manufacturer’s requirements.

3.11 CONNECTIONS

A. Install ball drip valves at each check valve for fire department connection, Route drain pipe to floor drain or outside building.

B. Connect piping to specialty valves, specialties, fire department connections, and accessories.

C. Connect alarm devices to sprinkler systems.

3.12 LABELING AND IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA #13, Division 22 Section "Basic Mechanical Materials and Methods", and the Delaware State Fire Prevention Regulations.

3.13 FIELD QUALITY CONTROL

A. Provide a flanged spool section of pipe and a temporary conical type strainer on the incoming fire protection water service, before the building fire protection and sprinkler system equipment (backflow preventer, etc.), for the fire protection system during installation. Prior to the final commissioning, remove the strainer and reinstall flanged spool section.

B. Flush, test, and inspect sprinkler piping according to NFPA #13, "System Acceptance" Chapter.

C. Replace piping system components that do not pass test procedures and retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.

D. Report test results promptly and in writing to Architect and authorities having jurisdiction.

3.14 CLEANING

A. Clean dirt and debris from sprinklers, remove protective covers used during painting.

B. Remove and replace sprinklers having paint other than factory finish.

3.15 PROTECTION

A. Protect sprinklers from damage until Substantial Completion.

3.16 COMMISSIONING

A. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.

B. Verify that specified tests of piping are complete.

C. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.

D. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.

E. Verify that fire department connections have threads compatible with local fire department equipment.

F. Fill wet-pipe sprinkler piping with water.

G. Adjust operating controls and pressure settings.

H. Coordinate with fire alarm tests. Operate alarm devices with water, as required to demonstrate proper function.

I. Provide a flow test for record on the site fire hydrants nearest the building regardless of the previous date. Data to be included below.

J. Provide an 8-1/2” x 11” drawing in “pdf” format for the Owner, Local Fire Department and the Fire Marshal’s Office. Data required on drawing shall indicate the following:

1. Name, address and location of the building.
2. The location of all fire suppression system control valves.
3. The location of all fire department connections for all fire suppression systems.
4. The location of the fire alarm control pane and annunciation panel.
5. The location of all site fire hydrants.
6. Main entrance and exits.
7. Name, and telephone numbers of responsible personnel for responding during emergencies.

3.17 SYSTEMS ACCEPTANCE AND TESTING

A. Notify the Authority Having Jurisdiction, the Owner’s representative, and Architect and Engineer of time and date of scheduled testing. Provide minimum of 5 day prior notice of testing to allow for witnessing.

B. Perform all required system testing and acceptance requirements on the new (and modified) system installations in accordance with NFPA 13, 14, & 25, the Delaware State Fire Prevention Regulations, the Authorities Having Jurisdiction (AHJ) requirements and all other local codes and ordinances. At a minimum provide the following:

1. Perform all acceptance requirements per the codes; pipe flushing, inspections, etc.

2. Perform all operational and functional tests of systems and equipment required by the codes and equipment manufacturers.

3. Perform hydronstatic pressure test on new above ground systems piping in accordance with NFPA 13. New system shall be tested to 50 psi over normal system working pressure (minimum 200 psi) for 2 hours without leaks.

C. Provide all required reports, records and documentation, to the owner, engineer and authority having jurisdiction prior to or at the completion of the project. At a minimum provide the following:

1. Completed and signed "Contractor's Material and Test Certificate for Aboveground Piping' for each system.

D. Prior to placing systems in final service, provide a final inspection of new systems to ensure item such as protective caps & strapes have been removed or put in place, escutcheons have been install, penetrations seals have been provided, ceiling tiles have been replaced, etc.

3.18 DEMONSTRATION

A. Demonstrate equipment, specialties, and accessories. Review operating and maintenance information.

B. Schedule demonstration with Owner with at least seven days' advance notice.

END OF SECTION 21 01 70

SECTION 22 00 00
GENERAL PROVISIONS - PLUMBING/FIRE PROTECTION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and all other applicable Divisions, apply to work of this Section.

B. This specification or drawing and the design features or resulting construction disclosed, are the property of Furlow Associates, Inc., and shall not be reproduced without written permission.

C. All fire protection suppression systems shall be part of and included in all of the following 220000 thru 220191 Sections.

1.2 WORK INCLUDED

A. Provide labor, materials, equipment and supervision necessary to install complete operating Plumbing and Fire Protection Systems as indicated the drawings and specified herein, including all work at the site and within the proposed construction areas to accomplish the required work.

1.3 REGULATIONS, CODES AND STANDARDS

A. Work shall be performed in accordance with latest adopted codes, regulations and ordinances by authorities having jurisdiction. Observe all safety regulations.

B. Latest editions of any referenced standards shall govern.

C. Obtain all municipal and/or the Authorities Having Jurisdiction permits and inspection certificates and pay all charges.

D. Make or arrange for any/or all inspection agency reviews or visits and pay all charges. This includes communication with each respective agency and/or utility to verify the project system work, coordination responsibilities, fees, back charges, etc., required.

E. All fees and back charges shall be verified during the bidding phase of the work. Any discrepancy of this item between any utility, inspection agency and the Contractor shall be brought to the attention of the A/E prior to bid opening.

F. Submission of a bid will be deemed evidence of having complied with these requirements.

1.4 RELATED WORK

A. Refer to equipment shown or specified in all other applicable Divisions that require Plumbing and Fire Protection services.

B. Refer to work related to Plumbing and Fire Protection as shown on the following contract drawings:

Architectural & Structural
HVAC
Electrical

1.5 COORDINATION

A. The Mechanical, Plumbing and Electrical Contractors are responsible to coordinate all manufacturer's

recommended circuit breakers, starters, disconnects and fuse sizes for all equipment. Submission of a shop drawing will certify that this has been completed. Any necessary changes required will be included as part of this contract.

B. Plumbing and Sprinkler Contractors shall coordinate scheduling, submittals and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of independent work elements, with provisions to accommodate items that may be installed at a later time.

C. Plumbing and Sprinkler Contractors shall verify utility requirements and all characteristics of operating equipment are compatible with the building utilities. Coordinate the work of all sections related and required for installing, connection and placing in service of all equipment.

D. Plumbing and Sprinkler Contractors shall coordinate all space requirements, supports and installation of all mechanical, electrical, plumbing and fire protection work, which are indicated diagrammatically on the Drawings. Verify routing of all pipes, ducts, conduits and equipment connections. Maximize accessibility for other work, and service requirements for maintenance and repairs.

E. Obtain written confirmation from all related trade Contractors and the Owner or his representative that requirements, conflicts and coordination issues have been discussed and resolved.

1.6 SUBMITTALS

A. Shop Drawings & Product Data:

1. Shop drawings and product data shall be submitted in accordance with Division 22 specifications except where herein modified.

NOTE: Submittals will only be reviewed once and resubmittals will be reviewed once. Any other submittals will be billed to the Contractor at the Engineer's standard rates.

2. Listed are the required shop drawings and reports required for this project. The Engineer/Owner shall reserve the right to require additional submissions not listed below:

- All fixtures, equipment and associated devices so listed on the Fixture Schedule on drawings.
- Insulation
- All specified piping systems.
- All specified valves.
- Gauges and thermometers
- Recirculating pump.
- Hanger and supports including Sumner system.
- Piping labels and identification.
- Sprinkler System and all related data, devices, switches and trimmings.
- Testing reports.
- Sterilization report.
- Operating/Maintenance manuals.
- As-Built Drawings.

3. Submittals comprising complete catalog cuts, shop drawings and performance test data for Plumbing materials and equipment as required by other sections of Division 22, shall be submitted for review checking. The Contractor shall review these for conformance to contract documents prior to submission and affix contractor's signature to each submittal certifying that this review has been done. By approving and submitting shop drawings, product data, samples and similar materials, the Contractor represents that the Contractor has determined and verified materials, field measurements and field construction data that relates to the work, and has checked and coordinated this information with all of the requirements contained in the contract documents for the work of all trades.

a. The Contractor and equipment manufacturer shall clearly identify in all submittals and shop drawings any and all applications standards which require additional work to accommodate this equipment and provide a complete and operational system as described in the contract documents.

b. The Contractor shall be completely responsible for any and all additional costs associated with the changes required by this and all other trades.

c. The indicated sprinkler system components including zone valves, alarm and monitoring switches are the minimum requirement based on design and project requirements. If the bidding fire protection contractor elects to furnish and install a different arrangement to achieve the same end result and fire marshal approved system, this contractor shall be responsible for any and all added costs. This shall include but not be limited to the previous items mentioned as well as the additional support and monitoring requirements of the project fire alarm system. There shall be no additional cost to the owner or project.

4. All submittals shall have the following identification data, as applicable, contained therein or permanently adhered thereto.

a. Project name.

b. Project number.

c. Sub-contractor's, vendor's and/or manufacturer's name and address.

d. Product identification.

e. Identification of deviation from contract documents.

f. Applicable contract drawings and specification section number.

g. Shop drawing title, drawing number, revision number, and date of drawing and revision.

h. Resubmit revised or additional submittals as requested.

i. Wherever shop drawings or vendor's standard data sheets indicate work to be done "by others", it shall be the responsibility of the contractor making the submission to identify by name, the contractor who is to do this work. If the contractor named is other than the contractor making the submission, the shop drawing submission must be reviewed by the named contractor and bear his mark of approval, prior to submission to the Architect/Engineer.

j. Where equipment proposed differs from that shown on the drawings or specified, he shall submit for approval drawings showing the manner in which the layout is affected by the substitution.

k. The Contractor shall keep one copy of approved shop drawings at the job site,, filed in a suitable metal container. The shop drawings shall be cataloged and kept in good repair, and shall be available for use by the Owner, Architect and Engineer.

l. No equipment shall be ordered, fabricated, etc., before approval of shop drawings.

B. Contractor is responsible for the shop drawing coordination and interface with the work of other contracts and adjacent work. The relationship of Contractor’s work shall be verified as it relates to adjacent and critical features of the work of this and all contracts and materials.

1.7 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in all other applicable Divisions. In addition, refer to specifications for special guarantees.

B. Wherever in the specification sections of this division, reference is made to a specific warranty period, this warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the contract documents.

1.8 SITE INSPECTION

A. The Contractor shall visit the site, inspect, and become aware of all conditions which may affect the work during the estimation phase of his work and prior to bid openings. Investigate utilities, protection requirements for adjacent facilities, storage locations, and access to the construction area.

B. Submission of a bid will be deemed evidence of having complied with this requirement.

1.9 SUBSTITUTIONS

A. Whenever a material, article, piece of equipment or system is identified in the following specification or indicated on the drawings by reference to manufacturers' or vendors' names, trade names, catalog numbers or the like, it is so identified for the purpose of establishing the basis of the Bid.

B. Substitution approval must be obtained and included as an addendum item prior to the submission of the bid. An approved substitution shall not be considered as an approval for the Contractor or an equipment vender to deviate from the written portion of the specifications unless so stated in the addendum.

C. The drawings illustrate the space allocated for equipment and the Contractor shall install the equipment accordingly. If changes are required in the building or arrangement due to substitution of equipment, the Contractor making the substitution must pay for the necessary modifications.

D. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements as indicated on all contract documents and as described within the specifications. This shall include, but shall not be limited to space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items furnished and installed by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, then they shall be responsible for any and all additional costs associated with the changes required by other trades.

1.10 LUBRICATION

A. Furnish, install and maintain all required lubrication of any equipment operated prior to acceptance by the Owner. Lubrication shall be as recommended by the equipment manufacturer.

B. Provide one year's supply of lubricants to Owner at date of acceptance.

C. Verify that required lubrication has taken place prior to any equipment start-up.

1.11 EQUIPMENT START-UP

A. Verify proper installation by manufacturer or his representative.

B. Advise General Contractor 2 days prior to actual start-up.

C. Verify proper operation. Obtain signed statement by manufacturer or his representative that equipment is operating within warranty requirements. Submit statement to General Contractor.

1.12 OPERATION & MAINTENANCE INSTRUCTIONS

A. Properly and fully instruct Owner's personnel in the operation and maintenance of all systems and equipment.

B. Ensure that the Owner's personnel are familiar with all operations to carry on required activities.

C. Such instruction shall be for each item of equipment and each system as a whole.

D. Provide report that instruction has taken place. Include in the report the equipment and/or systems instructed, date, contractor, Owner's personnel, vendor, and that a complete operating and maintenance manual has been reviewed.

E. Manual shall include all instructions on operation, maintenance, repair parts list, lubrication requirements, brochures, catalogue cuts, wiring diagrams, piping diagrams, control sequences, service requirements, names and addresses of vendors, suppliers and emergency contacts. Three manuals shall be provided.

F. Submit manuals for review prior to operating instruction period. Manuals shall be 8-1/2 x 11" with hard cover, suitably bound.

G. Provide to the Owner any special tools necessary for operation and routine maintenance of any of the equipment.

1.13 TOOLS

A. All equipment furnished by the Contractor which requires special tools or devices other than those normally available to the maintenance or operating staff shall be furnished in duplicate to the Owner, sufficiently marked, packed or boxed for staff usage. The tools provided shall be listed by the Contractor identified as to their use or the equipment applicable in a written transmittal to the Owner.

1.14 CLEANING AND FINISHING

A. After equipment start-up and all operating tests have been made and the system pronounced satisfactory, each respective Contractor shall go over the entire project, clean all equipment, etc., installed by him and leave in a clean and working condition. Any surfaces found marred after this final cleaning shall be refinished or replaced by each Contractor at no cost to the Owner.

B. Provide for the safety and good condition of all materials and equipment until final acceptance by the Owner. Protect all materials and equipment from damage. Provide adequate and proper storage facilities during the progress of the work. Special care shall be taken to provide protection for bearings, open connections, pipe coils, pumps, compressors and similar equipment.

C. All NEW fixtures, piping, finished surfaces and equipment installed shall have all grease, adhesive labels and foreign materials removed.

D. All new piping installed shall be drained and flushed to remove grease and foreign matter. Pressure regulating assemblies, traps, flush valves and similar items shall be thoroughly cleaned. Remove and thoroughly clean and reinstall all liquid strainer screens after the system has been in operation ten (10) days.

E. Gas piping shall be blown out with clean compressed air or inert gas.

F. When connections are made to existing systems, the Contractor shall do all cleaning and purging of the existing systems required to restore them to the condition existing prior to the start of work.

G. Clean-up: Remove from the premises, all unused material and debris resulting from the performance of work under this section.

PART 2 – PRODUCTS

2.1 GENERAL

A. All material and equipment shall be new and of present day manufacture, and shall conform to accepted standards of the trade where such a standard has been established for the particular type of equipment or material.

B. Whenever equipment or material is referred to in the singular, such as "the plumbing fixture", it shall be deemed to apply to as many such items as necessary to complete the work.

2.2 PRODUCT DELIVERY, STORAGE AND HANDLING

A. During loading, transporting and unloading exercise care to prevent damage to material.

B. Store all materials in dry enclosures or under protective coverings out of way of work progress.

C. Material shall not be allowed to be stored directly on ground.

D. Deliver in manufacturer's original cartons or on skids.

E. Handle and protect so as to prevent damage to product or any surrounding material.

2.3 CONCRETE

A. Concrete if used on this project, shall be in accordance with Section 033000.

B. The 28-day minimum compressive strength shall be 3000 psi.

PART 3 – EXECUTION

3.1 PROTECTION

A. Plug or cap open ends of piping systems.

B. Stored materials shall be covered to prevent damage by inclement weather, sun, dust or moisture.

C. Protect all installed work until accepted in place by the Owner.

D. Plates, polished metal escutcheons and other finished devices shall not be installed until masonry, tile, and painting operations are complete unless otherwise protected.

E. Protect all work from operations which may cause damage such as hauling, welding, soldering, painting, insulating and covering.

F. Do not remove protective material until equipment is placed in service.

3.2 WORKMANSHIP

A. Install all work neat, trim and plumb with building lines.

B. Install work in spaces allocated.

C. Cutting and patching shall be performed by skilled tradesmen normally employed for the work involved.

3.3 EXCAVATION

A. The excavation shall be of the open-trench method and to the depths and widths as may be necessary. The Contractor shall do all excavation required in connection with his work. Bottoms of trenches shall be excavated to a uniform grade. All materials excavated shall be deposited on the side of the trenches and beyond the reach of the slides. Excavated material shall not be piled where it will interfere with traffic. If rock is encountered, it shall be removed by the General Contractor. See provisions in Division 2.

B. No piping shall be bedded directly on rock. They shall be cushioned by a 6-inch layer of crushed stone or gravel of selected grade, of size to pass through 3/4" mesh sieve. Not less than 30% shall be fine which will pass through a 3/8" mesh sieve.

3.4 SHORING AND PUMPING

A. The Contractor shall provide all shoring, bracing or sheet piling necessary to maintain the banks of his excavation and shall take out same as the work progresses and filling in has been accomplished. Shoring shall be in accordance with OSHA Standards.

B. The arrangement of shoring must be such as to prevent any movement of the trench banks and consequent strains on the conduits. Shoring shall be provided to prevent damage to work installed by other trades.

C. The Contractor shall do all pumping required to keep his excavations free of water. The water shall be conveyed in piping or watertight troughs a sufficient distance that it will flow from the site and not affect other work being performed.

3.5 BACKFILLING

A. After work in trenches has been completed, they shall be filled with select fill in 8" layers and shall be pneumatically tamped before the next layer of material has been filled in. The backfill shall be free of excavated rock, cinders, stones, brickbats or other debris.

B. Wherever rock is removed, the Contractor shall secure and fill select clean earth to a minimum depth of 3'-0" above the top of the pipe. Unless otherwise indicated, no rock shall be deposited in the trench fill. This clean earth fill shall be procured other than from the site unless permission for earth borrow from the site is granted by the Architect. If site borrow is permitted, the topsoil removal, relocation and finished grading will be accomplished as directed by the Architect.

C. Under no circumstances shall excavated material be left where it will interfere with the Owner's or other Contractor's operations.

D. All earth and other materials taken from the trenches and not required for backfilling shall be deposited where directed, or removed from the premises as directed by the Architect.

E. Any rock removed from the excavation shall be removed from the project site by the Contractor.

F. Trenches which pass under wall footings or within 18" of column footings shall be backfilled with lean concrete. To secure adequate foundation support, the method and depositing of the concrete fill shall be as directed by the Architect. To prevent the concrete from adhering to the pipes, necessary pipe protection shall be applied.

3.6 EQUIPMENT SETTING

A. Furnish and install as a minimum, a 4 inch concrete pad beneath all floor-mounted equipment. Install anchor bolts in pour.

B. Furnish and install as a minimum, spring vibration isolation under any equipment 10 HP and over and rubber in shear vibration isolation on any equipment up to 10 HP.

C. Concrete shall be 3,000 psi, 28-day compressive strength in accordance with ACI-613. Reinforce with No. 4 rod 12" on centers both ways or as otherwise detailed.

3.7 FASTENERS, HANGERS AND SUPPORTS

A. Furnish and install all hangers and supports required to suspend, mount, or hang the work.

B. Furnish and install all miscellaneous steel angles, channels, beams, clips, brackets and anchors necessary to hang or support the work. Provide submissions for review.

C. Install concrete inserts before concrete is poured.

D. Drilled inserts shall not be loaded more than 1/4 rated capacity or 200 pounds.

E. Power-driven fasteners shall not be allowed for piping larger than 2 inch, or equipment. When used they shall not be loaded more than 1/8 rated capacity or 200 pounds.

F. All hangers, miscellaneous steel, braces and supports shall be galvanized, cadmium plated, or primed steel. Copper tubing shall be supported with copper hangers. No direct contact of dissimilar metals between the piping system and its hanger support shall be permitted.

G. Piping shall be supported from adjustable clevis type hangers with insulation pipe saddles. Where hangers are 18” or longer, provide lateral bracing at every fourth hanger. See IPC Pipe Support Table below:

PIPE SUPPORT SPACING

Material	Horizontal Max. Feet	Vertical Max. Feet
ABS Pipe	4	10
Aluminum	10	15
Brass	10	10
Brass Tube up to 1-1/4”	6	10
Brass Tube over 1-1/2”	10	10
Cast Iron	5	15
Copper up to 1-1/4”	6	10
Copper over 1-1/4”	10	10
CPVC Up to 1”	3	10
CPVC Over 1”	4	10
Lead Pipe	Continuous	4
PB Pipe/Tubing	2.6 ft. (32”)	10
PVC Pipe	4	10
PEX	2.6 ft. (32”)	10
Steel Tubing	8	10
Steel Pipe	12	15

H. Support vertical piping at floor levels using approved riser clamps. Clamp material shall be compatible with pipe material. Maximum vertical spacing shall be10’-0”.

3.8 SLEEVES

A. Provide each pipe passing through a masonry or concrete wall, floor or partition with a sleeve made from standard weight steel pipe for pipe with smooth edges, securely and neatly cemented in place. Provide each pipe passing through a frame or metal partition with a sleeve made from No. 22 gauge galvanized sheet metal, securely fastened in place.

B. Pipe passing through foundation wall or under foundation shall be provided with relieving arch or steel pipe per IPC Section 305.5.

C. Be responsible for the proper location and alignment of all sleeves.

D. Provide hydrostatic seals for sleeves passing through outside walls, below grade, or through hydrostatically sealed slabs or floors on grade. Provide fire-rated seals for all other sleeves.

E. Install both piping and sleeve seals so as to maintain integrity of seals with expansion and contraction of piping.

F. Set floor sleeves flush with floor surface in finished areas, 1" above the finished floor in kitchens, cafeterias, and similar service areas unless such areas are slab-on-grade; 1" above the floor in mechanical rooms, pipe chases, pipe spaces and other unfinished areas, unless otherwise indicated, and flush with the underside of slabs. Extend wall and partition sleeves through and cut flush with each surface unless otherwise indicated or specified.

G. Select sleeves two pipe sizes larger than any pipe that is to remain uncovered, unless otherwise required by the sealing method specified. Where pipes are to be covered, provide sleeves large enough to allow the covering to pass through the sleeves with sufficient clearance for sealing as specified hereinafter. Size sleeves for branch piping from vertical risers large enough to permit vertical expansion at the riser.

H. Place sleeves imbedded in concrete floors or walls in the forms before concrete is poured; sleeves shall have integral waterstop flanges, where they are to receive either watertight or hydrostatic seals.

I. Install sleeves passing through above-grade floors of mechanical rooms, toilet rooms, kitchens or similar service areas where liquid leaks or spillover may occur in a watertight manner. Sleeves shall be such that waterproofing membrane can be flashed around and into the sleeve where necessary.

J. Seal sleeves for pipes passing through ceiling air plenum walls or the floor above air tight in a manner similar to that specified for fire-rated sleeves.

K. Hydrostatic Sealing Method: Provide compressible synthetic rubber seals, equivalent to LINK SEAL, manufactured by the Thunderline Corporation, or THRUWALL manufactured by O.Z. Gedney. Install seals in accordance with the manufacturer's recommendations to provide air tightness aboveground and hydrostatic sealing belowgrade. Caulking or other type mastic is not acceptable.

L. Fire-Rated Sealing Method:

1. Sleeves, openings and sealants shall comply with applicable codes, recommended practices and standards, and manufacturer's instructions. Fire sealants shall have ability to prevent spread of flame, smoke or water throughout the penetration and shall pass 3 hour test, UL test ASTM E814 and UL 1479.

2. Products: Chase Corporation CTC PR-855, O. Z. Gedney CRS/CAFS, 3M Electro-Products Division Putty 303 or Caulk CP25 penetration sealing kits, General Electric Company sealants type RTV-850, 6428 or 7403, Thunderline Corporation "Link-Seal Pyro-Pak". Installation and type of sealant to be used as recommended by the manufacturer.

3. Expansion collars, fire seal/firestop collars – ASTM E814 (UL1479). Spec Seal Corporation, Inc. (plastic pipe).

3.9 PLATES

A. Furnish and install chrome plated plates wherever piping passes into finished area.

B. Plates shall be securely fastened to piping or building construction.

C. Floor plates shall cover 1-inch sleeve extension.

3.10 OFFSETS, TRANSITIONS, MODIFICATIONS

A. Furnish and install all offsets necessary to install the work and to provide clearance for other trades.

B. Maintain adequate headroom and clearance.

C. Incidental modifications necessary to the installation of the systems shall be made as necessary and as approved by the Architect.

3.11 RECESSES

A. Furnish information to the General Contractor as to sizes and locations of recesses required to install panels, boxes, and other equipment or devices which are to be recessed in walls.

B. Make offsets or modifications as required to suit final locations.

3.12 LABELING

A. All Plumbing equipment such as pumps, and devices requiring identification for operating procedures shall be provided with permanent black laminated micarta white core labels with 3/8 inch letters.

B. This shall also apply to all controllers, remote start/stop pushbuttons and equipment cabinets.

3.13 FLASHING AND COUNTERFLASHING

A. Roof drains, vents, roof curbs, etc., shall have counterflashing fittings. General Contractor shall provide flashing.

B. Piping and conduit thru the roof shall be flashed by the General Contractor. Furnish and install counterflashing.

3.14 ACCESS

A. Locate all equipment, valves, devices and controllers which may need service in accessible places.

B. Where access is not available, access panels shall be provided. Furnish access doors to the General Contractor for installation.

C. Access doors shall be Elmdor, Karp Co., MIFAB or Controlled Air Manufacturing Limited, with 16 gauge frames and 14 gauge steel door, prime painted.

D. Maintain required access clearances.

3.15 WIRING

A. Packaged plumbing system equipment shall be furnished with disconnect switches, and magnetic starters, factory furnished and wired by the unit manufacturer.

B. All control wiring shall be furnished and installed under this Division of the work.

C. All wiring shall be in accordance with the National Electrical Code and as recommended by the equipment manufacturer.

3.16 UTILITIES

A. Do not interrupt any utility or service to the Owner without adequate previous notice and schedule.

B. Arrange and pay for the relocation, disconnection or removal of, or relocate, disconnect or remove existing utilities and services where such work is shown or where such utilities or services interfere with new construction, whether or not shown. Provide all excavation, backfilling and paving required by such work.

C. Perform alteration of utilities and services in accordance with the rules, regulations and requirements of the involved utility companies, regulatory agencies having jurisdiction.

3.17 CUTTING AND PATCHING EXTERIOR SURFACES

A. This Contractor shall be responsible for returning disturbed paved and/or grass areas to original condition where excavation for utilities has been required.

B. Cut and patch paved areas to match original surface.

C. Properly tamp backfill before finishing or repairing disturbed area surfaces.

3.18 OPENINGS - CUTTING, REPAIRING

A. This contractor shall cooperate with the work to be done under other sections in providing information as to openings required in walls, slabs and footings for all piping and equipment, including sleeves where required.

B. Any drilling or cutting required for the performance of work under this Section, shall be the responsibility of this Contractor and the cost thereof shall be borne by him.

C. Holes in Concrete: Sleeves shall be furnished, accurately located and installed in forms before pouring of concrete. This contractor shall pay all additional costs for cutting of holes as the result of the incorrect location of sleeves. All holes through existing concrete shall be either core drill or saw cut. All holes required shall have the approval of the Structural Engineer prior to cutting or drilling.

D. It shall be the responsibility of this Contractor to ascertain that all chases and openings are properly located.

3.19 GUARANTEE

A. All materials and equipment provided and/or installed under this section of the specifications shall be guaranteed for a period of two years from the date of acceptance of the work by the Owner unless otherwise specified in other applicable Divisions. Should any trouble develop during this period due to defective materials or faulty workmanship, the Contractor shall furnish all necessary labor and materials to correct the trouble without any cost to the Owner. Any defective materials or inferior workmanship noticed at time of installation and/or during the guarantee period shall be corrected immediately to the entire satisfaction of the Owner.

In the event of occupancy by the Owner prior to final acceptance of the project, the guarantee date for equipment placed in operation shall be mutually agreed to by the Contractor and the Owner's representative.

3.20 DRAWINGS

A. The Plumbing and Fire Protection Systems are indicated on the Contract Drawings. Certain pertinent information and details required by the Plumbing and Fire Protection Work appear on the Architectural, Structural and Electrical Drawings; become familiar with all Drawings; and incorporate all pertinent requirements.

B. Drawings are diagrammatic and indicate the general arrangement of systems and requirements of the Work. Do not scale Drawings. Exact locations of fixtures and equipment, not specifically shown shall be obtained before starting work.

C. When indicated on the drawings, plumbing riser diagrams are completely diagrammatic and indicate the intent of the work for both the Contractor, L&I review agencies and/or Authorities Having Jurisdiction. Where valves, shock absorbers, incidental equipment, devices, etc., including execution notes are indicated on the riser diagrams, they shall be so required and installed as part of the system work.

3.21 RECORD DRAWINGS

A. As-Built record drawings, showing dimensions, locations and depth of all buried and concealed piping, plugged outlets and equipment shall be kept up to date. Master copy shall be kept on the job. No backfilling of trenches shall be permitted until as-built drawings are approved as up-to-date by the Owner/Representative. No plumbing progress payments shall be approved unless as-built drawings are up- to-date. Depth of sewers shall be from a permanent bench mark as shown on the contract drawings. Refer to project record drawings under General Conditions.

END OF SECTION 22 00 00

SECTION 22 00 10
BASIC MATERIALS AND METHODS - PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this Section.

1.2 REFERENCE

A. Install all piping, fixtures, equipment, etc., to meet the requirements of the following:

Middletown Department of License and Inspection
Middletown Department of Sewers
State of Delaware Plumbing Code
Delaware State Fire Marshal's Office
International Plumbing Code (All applicable sections)
International Mechanical Code (All applicable sections)
International Fuel Gas Code (All applicable sections)
Gas Utility Company
Water Company
NFPA
OSHA

All requirements of the above governing agencies shall be in compliance with the latest issues, rules or regulations in effect.

B. Appliances and materials governed by UL requirements shall meet such requirements and bear the label.

1.3 QUALITY ASSURANCE

A. Provide adequate supervision of labor force to assure all aspects of specifications are being fulfilled.

B. Ensure that all work and equipment is installed in accordance with manufacturer's warranty requirements.

C. Replace all pipes and fittings shown to be defective as a result of testing.

1.4 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 220000.

B. Submit the following:

1. Manufacturer's Product Data on all pipe and fittings to be used in project.
2. Manufacturer's Product Data on all valves to be used in project.

1.5 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS.

PART 2 – PRODUCTS

2.1 STEEL PIPE & FITTINGS

A. Pipe: ASTM A-53, Schedule 40.

B. Fittings:

1. Cast iron, threaded, 175 psi, ANSI B-16.4.
2. Malleable iron, threaded, ASA B 16.3.
3. Steel, socket weld, ASTM A-53.
4. Wrought iron, socket weld, ASTM A-72.

C. Thread tape shall be teflon tape, 3 mils minimum thickness. Teflon tape shall not be permitted for use on gas piping systems.

D. See Section 220130 for Gas Piping Systems.

2.2 CAST IRON PIPE AND FITTINGS
(Note: Any cast iron piping made or marked “CHINA” will NOT be acceptable on this project)

A. Aboveground:

1. Pipe & Fittings: Hubless cast iron, CISPI 301, ASTM A-74 and ASTM A-888 shall be marked with the collective trademark of the Cast Iron Institute (soil pipe).

2. Joints: Neoprene sleeve and stainless-steel shield and clamp assembly, CISPI 310, ASTM-1277.

B. Below grade and/or slab: (Contractor's Option)

1. Bell and Spigot: Service weight bell and spigot pattern ASTM-74 with compression type neoprene gaskets ASTM C-564.

2. Hubless: Hubless cast iron pipe CISPI 301, with heavy duty 3.04.016 stainless steel bands for below-grade installation. Elastomeric seal component ASTM C-564 and CSA B-602.

3. Hubless Joints: Cast iron CISPI 310 and as TM C-1277.

4. PVC DWV pipe and fittings, Schedule 40, ASTM D-2665, D2949, F891 and CSA B181.2.

5. Corrosion protection shall be in accordance with IPC 305.1. Provide appropriate wrapping or sheathing when pipe is exposed to lime and acid of concrete, cinder or other corrosive materials.

6. Protection of all below-grade storm and sanitary shall be in accordance with IPC Section 305.

7. All Kitchen and Boiler Room below slab piping shall be service weight cast iron only. PVC not allowed.

C. Corrosion protection shall be in accordance with IPC 305.1. Provide appropriate wrapping or sheathing when piping is exposed to lime and acid of concrete, cinder or other corrosive materials.

2.3 COPPER TUBING

A. Domestic hot, cold and recirculated water:

1. Aboveground:
   a. Tubing: Hard-drawn, seamless ASTM B-88, Type "L".
   b. Fittings: Solder joint wrought copper ANSI B-16.22.

c. Joints: Lead-free solder 410°, ASTM B-32 alloy designation “TC”, ASTM B-828.
d. Flux: Non-toxic and non-corrosive, ASTM B-813.

2. Underground:
a. Tubing: Soft-drawn, seamless ASTM B-88, Type "K".
b. Fittings: Solder joint wrought copper ANSI B-16.22.
c. Joints: Lead-free solder 410°, ASTM B-32, ASTM B-828.
d. Flux: Non-toxic and non-corrosive, ASTM B-813.

B. Drainage and vent piping:

1. Aboveground:
a. Tubing: Hard-drawn seamless ASTM B-88, ASTM B-75, Type "M" and DWV as pipe size permits.
b. Fittings: Solder joint cast copper drainage type ANSI B-16.29.
c. Joints: Soldered, 95/5 tin-antimony ASTM B-828, ASTM B-32.
d. Flux: Non-toxic and non-corrosive, ASTM B-813.

C. Solder/Flux: See Paragraph 3.4 of this section for Soldering/Brazing.

2.4 DUCTILE IRON PIPE

A. Pipe: Ductile iron, ANSI A-21.51, ANSI/AWWA C151.

B. Joints: Rubber gasket, ANSI A-21.11, ANSI/AWWA C111.

C. Fittings: Mechanical joint, ANSI/AWWA C110, C153 bolt tolerances – AWWA C-111, ASTM A-563.

D. Lining: Cement mortar, ANSI A-21.4, ANSI/AWWA C104.

2.5 PVC GRAVITY SEWER PIPE

A. Pipe: Unplasticized polyvinyl chloride (PVC) with integral wall bell and spigot joints.

B. Material: ASTM D-3034 for SDR 35, colored green for inground identification as sewer pipe.

C. Joints: Two sections of pipe shall be assembled in accordance with manufacturer's recommendations and tested as per ASTM D 3212 for use with flexible elastomeric seals.

D. Sizes: For site drainage systems 4" to 15".

E. Additional compliances:

1. Drop Impact Test - ASTM D-2444
2. Pipe Stiffness - ASTM D-2412
3. Temperature for Testing - Designed to pass all tests at 73 degrees F (+/- 3 degrees F).

2.6 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. Aboveground – Drainage & Vent (Sanitary) IPC Table 202.1

1. ASTM D 2665
2. ASTM D 2949
3. CSA CAN/CSA B 181.2
4. ASTM F 1488
5. ASTM F-81

B. Underground – Drainage & Vent (Sanitary) IPC Table 702.2

1. ASTM D 2665
2. ASTM D 2949
3. ASTM F 891
4. CSA CAN/CSA-B 181.2

C. Building Sewer Pipe (Near Water Service) IPC Table 702.3 (DWV)

1. ASTM D 2665
2. ASTM D 2949
3. ASTM D 3034
4. ASTM F 891
5. CSA B182.2
6. CSA B 182.4 (Ribbed Sewer Pipe & Fittings)

D. Fittings:

1. ASTM D 3311
2. ASTM D-2665
3. ASTM F-1866

E. Solvent Cement: (All Purpose on ABS, PVC and CPVC)
Potable Water, Sewer, Drain Waste and Vent

1. ASTM D-2564, D-2235 and F-493
2. CSA B137.3
3. CSA B181.2 or B182.1 (Sanitary Pipe only)
4. ASTM D2855
5. CSA B181.1

F. Primers: (PVC and CPVC)

1. ASTM F 656, purple color, SCAQMD Rule 1168 and OTC Regulations for VOC emission levels. NSF Standard 61 PW, DWV, Sewer.

G. Uniformity: To insure installation uniformity, all piping components shall be of one manufacturer.

2.7 POLYPROPYLENE PIPE & FITTINGS

A. Pipe & Fittings: Polypropylene flame retardant ASTM D-2146 Schedule (40) (80).

B. Joints: (Aboveground)

1. Mechanical
2. Fusion welded socket ends.

C. Joints: (Below ground) Fusion welded - socket ends

2.8 CORRUGATED METAL PIPE

A. Pipe:

1. 24" diameter and smaller shall be 16 U.S. gauge steel.
2. 30" diameter and larger shall be 14 U.S. gauge steel.
3. All piping shall be completely bituminous coated on the interior and exterior and shall have a paved invert for 25% of its periphery.

B. Joints: Standard coupling bands and bolts as furnished by the pipe manufacturer.

2.9 VALVES (Copper Systems) – Solder ends of Threaded

A. Valves listed below shall be for domestic water systems and comply with the latest requirements of NSF 61-8. Refer to individual sections for gas valves.

B. Ball Valves: NIBCO two-piece, full port, 600 psi WOG rated, cold non-shock valve with reinforced TFE seals, 316 stainless steel ball, Eco-brass body, ASTM 584, Alloy C87850, solder ends, or threaded non-blowout stem design. Acceptable NIBCO figure numbers: T/S 685-80-66-LF; T/S 595-Y-66-LF (3 piece).

C. Check Valves: NIBCO Class 125, Eco-brass body, ASTM 584, Alloy C87850, swing type, Y Pattern, threaded cap access. Acceptable NIBCO figure number: T/S 413-LF. For condensate drainage systems use the NIBCO T/S-413-B or approved equal. (Nibco figure number T/S-413-B for condensate drainage.)

D. Gate Valves: NIBCO Class 125, Eco-Brass body, ASTM 584, Alloy C87850, Rising Stem. Acceptable NIBCO figure number: T/S 113-LF.

E. Balance Valves: All balance valves shall be provided with a memory stop feature with calibrated name plate to assure specific valve setting. Bronze body/brass ball, carbon filled TFE seat rings. NIBCO, Bell & Gosset, Accu-Flow, Taco or Flow Design "Accusetter". Acceptable NIBCO figure numbers: T/S 1710, F/G 737.

F. Strainers:

1. Class 125 Bronze Y-Strainer, body to be ASTM B584 or B62 bronze with threaded, solder or female press end connections and .033 inch perforated type 304 stainless steel screen or 20 mesh type 304 stainless steel screen accessible without removing the strainer from the line. Acceptable Figure numbers: NIBCO Fig. S/T-221, S/T-222, PF-221/222-A,B.

2. Class 125 Flanged Cast Iron Y-Strainer, body to be ASTM A-126 Class B cast iron. End connections to be Class 125 flanged, tapped bolted bonnet with plug. Screen shall be .033 inch perforated type 304 stainless steel screen or 20 mesh type 304 stainless steel screen accessible without removing the strainer from the line. Acceptable Figure numbers: NIBCO Fig. F 721-A.

3. Class 250 Threaded Cast Iron Y-Strainer: Strainer body to be ASTM A-126 Class B cast iron. End connections to be Class 250 threaded, tapped screw-in bonnet with plug. Screen shall be .033 inch perforated type 304 stainless steel screen or 20 mesh type 304 stainless steel screen accessible without removing the strainer from the line. Acceptable Figure numbers: NIBCO Fig. T-751-A

G. VALVES (Copper Systems) – Press Fit

1. Valves listed below shall be for domestic water systems and comply with the latest requirements of NSF-61-8.

a. 2 Inch and Smaller Ball Valves (On/Off):

Ball Valves with male or female press to connect shall be rated at 200 PSI CWP to +225°F maximum. Valves shall be manufactured in accordance with MSS SP-110 and constructed of dezincification resistant cast bronze bodies. Brass with more than 15% zinc shall not be approved. Valve shall have reinforced PTFE Seats, Blow-out Proof Stem, Full Port Ball, Chrome/Nickel Plated or Stainless Steel Ball for aggressive water.

b. 2 Inch and Smaller Check Valves (Swing Type):

Check valves shall be swing type Y pattern with male or female press to connect ends and shall be

rated 200 PSI CWP to + 250°F maximum. Valves shall be manufactured in accordance with MSS SP-80. Body & cap shall be manufactured of dezincification resistant cast bronze ASTM B62 or ASTM B584 Alloy C8440. Valves shall have PTFE seat disc.

c. 2 Inch and Smaller Check Valves (Lift or Spring Type):

Incline resilient disc, spring actuated, 250psi rating, non-shock cold working pressure, 2500F maximum working temperature, bronze ASTM B584 alloy C84400. Stainless steel stem and disc holder and spring, EDPM O-ring.

H. Insofar as possible, all valves of the same type shall be of the same manufacturer.

I. Valve Manufacturers: Subject to compliance with requirements, provide valves of one of the following:

Apollo/Conbraco
Stockham
Nibco
Milwaukee
Watts
Hammond
Webstone

J. System Application:

1. Domestic Water:

a. Check Valves - 2" & Smaller - threaded or soldered.
b. Ball Valves - 3" & Smaller - threaded or soldered.
c. Balance Valves - All sizes - threaded.
d. Butterfly Valves - 4" and larger - flanged.
e. Butterfly Valves – 3” and smaller – wafer type.

2.10 THERMOMETERS

A. Separable socket, inserted into fluid flow, adjustable, hermetically sealed, red mercury, die-cast, baked enamel finish, double strength glass lens, white scale and black graduations.

B. Scale: Select range of thermometer to indicate normal operating temperature at mid-point of scale for domestic water systems.

C. Manufacturer: U.S. Gauge, H.O. Trerice, Moeller, Duro.

2.11 GAUGES

A. Phosphor bronze bourdon tube, polypropylene case, gasketed glass crystal, aluminum dial, black graduations 4-1/2 inch diameter.

B. Range: 0 to 150 psi, 5 pound intervals, 1/2 pound graduations.

C. Manufacturers: Danton, U.S. Gauge, H.O. Trerice, Moeller.

D. Install with bronze gauge cock.

2.12 ISOLATING FITTINGS

A. Furnish isolating fittings between all sections of dissimilar piping materials or piping, general supports, equipment and supports, including piping hanger and rack supports where one material is ferrous and the other

is non-ferrous.

B. Install copper or brass piping or tubing in such a way as not to touch or come in contact with ferrous metals.

C. Where ferrous piping or equipment is connected to copper or brass piping, make connection with insulating or dielectric unions to prevent electrolytic action between the ferrous and non-ferrous metals.

D. Where copper or brass piping, tubing or fittings are anchored to, supported by or may come in contact with ferrous metal construction, provide an insulating nonconductor spacer of rubber, fiber or equivalent material to assure prevention of electrolysis.

E. Manufacturer: Epco Sales, Inc., or insulated unions by Central Plastic Co.

2.13 ANCHORS AND GUIDES

A. Anchors and guides shall be provided to support and maintain pipes in position and properly distribute expansion. The anchors and guides must be securely fastened to the building structure, and must be completely installed before the system is tested.

B. Guides shall be as manufactured by J.J. McNally, Inc., Flexonics, Inc., Tube-Turns, American District Steam Co.

2.14 UNIONS

A. Up to and including 2 inch pipe size: Screwed pattern, bronze-to- bronze seat.

B. Above 2 inch pipe size: 125 Class Flanged pattern, A.S.A. sweat copper fitting, with gaskets, bolts and nuts.

C. Copper tubing unions shall have sweated type ends. Flanged unions on copper tubing may be soldered connections.

D. Materials and pressure ratings shall be the same as specified for the respective pipe and fitting system unless otherwise specified.

PART 3 – EXECUTION

3.1 PIPING SYSTEM INSTALLATION REQUIREMENTS

A. Drawings are generally diagrammatic and due to small scale, it is impossible to indicate all fittings, valves, gauges and specialties required. Provide complete operating systems and all necessary fittings, valves gauges and specialties whether or not indicated.

B. Install all piping in accordance with the best practices of the trade and latest code requirements. Use uniform system materials throughout the building. All branch take-offs shall be off the top of the pipe.

C. Pipe and fittings shall be clean from cutting burrs, foreign materials and defects in structure and threading. Make all cuts square. Ream after cutting. Clean off scale and dirt inside and outside, before assembly. Remove welding slag or other foreign material.

D. Keep all piping as high as possible, consistent with proper pitch, to maintain maximum headroom. Cut piping accurately to measurements established at the building, work into place without springing, forcing or cutting of the building structure, and install as directly as possible between connecting points parallel with or at right angles to building construction, except as required to obtain pitch.

E. Unless otherwise shown, run piping within the building, concealed in the walls, furred spaces, pipe spaces or above suspended ceilings. Unless otherwise noted, do not build in or bury horizontal piping in partitions. Install all exposed piping as closely as possible to walls, ceilings and columns, consistent with access and

applicable insulation requirements.

F. All piping to drain to low points. Low points will be provided with drain valves with hose thread. All piping shall have high points vented with ball valve, nipple and threaded cap.

G. Do not install trapped lines where water cannot be drained or air can accumulate without being vented.

H. Piping shall run square with building lines.

I. Piping shall not be insulated or covered until tested and until building is closed in.

J. Necessary drains, off-sets, vents and drips shall be provided for coordination of the work as part of the contract.

K. Piping shall not be installed over electrical transformers, panels, switchgear, substations, and control panels as per the National Electric Code. No piping shall be installed in elevator machine rooms unless it is directly related to the room's system equipment.

L. Allow clearance for expansion and contraction.

M. Install isolating fittings between sections of ferrous and non- ferrous pipe or connected equipment.

N. Valves shall be installed with stems above horizontal.

O. Valves shall be installed on all sides of equipment and control valves to allow isolation for repair.

P. Do not support piping from other piping, conduits or equipment. Provide additional bracing to prevent movement of trapeze piping, or any singular run of pipe to fixtures. Provide additional bracing on all piping through walls to flush valves to prevent movement during normal operation or performing maintenance on valves.

Q. Thermometers and gauges shall be installed where indicated on the drawings, required by equipment specifications and where indicated elsewhere in the specifications. Gauges shall be located at an elevation that can be readable.

R. Unions shall be provided adjacent to all valves, at equipment connections, and where necessary to facilitate dismantling of the piping system.

S. Ball valves to be installed with the proper clearance for operating the valve handle. A minimum clearance of 10" from center of valve to wall must be maintained for ease of operation.

T. Thermometers are to be located so they can easily be seen from the floor in front of unit. Make final adjustment by tilting thermometer. Locate bulb in waterway with an oversized tee or elbow fitting.

U. Install pressure gauges on incoming services both domestic water and fire services. Locate pressure gauge after main shut-off valve and ahead of water meter if one is provided within building.

V. All pipe unions installed shall be accessible. Unions shall not be concealed or located in places where they cannot be maintained.

W. Support and bracing of 4" and above pipe shall be in accordance with the CISPI Standards and IPC Chapter 3.

3.2 TAGS, CHARTS, AND IDENTIFICATION

A. All piping shall be labeled in accordance with IPC 303.1 and 303.4.

B. Identify each valve in all systems with black, numbered and stamped 1-1/2" brass or aluminum tags fastened to valve by brass chain and S-hook.

C. Piping Identification: Provide identification and safety products, semi-rigid plastic, wraparound pipe markers with flow arrows and conforming to ANSI A13.1. Locate marker at each valve, changes in direction, where pipes pass thru barriers and every 25' of horizontal runs. Lettering on background shall be in accordance with the following colors:

Legend	Background	Lettering
1. Gas	- Yellow	- Black
2. Fire Protection	- Red	- White
3. Domestic Cold Water	- Green	- White
4. Domestic Hot Water (110° ^ 140°)	- Yellow	- Black
5. Domestic Hot Water Return (110° ^ 140°)	- Yellow	- Black
6. Sanitary Drainage	- Green	- White
7. Condensate Drainage	- Yellow	- Black
8. Vent	- Yellow	- Black
9. Storm Drainage	- Green	- White
10. Medical Gas	Conform to NFPA-99 Regulations	
11. Plant Compressed Air	- Yellow	- Black

D. Provide 1/8" scale diagrams showing location, number and service or function of each tagged item.

1. Frame diagrams in approved metal frames with clear acrylic front, hinges, and locks.
2. Secure to wall in Mechanical Room.
3. Provide two additional separate copies permanently covered and bound.

E. Furnish and install color coded 1” diameter markers on ceiling tile grids to indicate system and valve locations.

1. Domestic cold water: - Green
2. Domestic hot water: - Yellow
3. Domestic hot water return: - Yellow
4. Gas - Yellow

F. Available Manufacturers: Subject to compliance with requirements, manufacturer’s offering identification markers which may be incorporated in the work are limited to the following:

Seton
Brimar
B-Line
Marking Services, Inc.

3.3 WELDING

A. All concealed and inaccessible black steel piping shall be welded.

B. All black steel piping larger than 2 inch shall be fusion welded.

C. All elevated pressure (above 14” WC) natural /propane gas piping within buildings shall be welded joints.

D. All elbows, tees and branch connections shall be made with welding fittings ANSI B16.9.

E. Welding shall be in accordance with the ASME Boiler and Pressure Vessel Code Section IX.

F. Furnish welder test certificate for review. Certificates of successful qualification by the following organizations shall be acceptable.

1. ASME Boiler and Pressure Vessel Code
2. ANSI Code for Pressure Piping
3. National Certified Pipe Welding Bureau
4. Military Specification MIL-STD-248

3.4 SOLDERING/BRAZING

A. Connections between copper tubing and copper sweat fittings shall be made by soldering using Taramet Sterling or approved substitute. Flux shall be non-corrosive type "Nokorode" or approved substitute or as recommended by the manufacturer of the solder.

B. All solder shall be "lead nickel and antimony free" in accordance with the Federal Safe Drinking Water Act Amendments of 1986 and 1996 as is ASTM B-32 Grade TC.

Composition:

Tin	95%
Copper	4.0 – 5.0%
Selenium	.04 - .2%
Tensile Strength	7,130 psi
Shear Strength	5,970 psi
Melting temperature	410°F

C. Tubing shall be cut square and then reamed and deburred. End of tubing and inside of fitting cup shall be cleaned with steel wool and the flux shall be applied to the clean surface before soldering. After soldering, the excess solder shall be wiped off while still plastic.

D. Silver brazing alloy shall be equal to and shall be used for joints in:

1. Medical Gas Piping (All Systems)
2. Medical Vacuum Piping

E. Brazed Joints:

1. All brazed joints shall be cleaned. An approved flux shall be applied; joint filler metal shall conform to AWS A5.8.

2. Flux shall meet AWS Standard A5.31, Type F83-A or F83-C.

F. 410 solder shall be used for all joints in:

1. Domestic cold water
2. Domestic hot water
3. Domestic hot water return
4. Copper drainage piping
5. Plant compressed air

G. Lead-Tin (50-50) solder or any solder containing lead shall NOT be used or permitted for joint connections on this project.

H. Where the silver brazing is performed in a confined non-ventilated space, a non-toxic, cadmium-free brazing alloy such as Stay-Brite shall be used instead of Easy-Flo. Bring joint to solder temperature or brazing temperature in as short a time as possible.

I. Form continuous solder bead or brazing filler bead around entire circumference of joint.

J. Wipe excess solder from joint area while solder is still plastic.

K. Solder joints shall be in accordance with IPC Section 605.2, 605.14.3 and ASTM B838. Flux shall conform to ASTM B-813.

3.5 PRESS-FIT SYSTEM

A. All new domestic water piping installed on this project shall be a solderless, press-fit, domestic water system. The system shall be Viega/Rigid copper press fitting system. Fittings shall be rated 0˚F to 250˚F at 200 psi and tested to 600 psi.

B. Fittings shall meet ANSI/NSF 61, – ASME B-16.22 and ASTM B88. Elastomeric seals shall meet ASTM D-2000.

C. Mechanical joining shall be recognized by:

IPC International Plumbing Code
SBCCI Standard Plumbing Code
IAPMO Uniform Plumbing Code
PHCC National Standard Plumbing Code

D. Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press end shall have SC (Smart Connect) feature design (leakage path). Smart Connect™ (SC Feature). In ProPress ½" to 4" dimensions, the Smart Connect Feature assures leakage of liquids and/or gases from inside the system past the sealing element of an unpressed connection. This feature shall provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.

E. Press Connections: Copper press fitting joints shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer.

F. Installer shall be a qualified installer, licensed within the jurisdiction, and familiar with the installation of Press-fit copper press joint systems. Press-fit copper press fittings shall be installed using the proper tool, actuator, jaws and rings as instructed by the press fitting manufacturer. The installation of copper tubing for hot and cold-water distribution systems shall conform to the requirements of the ICC International Plumbing Code or IAPMO Uniform Plumbing Code.

G. Note: Viega ProPress and Nibco Press-fit installation shall only be permitted on this project. Push-on shark-teeth, or any type connection fittings that are not press-fit, shall NOT be approved.

H. T-drill mechanically formed tee fittings shall be used in conjunction with the press-fit copper system in accordance with the IPC Chapter 6 Section 605.5.1, 605.5.1.2 and 605.14.1. Use caution around combustible material and follow all safety guidelines for open flame during silver brazing.

END OF SECTION 22 00 10

SECTION 22 00 30
INSULATION & COVERING – PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the Work specified in this Section.

1.2 DESCRIPTION OF WORK

A. This section includes insulation and covering furnished and installed on the following piping systems and equipment:

1. Domestic cold water.
2. Domestic hot water supply and return
3. "Primary" Horizontal rainwater conductors including underside of roof drains. "Secondary" rainwater systems insulation is not required.
4. Condensate waste piping from air conditioning units.
5. Exposed waste, trap and wall supplies at all handicap lavatories.
6. Branch waste lines from all chilled water fountains.

1.3 REFERENCE STANDARDS

A. Refer to Section 220000 for a general description of requirements applying to this section.

B. Materials shall conform to the requirements of the NFPA Code.

1.4 QUALITY ASSURANCE

A. Refer to Section 220010 for a general description of requirements applying to this section.

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 220000.

B. Submit the following:

1. Product data on all insulation and covering.

1.6 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS.

PART 2 – PRODUCTS

2.1 PIPE INSULATION MATERIAL

A. Fiberglass:

1. Material: Preformed fiberglass bonded with resins to form circular pipe sleeves with factory applied, white all-service jacket bonded to reinforced foil vapor barrier jacketing. The jacket shall have factory-applied double pressure-sensitive adhesive closure and vapor sealing of longitudinal joints. Thermal Conductivity: .25 per inch at 100 degrees F. Flame spread of 25 and developed smoke of 50 or less.

2. All Valves and Fittings:

   a. Class fiber insert and premolded PVC cover, Manville "Zeston" and "Hi-Lo Temp Inserts" for valves and fittings.

   b. Factory molded fibrous glass fitting covering for fittings.

   c. Mitered sections of pipe covering for valves.

3. Manufacturers: Johns-Manville, Certain-Teed, Owens-Corning.

B. Closed Cell:

1. Material: Flexible elastomeric foamed plastic closed cell structure insulation 25/50 rated with a flame spread rating of 25 or less and a smoke developed rating of 50 or less.

2. Flexible pipe insulation shall be a foamed plastic closed cell structure material, with a thermal conductivity of not more than 0.27 Btu/Hr./Sq. Ft./Inch at a mean temperature of 75 degrees F. The insulation shall have an average density of at least 2 pounds per cubic foot, shall be self-extinguishing, and shall have a water vapor transmission rating of not more than 0.1 perms. Between temperature limits of -40 degrees F and plus 220 degrees F, the insulation shall not indicate any deviation from its original state.

3. Manufacturers: Armacel, Insul-Tube, Nomaco Insulation.

4. Specification Compliance: (Latest accepted Standards and Codes)

IECC 804.5:	Insulation thickness for domestic hot and recirculation mains.
ASTM-E-84	Flame spread and smoke developed.
NFPA 255:	Standard method of test of surface burning of building materials.
ASTM C177:	Thermal conductivity.
NFPA 90A, 90B: Flame & smoke rating	
ASTM-C-534 Type 1 Tubular Grade, Self-Sealing	
UL 181	Factory made air ducts and air connectors. (Armacell UL181 has to do with mold growth)
UL723	Test for surface burning characteristics of building materials.
ASTM G21/C1338:	Fungi resistance
ASTM G2:	Bacterial Resistance
ASTM D1056, 2B1:	Standard spec for flexible cellular materials.
MIL-P-15280J, FORMT	
MIL-C-3133B (MIL STD 670B) Grade SBE-3	
MEA 96-85M	

C. Covering of Pipe Insulation Outdoors:

1. Wrapping: Wrap insulation with embossed .016" aluminum jacket.
2. Fastenings: Cover shall be held in place with soft aluminum bands on 12" centers.
3. Valves and Fittings: Weatherproof all valves and fittings.
4. Manufacturers: Johns-Manville, Certain-Teed, Owens-Corning, Knauf.

D. Protective cover for foam insulation in wet areas indoors:

1. PVC heavy duty fitting covers and jacketing for kitchen wet areas.

2. Fitting covers shall be glossy white, high impact, UV resistant PVC.
3. Operating Temperature Limit: Up to 150ºF.
4. Flame Spread: 25 or less.
5. Smoke Developed: 50 or less.
6. Grade: Weatherable.
7. Color: White
8. Finish: Gloss
9. Fitting covers and jacketing shall be “Zeston” 300 Series PVC, heavy duty covers and “Zeston” PVC jacketing.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Do not install until systems have been tested and meet requirements.

B. Do not install until building is closed in.

C. Heavy work which may damage insulation shall have been completed in the vicinity of the insulation work.

D. All installations shall be made by skilled craftsmen regularly engaged in this type of work.

E. Insulation shall be continuous thru-wall, ceiling and floors.

F. Pipe and equipment to be clean and dry prior to insulating.

G. Install all insulation in strict conformance with manufacturer's instructions.

H. Where "Barrier-free" lavatory supplies and waste are covered with a protective covering or insulation, the insulation must be installed back to wall, flush with wall escutcheon. Escutcheon to be finished flush with wall and wall opening to be smaller than escutcheon plate through entire building.

I. Install pipe insulation by slitting tubular sections and applying onto piping or tubing. Alternately, whenever possible, slide unslit sections over the open ends of piping or tubing. All seams and butt joints shall be adhered and sealed using Armaflex 520 or 520 BLV Adhesive. If when using AP Armaflex SS, only the butt joints shall be adhered using Armaflex 520 or 520 BLV Adhesive, Armaflex HT 625 Adhesive shall be used with HT Armaflex.

J. Insulation shall be pushed onto the pipe, never pulled. Stretching of insulation may result in open seams and joints.

K. Tape the ends of the copper tubing before slipping the Armaflex insulation over the new pipes to prevent dust from entering the pipe.

L. All edges shall be clean cut. Rough or jagged edges of the insulation shall not be permitted. Proper tools such as sharp, non-serrated knives must be used.

M. On cold piping, insulation shall be adhered directly to the piping at the high end of the run using a two-inch strip of Armaflex 520 or 520 BLV Adhesive on the ID of the insulation and on the pipe. All exposed end cuts of the insulation shall be coated with Armaflex 520 or 520 BLV Adhesive. All penetrations through the insulation and termination points must be adhered to the substrate to prevent condensation migration.

N. Sheet insulation shall be used on all pipes larger than 6” IPS. Insulation shall not be stretched around the pipe. On pipes larger than 12” IPS, adhere insulation directly to the pipe on the lower 1/3 of the pipe.

O. Seams shall be staggered when applying multiple layers of insulation.

3.2 VALVES, FLANGES AND FITTINGS:

A. All fittings shall be insulated with the same insulation thickness as the adjacent piping. All seams and mitered joints shall be adhered with Armaflex 520 or 520 BLV Adhesive. Screwed fittings shall be sleeved and adhered with a minimum 1" overlap onto the adjacent insulation. Armaflex HT 625 Adhesive shall be used with HT Armaflex.

B. Valves, flanges, strainers and Victaulic couplings shall be insulated using Armaflex donuts that shall then be covered with sheet or oversized tubular insulation.

3.3 HANGERS

A. Support piping system using high density inserts with sufficient compressive strength. The pipe support insulation shall be elastomeric foam with the same or greater thickness than the pipe insulation. All joints shall be sealed with Armaflex 520 or 520 BLV adhesive.

B. Standard and split hangers: Piping supported by ring hangers shall have hangers insulated with the same insulation thickness as the adjacent pipe. All seams and butt joints shall be sealed with Armaflex 520 or 520 BLV Adhesive. Armaflex HT 625 Adhesive shall be used with HT Armaflex. Ring hangers may be sleeved using oversized tubular insulation. On cold piping, insulation shall extend up the hanger rod a distance equal to four times the insulation thickness. Insulation tape may be used to a thickness equal to the adjacent insulation thickness.

C. Clevis Hangers or other pipe support systems: Saddles shall be installed under all insulated lines at unistrut clamps, clevis hangers or locations where the insulation may be compressed due to the weight of the pipe. All piping shall have wooden dowels or blocks of a thickness equal to the insulation inserted and adhered to the insulation between the pipe and the saddle.

It is highly recommended for continuous insulation protection to use hanger sizes equal to the outer diameter of the pipe plus insulation thickness

D. Armafix IPH o Armafix NPH can be used to prevent compression of insulation at standard split, clevis hangers or other pipe support systems. To minimize the movement of Armafix, it is recommended that a pair of non-skid pads be adhered to the clamps. In addition, to prevent loosening of the clamps, use of an antivibratory fastener, such as a nylon-locking nut, is also recommended.

3.4 PIPE COVERING (FOAMED PLASTIC TYPE)

A. All joints and seams shall be sealed with a compatible adhesive. Approved adhesives are as follows:

Armacel No. 520 (Low VOC use 520 BLV
Benjamin Foster Company No. 85-75 up to 200 degrees F.

Contractor may use self-sealing insulation in lieu of above.

B. Fitting covers shall be fabricated from the foamed plastic pipe insulation or from sheet insulation of the identical material. The fabrication shall be in accordance with manufacturer's instructions, and all seams mitered joints shall be joined using the adhesives described.

3.5 PIPE INSULATION – TYPES & THICKNESSES

A. Flexible Closed Cell:

Piping System	Up to 3"	Over 3" to 6"	Over 6"
Cold Water	½"	½"	¾"
Hot Water (120º)	1"	1"	1-1/2"

Hot Water Return (120º)	1”	1”	1-1/2”
Hot Water (140º)	1”	1”	1-1/2”
Hot Water Return (140º)	1”	1”	1-1/2”
Condensate Waste	½”	½”	-
Horizontal Storm (Primary)	½”	½”	¾”
Horizontal Storm (Secondary) -----Not Required-----			
Underside of Roof Drains	½”	½”	¾”
Branch Waste From EWC’s	½”	---	---
Handicap Lav Waste & Water	½”	---	---
Soil/Waste Piping Above Ceiling (where indicated)	½”	½”	¾”

B. Fiberglass:

Piping System	Up to 3”	Over 3” to 6”	Over 6”
Cold Water	½”	½”	¾”
Hot Water	1”	1”	1-1/2”
Hot Water Return	1”	1”	1-1/2”
Hot Water	1”	1”	1-1/2”
Hot Water Return	1”	1”	1-1/2”
Condensate Waste	½”	½”	---
Horizontal Storm (Primary)	½”	½”	¾”
Horizontal Storm (Secondary) -----Not Required-----			
Underside of Roof Drains	½”	½”	---
Soil/Waste Piping Above Ceiling (where indicated)	½”	½”	¾”

END OF SECTION 22 00 30

SECTION 22 01 10
DRAINAGE SYSTEMS – PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this Section.

1.2 DESCRIPTION OF WORK

A. This section includes:

1. Soil and waste piping system work as indicated on drawings and schedules, and by requirements of this section.

2. Applications for soil and waste piping systems include the following:

a. Above ground soil, waste and vent piping within buildings including soil stacks, vent stacks, horizontal branches, traps and connections to fixtures and drains.

b. Underground building drain piping including mains, branches, traps, connections to fixtures and drains, and connections to stacks, extension from the building, terminating at connection to site sewer.

3. Storm water drainage piping as indicated on drawings and by requirements of this section.

4. Applications for storm water drainage piping include the following:

a. Roof drains and connections to gutters, with rain water conductors and connections to underground building storm drains.

b. Underground building storm drains, extending and connecting to site drainage system.

5. Insulation for soil and waste and storm water drainage as specified in Section 220030 is included as work of this section.

6. Trenching and backfilling required in conjunction with underground building drainage and site drainage piping as specified in Section 220000 is included as work of this section. Refer to Division I.

7. Installation of detectable metallic underground tape for <u>all</u> exterior buried PVC drainage piping.

1.3 REFERENCE STANDARDS

A. Refer to Section 220000 for a general description of requirements applying to this section.

1.4 QUALITY ASSURANCE

A. Refer to Section 220010 for a general description of requirements applying to this section, and a listing of all applicable codes.

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 220000.

B. Submit the following:

1. Product data on all systems equipment.

C. See requirements for submission of cross-referencing information.

1.6 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS.

PART 2 – PRODUCTS

2.1 PIPING UNDERGROUND

A. Interior:

1. Sanitary, storm water and condensate waste drainage piping within the building and extending beyond the building wall, unless otherwise noted on the plans shall be an option selection of a, b, or c below:

   a. Service weight hub and spigot pattern cast iron soil pipe and fittings with neoprene gaskets.

   b. Hubless cast iron soil pipe and fittings with cast iron coupling clamps and gaskets or heavy duty 3.04-.016" thick stainless steel bands.

   c. PVC Schedule 40 pipe and fittings with solvent cement joints.

2. Kitchen Sanitary Drainage and/or Mechanical Room Sanitary Drainage: All Kitchen and/or Mechanical Room sanitary below slab piping and fittings shall be service weight cast iron hub and spigot fitting with butyl rubber gaskets or hubless fittings with heavy duty couplings (no PVC shall be acceptable).

B. Exterior:

1. Stormwater drainage piping 10 inches and smaller, and all sanitary drainage piping unless otherwise noted on the plans, shall be:

   a. Service weight hub and spigot pattern cast iron soil pipe and fittings, with neoprene gaskets.
   b. Hubless cast iron soil pipe and fittings with cast iron coupling clamps and gaskets.
   c. Unplasticized PVC sewer pipe and fittings SDR-35.

2. Stormwater drainage piping 12 inches and larger, shall be:

   a. Reinforced concrete pipe and fittings.
   b. Corrugated metal pipe.
   c. As identified on the drawings.

3. Foundation drainage piping shall be:

   a. Porous concrete pipe and fittings.
   b. Perforated PVC pipe and fittings Schedule 40.

2.2 PIPING ABOVE GROUND

A. All above ground storm water, condensate, soil, waste and vent piping shall be:

1. Hubless cast iron soil pipe with cast iron drainage fittings, couplings and stainless steel clamp bands for piping 2" and larger.

2. Copper tubing, type DWV with wrought copper solder type drainage fitting for piping smaller than 2" in size.

3. PVC pipe and fittings type DWV with solvent cement joint connections. (Not permitted in areas of plenum rated ceilings.)

2.3 CONDENSATE WASTE PIPING SYSTEM

A. All aboveground condensate waste piping including connection to equipment shall be:

1. PVC pipe and fittings type DWV with solvent cement joint connections. (Not permitted in areas of plenum rated ceilings.)

2. Copper tubing, type DWV with wrought copper solder type drainage fittings.

2.4 FLASHING

A. All vents extending through the roof shall be flashed by the General Contractor. However, the Plumbing Contractor shall furnish and install the necessary counterflashing consisting of a Jay R. Smith Figure 1748 counterflashing fitting, or approved substitute as manufactured by Josam or Zurn. Vents shall terminate 18" above the roof.

2.5 SPECIAL EXPANSION COMPENSATION

A. Special expansion compensation products required for storm, condensate, soil and waste piping systems include the following types:

B. Cast Iron Drainage System Expansion Joints: Cast-iron body, adjustable bronze sleeve, bronze bolts with wing nuts; for vertical installation only.

C. PVC Drainage System Expansion Joints: Factory prelubricated "O" ring expansion joint fitting. Installation must be in strict conformance with manufacturer's recommendations.

D. Available Manufacturers: Subject to compliance with requirements. Manufacturers offering expansion joints which may be incorporated in the work include:

1. Cast Iron Piping Systems - J.R. Smith or approved substitute.
2. PVC Piping Systems – George Fisher or approved substitute.

2.6 SYSTEMS EQUIPMENT

A. Refer to Plumbing Fixture and Equipment Schedule for type, number, size and manufacturer of all drainage equipment and accessories.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering drainage equipment which may be incorporated in the work are limited to the following:

<u>Floor Drains (all types)</u>

Zurn
Josam
Wade
Watts
Smith
MIFAB

Roof Drains

Zurn/Froet
Josam
Wade
Watts
Smith
MIFAB

Cleanouts

Zurn
Josam
Wade
Watts
Smith
MIFAB

Interceptors

Zurn
Josam
Wade
Watts
Smith
Woodford
MIFAB

Backwater Valves & Traps (Cast Iron)

Zurn
Josam
Wade
Watts
Smith
Red Valve Co.
MIFAB

Wall Spout Nozzles

Zurn/Froet
Josam
Wade
Watts
Smith
MIFAB

C. Cross Reference Identification:

1. If the Contractor selects a manufacturer of drainage equipment products other than as identified on the Schedule but is selected from the available manufacturers listed above, a cover sheet shall be included with the submission of shop drawings indicating the cross-referenced manufacturer and model number.

2. Shop drawings shall not be reviewed or accepted if not in compliance with this requirement.

PART 3 – EXECUTION

3.1 INSTALLATION OF SOIL AND WASTE PIPING

A. The Plumbing Contractor shall install a complete system of sanitary drainage piping as shown on the drawings. All drainage lines shall be properly run, trapped and vented in accordance with the local Plumbing Code and all dry vents, back vents, loop vents, revents or special vents required by the Code shall be furnished and installed by the Plumbing Contractor.

B. Drainage lines of the sizes shown on the drawings shall be extended within the building with branches connecting to the base of all soil, waste and vent stack, etc., leaving outlets for connection to all fixtures, floor drains, as required.

C. All changes in direction of drainage piping shall be installed with "Y" branches and 1/8 bends. All stacks shall be supported with concealed pipe clamps or hangers as required and the openings in the roof for the vent pipes will be provided by this Contractor.

D. All drainage piping which will be located above suspended ceilings shall be checked for slope to assure positive drainage, prior to installation of the ceilings. Pressure tests for leaks, as hereinafter specified, shall also be performed prior to ceiling installation.

E. Install soil and vent piping pitched to drain at minimum slope of 1/4" per foot (2%) for piping 2-1/2" and smaller, and 1/8" per foot (1%) for piping 3" and larger.

F. Vertical to horizontal change in direction to be made with long radius fittings.

G. Support all soil and waste piping per IPC Section 308.5, 308.6 and 308.7.

H. Provide exterior clean-out on both sanitary and storm drain mains. Minimum size shall be 4” installed within 5 ft. of the building. (Also see Paragraph 3.5).

3.2 INSTALLATION OF STORM WATER DRAINAGE PIPING

A. Connect piping to roof drains and outlets provided in gutters, install rainwater conductors and extend to underground storm building drains as indicated.

B. Underground storm building drains shall be extended from the building, terminating beyond the building wall.

C. Provide exterior clean-out on both sanitary and storm drain mains. Minimum size shall be 4” installed within 5 ft. of the building. (Also see Paragraph 3.5).

D. All changes in direction of drainage piping shall be installed with "Y" branches and 1/8 bends. All stacks shall be supported with concealed pipe clamps or hangers as required, and the openings in the roof for the vent pipes will be provided by this Contractor.

E. All drainage piping which will be located above suspended ceilings shall be checked for slope to assure positive drainage, prior to installation of the ceilings. Pressure tests for leaks, as hereinafter specified, shall also be performed prior to ceiling installation.

F. Install storm water drainage piping pitched to drain at minimum slope of 1/8" per foot (1%) for piping 4" and larger.

G. Vertical to horizontal change in direction to be made with long radius fittings.

3.3 INSTALLATION OF CONDENSATE DRAINAGE PIPING

A. Connect piping to HVAC equipment and/or appliance requiring condensate drainage and extend to condensate risers and/or underground storm building drainage as indicated. (Extend condensate drainage discharge to the back of exterior downspouts or to exterior grade where indicated.)

B. Underground condensate building drains shall be extended to underground storm building drainage or from the building, terminating beyond the building wall where indicated.

C. Provide clean-outs on condensate drainage where indicated. Condensate drainage piping shall be configured to permit the cleaning of blockages and performance maintenance without requiring piping to be cut.

D. All changes in direction of condensate drainage piping sizes 1-1/4” and above shall be installed with "Y" branches and 1/8 bends.

E. All condensate drainage piping shall be hung and/or supported in accordance with the plumbing code. All stacks/risers shall be supported with concealed pipe clamps or hangers as required. (Where indicated the openings in the roof for the vent pipes will be provided by this contractor.)

F. All condensate drainage piping which will be located above suspended ceilings shall be checked for slope to assure positive drainage, prior to installation of the ceilings. Pressure tests for leaks, as hereinafter specified, shall also be performed prior to ceiling installation.

G. Install condensate drainage piping pitched to drain at minimum slope of 1/8" per foot (1 percent slope.)

H. Condensate piping shall be trapped where, and as required, by HVAC equipment and/or appliance manufacturer. Provide trap in accordance with HVAC equipment and/or appliance manufacturer.

I. Condensate piping shall be provided with in-line, swing, Y-pattern, type check valves as indicated and/or where condensate piping connects to storm drainage (via direct connection to above ground storm piping or underground storm drainage piping.) or as required by, and in accordance with, HVAC equipment or appliance manufacture (i.e. ductless mini-split systems.) Where condensate check valves (in-line swing, Y-pattern type) are installed, they shall be installed on above ground horizontal piping in horizontal position in the direction of drain flow with assembly cap in the upright position and in areas with access for inspection and maintenance.

J. After the completed installation (including inspection and testing) and before placing connected HVAC and/or appliances into service, condensate piping shall be flushed with water for a period of approximately 10 to 15 minutes to remove construction debris, left-over solder flux, etc. and to verify proper operation. (Where non-water-based flux is use, flush with hot water.)

3.4 INSTALLATION OF SPECIAL EXPANSION COMPENSATION PRODUCTS

A. Expansion Joints: Install expansion joints on vertical risers as indicated, and/or as required by International Plumbing Code.

B. PVC piping systems in multi-story (four stories or more) shall require "O" ring expansion joints to compensate for length changes in soil, waste and vent stacks. Expansion joints shall be required at every floor level for soil and waste stack and at alternate floors for vent stacks and rainwater conductors.

3.5 INSTALLATION OF CLEANOUTS

A. Cleanouts: Install in sanitary piping and storm conductor and building drain piping as indicated, and/or as required by International Plumbing Code; at each change in direction of piping greater than 45 degrees; at minimum intervals of 100' for all size straight run piping; and at base of each conductor. Install floor and wall cleanout covers for concealed piping, select type to match adjacent building finish.

B. Exterior cleanouts shall be installed with access covers flush to grade. The cleanout shall be installed within a concrete pad, 18”x18”x6” thick.

3.6 INSTALLATION OF FLOOR DRAINS (ALL TYPES)

A. Install floor drains in accordance with manufacturer's written instructions and in locations indicated.

B. Install floor drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with finished floor.

C. Install drain flashing collar or flange so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.

D. Position drains so that they are accessible and easy to maintain.

E. All exposed drainage piping shall be DWV copper pipe and fittings. All piping shall be rigidly supported off the wall with split ring clamps or uni-strut.

3.7 INSTALLATION OF ROOF DRAINS

A. Install drains in accordance with manufacturer's written instruction and in location indicated.

B. Coordinate with roofing as necessary to interface roof drains with roofing work.

C. Install drains at low points of surface areas to be drained, or as indicated.

D. Install drain flashing collar or flange so that no leakage occurs between drain and adjoining roofing. Maintain integrity of waterproof membranes, where penetrated.

E. Position drains so that they are accessible and easy to maintain.

F. The roof drain specified is a combination “Primary and Secondary” arrangement. Verify the correct outlet connections to their respective systems.

3.8 INSTALLATION OF INTERCEPTORS

A. Install interceptors in accordance with manufacturer's written instruction and in location indicated.

B. Install flow control fitting where indicated on the drawing and/or diagrams including vent relief piping.

C. Interceptors shall be vented in accordance with the local plumbing code and as indicated on the drawings.

3.9 UNDERGROUND METALLIC TAPE

A. All exterior underground PVC drainage piping (sanitary, storm, condensate waste) shall be provided with detectable metallic underground tape.

B. Tape shall be similar to Lineguard Maintenance Systems as provided by Utility Supply of America 800-548-1234 or approved substitute as manufactured by Seton.

C. Installation shall comply with manufacturer’s recommendations and shall be installed in the backfill after refilling the trench opening completely, and allowed to settle to the desired 4” to 6” depth. The Contractor shall install the tape after final lifts in compaction backfilling or unroll it before final restoration or installation of sod, black dirt, seeding, etc.

D. The tape system shall be installed under the supervision of the Owner's Representative. When the tape system is complete, the Contractor shall provide a test using the tape manufacturer's recommended detection device, to prove the integrity of the installation with the Owner's Representative.

3.10 INVERTS AND ELEVATIONS

A. Indicated inverts and elevations of existing utilities are approximate and based on the best information available. Upon award of Contract, Contractor shall verify in the field all such information and report any discrepancies to the Engineer before proceeding with work.

3.11 PIPING INSTALLED IN FILLED GROUND

A. Piping located below floor slab in filled areas shall be supported either from the floor slab, or with masonry piers to undisturbed earth. Drainage piping shall be supported at each joint. Exterior piping located in filled areas shall be supported with piers.

B. Details of supports and method of installation shall meet with the approval of the Engineer.

3.12 INSPECTION

A. The Plumbing Contractor shall, upon completion of the drainage systems, secure from the Inspector and/or the Municipality under which the installation was made and inspected, certificates or letters of approval indicating the system has been installed satisfactorily. The Plumbing Contractor shall certify that all inspection fees, permits and charges have been duly paid.

END OF SECTION 22 01 10

SECTION 22 01 20
DOMESTIC WATER SYSTEMS - PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this Section.

1.2 DESCRIPTION OF WORK

A. This Section includes:

1. Domestic water piping systems work is indicated on drawings and schedules and by requirements of this section.

B. Applications for water piping systems include the following:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic recirculating-water piping.

C. Complete flow balancing of the entire domestic hot water return system.

D. Insulation for domestic water piping as specified in Section 220030 is included as work of this section.

1.3 REFERENCE STANDARDS

A. Refer to Section 220000 for a general description of requirements applying to this section.

1.4 QUALITY ASSURANCE

A. Refer to Section 220010 for a general description of requirements applying to this section.

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 220000.

B. Submit the following:

1. Product data on all specialties and systems equipment.

1.6 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS.

PART 2 – PRODUCTS

2.1 DOMESTIC WATER PIPING MATERIALS AND PRODUCTS

A. Provide piping materials and factory fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in domestic water piping systems. Where more than 1 type of materials or products are indicated, selection is Installer's option.

2.2 BASIC PIPE, TUBE AND FITTINGS

A. Provide pipe, tube, and fittings complying with Division 22 Basic Materials and Methods section "Pipe, Tube, and Fittings", in accordance with the following listing:

B. Interior Domestic Water Piping:

Tube Size 4" and Smaller:	Copper tube.
Wall Thickness:	Type "L" hard-drawn temper.
Fittings:	Wrought-copper, solder-joints.

2.3 BASIC PIPING SPECIALTIES

A. Provide piping specialties complying with Section 220010 Basic Materials and Methods in accordance with the following listing:

Pipe escutcheons
Dielectric unions
Drip pans
Pipe sleeves
Sleeve seals

2.4 SPECIAL PIPING SPECIALTIES

A. Water Hammer Arresters: Provide bellows or piston type water hammer arresters, pressure rated for 250 psi, tested and certified in accordance with PDI Standard WH-201.

2.5 BASIC VALVES

A. Provide valves complying with applicable Division 22 sections "Valves", in accordance with the following listing:

B. <u>Sectional Valves:</u>

2-1/2" and Smaller:	Ball Valves. Gate Valves.
3” and Larger:	Ball Valves. Butterfly Valves.

C. <u>Shutoff Valves:</u>

2-1/2" and Smaller:	Ball Valves. Gate Valves
3" and Larger:	Ball Valves. Butterfly Valves.

D. <u>Drain Valves:</u>

All	Hose End Threaded Gate or Ball Valves.

E. <u>Balancing Valves:</u>

2" and Smaller:	Ball Valves (Circuit Setter Type). (w/ Memory Stop)

F. Check Valves:
All Sizes: Swing Check Valves. Horizontal Installations
Spring Check Valves. Vertical Installations

2.6 WATER METER

A. Provide water meter and related piping conforming to applicable local Utility Company regulations and AWWA Standards.

B. Water Meter: Provided by Local Utility Company. Provide roughing- in and bypass for meter in accordance with Utility Company requirements.

2.7 SPECIAL VALVES

A. Special valves required for domestic water piping systems include the following types:

B. Hose Bibbs: Threaded end, renewable composition disc, tee handle, 3/4" NPT inlet, 3/4" hose outlet with vacuum breaker.

1. Finished Areas: Chrome plated.
2. Unfinished Areas: Bronze finish.

C. Wall Hydrants: Non-freeze, cast-bronze body, tee handle key, bronze casing, length to suit wall thickness, vacuum breaker, hinged locking cover, 3/4" inlet, hose outlet.

2.8 BASIC THERMOMETERS AND GAUGES

A. Provide thermometers and gauges complying with Division 22 Basic Materials and Methods Section "Meters and Gauges", in accordance with the following listing:

Pressure gauges
Glass thermometers
Pressure and temperature connections

2.9 BASIC PUMPS

A. Provide pumps as specified in applicable Section 220150 Equipment - Plumbing. Use inline pumps for hot water recirculating.

2.10 BACKFLOW PREVENTERS

A. Provide, of the type indicated on the drawing schedule, reduced pressure principal type, blackflow preventers shall consist of an assembly including shutoff valves on inlet and outlet, and strainer on inlet. Backflow preventers shall include test cocks, and pressure-differential relief valve located between two positive seating check valves. Construct in accordance with ASSE Standard.

B. On dead-end services (HVAC make-up) provide a spring-loaded check valve ahead of the backflow preventer assembly.

2.11 SYSTEMS EQUIPMENT MANUFACTURERS

A. Refer to Plumbing Fixture and Equipment Schedule for type, number, size and manufacturer of all equipment and accessories.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering equipment which may be incorporated in the work are limited to the following:

Shock Absorbers:
Zurn
Josam
Wade
Watts
Smith
PPP Inc.
MIFAB

Hose Bibbs
Nibco
Tanner
Central Brass
Wolverine

Wall Hydrants
Zurn
Josam
Wade
Watts
Smith
Woodford
MIFAB

Backflow Preventers (including RP2 Type)
Conbraco
Febco
Cla-Val
Wilkins
ITT Grinnell
Neptune
Watts

Relief Valves
Rockwell
Fisher
DeZurik

Pressure Reducing Valves
Conbraco
Jamesbury
DeZurik
Fisher
ITT Bell & Gossett

PART 3 – EXECUTION

3.1 INSTALLATION OF BASIC IDENTIFICATION

A. Install mechanical identification in accordance with Section 220010 Basic Materials and Methods.

B. Support vertical piping at floor levels using approved riser clamps. Clamp material shall be compatible with pipe material. Maximum vertical spacing shall be 10’-0”. Domestic water piping shall be supported in accordance with the International Mechanical Code, Section 305 and Table 305.4 Spacing Intervals, or in accordance with MSS-SP-69. International Plumbing Code’s latest edition, Section 308.5, accept as follows:

1. Copper tubing ½” to 1-1/4” nominal size, not to exceed 6 ft. horizontal intervals.

2. Copper tubing 1-1/2” and larger nominal size, not to exceed 10 ft. horizontal intervals.
3. Copper tubing ½” to 1-1/4” nominal size, not to exceed 10 ft. vertical intervals.
4. Copper tubing 1-1/2” and larger nominal size not to exceed 10 ft. vertical intervals.
5. CPVC pipe or tubing ¼” to 1” nominal size, not to exceed 3 ft. horizontal spacing.
6. CPVC pipe or tubing 1-1/4” and larger nominal size not to exceed 4 ft. horizontal spacing.
7. CPVC pipe or tubing ¼” to 1” nominal size not to exceed 10 ft. vertical.
8. CPVC pipe or tubing 1-1/4” and larger nominal size not to exceed 10 ft. vertical.”
   *Mid-Story Guide.

3.2 INSTALLATION OF DOMESTIC WATER SERVICE SYSTEM - BUILDING

A. Install water distribution system in accordance with Section 220010 Basic Materials and Methods, and the International Mechanical Codes Section 305, and Support Intervals under Tables 305.4 and 308.5 or in accordance with MSS-SP-69.

3.3 INSTALLATION OF PIPING SPECIALTIES

A. Install piping specialties in accordance with Section 220010 Basic Materials and Methods.

B. Water Hammer Arresters: Install in upright position, in locations and of sizes in accordance with PDI Standard WH-201, and elsewhere as indicated.

3.4 REACTION BACKING

A. All plugs, tees and elbows in the underground piping shall be provided with reaction backing consisting of concrete placed between solid undisturbed earth and the fitting to be anchored. Concrete shall be of such bearing area as to assure adequate resistance to the thrust to be encountered. In general, backing shall be so placed that the joint will be accessible for inspection and repair.

3.5 INSTALLATION OF VALVES

A. Install valves in accordance with Division 22 Basic Materials and Methods section, "Valves".

B. Sectional Valves: Install on each branch and riser, close to main, where branch or riser serves 2 or more fixtures, equipment connections, and elsewhere as indicated.

C. Shutoff Valves: Install on inlet of each plumbing equipment item, and on inlet of each plumbing fixture, and elsewhere as indicated.

D. Drain Valves: Install on each plumbing equipment item located to completely drain equipment for service or repair. Install at base of each riser, at base of each rise or drop in piping system, and elsewhere where indicated or required to completely drain domestic water piping system.

E. Check Valves: Install on discharge side of each pump, and elsewhere as indicated.

F. Balance Cocks: Install in main recirculating loop and in each branch hot water recirculating loop. Install a ball valve and check valve at each balance valve installation.

G. Hose Bibbs: Install on exposed piping where indicated, with vacuum breaker.

3.6 INSTALLATION OF BACKFLOW PREVENTERS

A. Install backflow preventers where indicated, and where required by International Plumbing Code. Locate in same room or area as equipment being protected.

B. RPZ type backflow preventers to be piped from the relief outlet to nearest floor drain.

C. A check valve is required on the upstream side of all RPZ installations.

3.7 INSTALLATION OF EXPANSION COMPENSATION PRODUCTS

A. This project shall require the installation of expansion compensators.

B. Furnish and install expansion compensation products in accordance with Section 220210 Basic Materials and Methods – HVAC

3.8 INSTALLATION OF THERMOMETERS AND GAUGES

A. Install thermometers and gauges in accordance with Section 220010 Basic Materials and Methods.

3.9 INSTALLATION OF WATER METER

A. Install water meter in accordance with Section 220010 Basic Materials and Methods.

B. Meter shall be supported in accordance with the requirements of the Water Department.

3.10 EQUIPMENT CONNECTIONS

A. Piping Runouts to Fixtures: Provide hot and cold water piping runouts to fixtures of sizes indicated, but in no case smaller than required by International Plumbing Code.

B. Equipment furnished by the Owner or Contractors other than this Contractor: After equipment has been set in place, this Contractor shall furnish all labor and material required to make final connections, between roughing-in and the equipment. Install valves, fittings, trim and appurtenances furnished with the equipment. All exposed piping in the kitchen areas shall be chrome plated. Piping in other areas shall be of the same material as the system to which it connects.

3.11 SPARE PARTS

A. Furnish to Owner, with receipt, one valve key for each key operated hydrant, bibb, or faucet installed.

3.12 KITCHEN DOMESTIC WATER

A. All kitchen domestic water system piping shall be roughed-in and strictly coordinated with the kitchen equipment drawings.

B. Provide all rough-in piping and final connections to equipment furnished by the Kitchen Equipment Contractor (KEC). This also includes any equipment items furnished by the KEC and are to be completely installed by the Plumbing Contractor.

C. Verify all responsibilities during the bid phase of the work.

D. All piping shall be supported off the wall with split ring clamps or uni-strut.

E. All piping shall be insulated and identified.

F. Provide shut-off valves and stainless-steel flex hose connections to all individual equipment connections.

G. All exposed piping shall be chrome plated brass.

3.13 DOMESTIC HOT WATER RETURN

A. This Contractor shall install complete and operating hot water return system. The system shall be balanced and include a report as required in HVAC Specification Section 230950.

B. Balancing Valves are required in the system as hereinbefore specified. The system shall also include the installation of "air bleed" or "burp" valves to remove any trapped air in the system.

C. Where emergency showers are installed with thermostatic mixing valve, they shall require the installation of a hot water return line as detailed on the drawings.

END OF SECTION 22 01 20

SECTION 22 01 30
GAS PIPING SYSTEMS – PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this Section.

1.2 DESCRIPTION OF WORK

A. This Section includes:

1. Natural gas piping system as indicated on drawings and schedules, and by requirements of this section.

2. Applications for natural gas piping systems include the following:

a. Gas service from street main to building meter by Chesapeake Gas Division.
b. Elevated pressure (psi) gas from meter location to rooftop gas-fired equipment.
c. Low pressure (WC) from the meter location to all other equipment and outlets, requiring gas service.

3. Trenching and backfill required in conjunction with exterior gas distribution as specified in Section 220000 is included as work of this section. Refer to Division 1.

1.3 REFERENCE STANDARDS

A. Refer to Section 220000 for a general description of requirements applying to this Section.

1.4 QUALITY ASSURANCE

A. Refer to Section 220010 for a general description of requirements applying to this section.

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 220000.

B. Submit the following:

1. Product data on gas valves.

1.6 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS.

PART 2 – PRODUCTS

2.1 NATURAL GAS PIPING MATERIALS AND PRODUCTS

A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide materials and products complying with ANSI B31.2 where applicable, base pressure rating on natural gas piping system maximum design pressures. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match piping materials used in natural gas piping systems. Where more than 1 type of material or product is indicated, selection is Installer's option.

2.2 BASIC IDENTIFICATION

A. Provide identification complying with Division 22 Sections and in accordance with the following listing:

Building Distribution Piping: Plastic pipe markers.

Gas Service: Underground type plastic line markers with detectable wire..

Gas Valves: Plastic valve tags.

2.3 BASIC PIPE, TUBE AND FITTINGS

A. Provide pipe, tube and fittings complying with Section 220010 Basic Materials and Methods - Plumbing and in accordance with the following listing:

1. Interior Piping: Schedule 40 black steel ASTM A-53, A-106

   Fittings: Malleable black iron, threaded (for low pressure gas)
   Wrought steel; butt weld (for elevated pressure gas)

2. Exterior Below Grade Piping: Medium-density polyethylene pipe fittings.

3. Exterior Exposed or Roof Top Piping: Schedule 40 black steel with weather coating.

   Fittings: Wrought steel, butt welded (for pipe 3-1/2" and larger).
   Malleable black iron, threaded (for 2" pipe and smaller)

2.4 BASIC PIPING SPECIALTIES

A. Provide piping specialties complying with applicable Division 22 Sections and in accordance with the following listing:

Pipe escutcheons
Pipe sleeves
Sleeve seals

2.5 SPECIAL VALVES

A. Valves required for gas piping systems on this project shall be the following types:

<u>Gas Valves: (Up to 3")</u>

1. Apollo 80-100 Series bronze gas ball valve. Threaded, 600 PSIG WOG, cold non-shock. 250 PSIG LP-Gas. 150 PSIG saturated steam. Vacuum service to 29 inches Hg. Federal Specification: WW-V-35C, Type: II, Composition: BZ, Style: 3.

2. Features:
   - UL Listed for LP-Gas and natural gas.
   - Large ports to reduce pressure drop
   - Reinforced TFE seats and seals
   - Blow-out-proof stem design
   - Optional tee handle available
   - Quarter turn on-off
   - Adjustable packing gland
   - One-piece bronze body
   - Chromium plated ball

3. UL Listings:
   - Guide YRPV: Gas shut-off valve for use with natural and manufactured gases.

4. This valve shall be used for all pipe sizes up to 3" in the system.

Gas Valves (4" and Larger)

1. Apollo 88A-100 Series carbon steel, ANSI Class 150 flanged standard port ball valves.

   Standards of Compliance:
   IFGC: Section 409 (Valves)
   ASME B16.5 – Pipe Fittings and Flanges
   ASME B16.33 – Manual Operated Metal Gas Valves up to 125 psig
   ASME B16.38 – Large Metal Valve Gas Distribution
   ASME B31.8 – Gas Transmission and Distribution Piping Systems
   UL 125

B. Manufacturers: Subject to compliance with requirements, provide gas valves of one of the following:

Apollo/Conbraco
Stockham
Milwaukee
NIBCO, Inc.
Watts

2.6 GAS METER

A. Provided by Chesapeake Gas Division.

2.7 GAS PRESSURE REGULATORS

A. ANSI Z21.18, single-stage, steel-jacketed, corrosion-resistant pressure regulators. Include atmospheric vent, elevation compensator, with threaded ends conforming to ASME B1.20.1 for 2 inch NPS and smaller and flanged ends for 2-1/2" NPS and larger. Regulator pressure ratings, inlet and outlet pressures, and flow volume in cubic feet per hour of natural gas at specific gravity are as indicated.

1. Service Pressure Regulators: Inlet pressure rating not less than natural gas distribution system service pressure.

2. Line Gas Pressure Regulators: Inlet pressure rating not less than system pressure.

3. Appliance Gas Pressure Regulators: Inlet pressure rating not less than system pressure.

4. Gas Pressure Regulator Vents: Factory or field installed corrosion-resistant screen in opening when not connected to vent piping.

5. Regulators shall be as noted in schedule.

B. AVAILABLE MANUFACTURES

1. Subject to compliance with the requirements, manufacturer of gas equipment products other than as identified on the Schedule but is selected from the available manufacturers listed above, a cover sheet shall be included with the submission of shop drawings indicating the cross-referenced manufacturer and model number.

2. Shop drawings shall not be reviewed or accepted if not in compliance with this requirement.

Fisher
Sensus
Emerson

PART 3 – EXECUTION

3.1 INSTALLATION OF BASIC IDENTIFICATION

A. Install mechanical identification in accordance with applicable Division 22 Sections.

3.2 INSTALLATION OF NATURAL GAS PIPING (INTERIOR)

A. Install natural gas distribution piping in accordance with Section 220010 Basic Materials and Methods - Plumbing and in accordance with applicable codes IFGC latest edition, and local Utility Company requirements.

B. Use sealants on metal gas piping threads which are chemically resistant to natural gas. Use sealants sparingly, and apply to only male threads of metal joints.

C. Remove cutting and threading burrs before assembling piping.

D. Do not install defective piping or fittings. Do not use pipe with threads which are chipped, stripped or damaged.

E. Plug each gas outlet, including valves, with threaded plug or cap immediately after installation and retain until continuing piping or equipment connections are completed.

F. Install drip-legs in gas piping where indicated, and where required by code or regulation.

G. Install "Tee" fitting with bottom outlet plugged or capped at bottom of pipe risers.

H. Use dielectric unions where dissimilar metals are joined together.

I. Install piping with 1" drop in 60' pipe run (0.14%) in direction of flow.

J. Install piping parallel to other piping, but maintain minimum of 12" clearance between gas piping and steam or hot water piping above 200 degrees F (93 degrees C).

K. For piping buried in building substrate, or below floor slabs, install in welded conduit, ventilated to outdoors on both ends, and tested to same requirements as gas piping.

L. Gas valves shall not be installed above ceilings without access and signage.

M. Supports:

1. All pipe, fittings, valves, installation and testing shall be in accordance with the IFGC, Chapter 4.

2. Gas piping shall be supported in accordance with the International Fuel Gas Code's latest accepted 2003 Edition, Section 407, as follows:

3. Support intervals shall be in accordance with the IFGC listed above and in Section 415, Table 415.1 as follows:

   a. Steel pipe ½" nominal size – not to exceed 6 ft.
   b. Steel pipe ¾" to 1" nominal size – not to exceed 8 ft.
   c. Steel pipe 1-1/4" and larger nominal size horizontal – not to exceed 10 ft.
   d. Steel pipe 1-1/4" and larger nominal size, vertical not to exceed every floor.

4. Support and spacing of CSST Systems shall be in accordance with CSST manufacturer’s instructions.

3.3 GAS SERVICE

A. Arrange and coordinate with Utility Company to provide gas service and meter at indicated location with shutoff at terminus. Consult with Utility as to extent of its work, costs, fees and permits involved. Pay such costs and fees; obtain permits.

B. Extend service pipe from Utility's terminus to distribution piping, in compliance with Utility's requirements.

3.4 INSTALLATION OF VALVES

A. Gas valves: Provide at connection to gas train for each gas-fired equipment item; and on risers and branches where indicated.

B. Locate gas valves where easily accessible, and where protected from possible damage.

3.5 EQUIPMENT CONNECTIONS

A. Connect gas piping to each gas-fired equipment item, with drip leg, union and shutoff gas valve. Comply with equipment manufacturer's instructions. Drip legs shall not be installed on any exterior gas piping.

B. Equipment furnished by the Owner, or Contractors other than this Contractor: After equipment has been set in place, this Contractor shall furnish all labor and material required to make final connections between roughing-in and the equipment. Install valves, fittings, trim and appurtenances furnished with the equipment. Piping shall be of the same material as the system to which it connects.

C. All rooftop, gas-fired equipment shall be provided with gas pressure regulating valve to reduce gas pressure from 2 psi to 7-14" WC. All regulators shall be provided with relief vent discharge piping of lengths as required for minimum distance of equipment air intake grilles.

3.6 INSTALLATION OF GAS PRESSURE REGULATORS

A. This Contractor shall furnish and install gas pressure regulating valves for all shown on the drawings. Installation shall be in strict accordance with the requirements of the Utility Company and the Canadian Gas Association.

B. All regulators installed shall be tagged with data noting the inlet and outlet pressure for each individual regulator installed.

C. Medium or High Pressure (MP) (HP) Regulators shall comply with the following:

1. The MP regulator shall be approved and shall be suitable for the inlet and outlet gas pressures for the application.

2. The MP regulator shall maintain a reduced outlet pressure under lockup (no flow) conditions.

3. The capacity of the MP regulator, determined by published ratings of its manufacturer, shall be adequate to supply the appliances served.

4. The MP pressure regulator shall be provided with access. Where located indoors, the regulator shall be vented to the outdoors or shall be equipped with a leak-limiting device, in either case complying with Section 410 of the IFGC.

5. A tee fitting with one opening capped or plugged shall be installed between the MP regulator and its upstream shutoff valve. Such tee fitting shall be positioned to allow connection of a pressure-measuring instrument and to serve as a sediment trap.

6. A tee fitting with one opening capped or plugged shall be installed not less than 10 pipe diameters downstream of the MP regulator outlet. Such tee fitting shall be positioned to allow connection of a pressure-measuring instrument.

3.7 EXTERIOR GAS PIPING

A. All rooftop or exterior gas piping shall be weatherproof with and epoxy resin approved by the Gas Company.

B. Uncoated, threaded or socket welded joints shall not be used in piping in contact with soil or where internal or external service corrosion is known to occur.

C. Protective Coatings and Wrapping: Pipe protective coatings and wrappings shall be approved for the application and shall be factory applied.

D. Detectable underground warning tape shall read (“CAUTION – BURIED GAS LINE BELOW”). Printed on APWA approved colors, minimum 2” wide, 5 mil tape with aluminum backing for using non-ferrous locator.

END OF SECTION 22 01 30

SECTION 22 01 40
FIXTURES - PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the Work specified in this Section.

1.2 DESCRIPTION OF WORK

A. This Section includes:

1. Plumbing fixtures and trim work as indicated by drawings and schedules, and by requirements of this section.

2. Types of plumbing fixtures required for the project include the following:

   Water Closets
   Urinals
   Lavatories
   Countertop Sinks
   Service Sinks
   Mop Receptors
   Electric Water Coolers
   Manually Operated Flush Valves and Faucets
   Handicap Lavatory Insulation
   Lavatory Shield Enclosure

3. Refer to Section 220120 for domestic water piping systems used in conjunction with plumbing fixtures; not work of this section.

4. Refer to Section 220110 for soil and waste piping systems used in conjunction with plumbing fixtures; not work of this section.

5. Refer to Division 26 sections for electrical connections to water coolers and other plumbing fixtures; not work of this section.

1.3 REFERENCE STANDARDS

A. Refer to Section 220000 for a general description of requirements applying to this section.

1.4 QUALITY ASSURANCE

A. Refer to Section 220010 for a general description of requirements applying to this section.

B. Manufacturers: Firms regularly engaged in manufacture of plumbing fixtures of the type, style and configuration required, whose products have been in satisfactory use in similar service for not less than 3 years.

C. Plumbing Fixture Standards: Comply with applicable portions of International Plumbing Code pertaining to materials and installation of plumbing fixtures.

D. ANSI Standards: Comply with applicable ANSI standards pertaining to plumbing fixtures and systems.

E. ANSI & ADA Standards: Comply with ANSI A171.1 Standard and the ADA Standard pertaining to plumbing fixtures and provisions for handicapped.

1. Water closets shall measure 17" to 19" from the floor to the top of the seat. Bowls shall be elongated type.

2. Flush valve mechanisms shall be on the wide side of the stall, no higher than 44" above the floor.

3. Urinals shall be elongated (14" rim from the wall) mounted no higher than 17" from the floor.

4. Lavatories shall be mounted no higher than 34" from the floor and provide knee clearance using an offset drain assembly with "P" trap set parallel to the fixture supporting wall. Trap and wall supplies shall be installed for clearance required for the installation of lavatory shield enclosures.

5. Faucets shall be lever operated, push type, touch type, electronically operated. See Fixture Schedule. All faucets shall operate on less than 5 pounds force and shall not require tight grasping, pinching or twisting of the wrist.

F. PDI Compliance: Comply with standards established by Plumbing and Drainage Institute pertaining to plumbing fixture supports.

G. Federal Standards: Comply with applicable FS WW-P-541/- Series sections pertaining to plumbing fixtures.

H. UL Labels: Provide water coolers which have been listed and labeled by Underwriters' Laboratories.

I. ARI Labels: Provide water coolers which are rated and certified in accordance with applicable Air-Conditioning and Refrigeration Institute Standards.

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 220000.

B. Submit the following:

1. Product Data: Submit manufacturer's specifications for plumbing fixtures and trim, including catalog cut of each fixture type and trim item furnished, roughing-in dimensioned drawings, templates for cutting substrates, fixture carriers, and installation instructions.

2. Color Selection Data: Submit charts or samples for color selection where applicable.

3. Maintenance Data: Submit maintenance data and parts lists for each fixture type and trim item, including instructions for care of finishes. Include this data in maintenance manual.

1.6 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver plumbing fixtures individually wrapped in factory-fabricated containers.

B. Handle plumbing fixtures carefully to prevent breakage, chipping and scoring the fixture finish. Do not install damaged plumbing fixtures; replace and return damaged units to equipment manufacturer.

PART 2 – PRODUCTS

2.1 PLUMBING FIXTURES

A. Provide factory-fabricated fixtures of type, style and material indicated. For each type fixture, provide fixture

manufacturer's standard trim, carrier, seats, and valves as indicated by their published product information; either as designed and constructed, or as recommended by the manufacturer and as required for a complete installation. Where more than one type is indicated, selection is Installer's option; but, all fixtures of same type must be furnished by single manufacturer. Where type is not otherwise indicated, provide fixtures complying with governing regulations.

2.2 MATERIALS

A. Unless otherwise specified, comply with applicable Federal Specification WW-P-541/-Series sections pertaining to plumbing fixtures, fittings, trim, metals and finishes. Comply with the requirements of WW-P-541/-specification relative to quality of ware, glazing, enamel, composition and finish of metals, air gaps, and vacuum breakers, even though some plumbing fixtures specified in this section are not described in WW-P-541/-.

B. Provide materials which have been selected for their surface flatness and smoothness. Exposed surfaces which exhibit pitting, seam marks, roller marks, foundry sand holes, stains, decoloration, or other surface imperfections on finished units are not acceptable.

C. Where fittings, trim and accessories are exposed or semi-exposed, provide bright chrome-plated or polished stainless-steel units. Provide copper or brass where not exposed.

D. Stainless Steel Sheets: ANSI/ASTM A-167, Type 302/304, hardest workable temper. Finish: No. 4, bright, directional polish on exposed surfaces.

E. Steel Sheets for Baked Enamel Finish: ANSI/ASTM A-591, coating Class C, galvanized-bonderized.

F. Steel Sheets for Porcelain Enamel Finish: ANSI/ASTM A-424, commercial quality, Type 1.

G. Vitreous China: High quality, free from fire cracks, spots, blisters, pinholes, and specks; glaze exposed surfaces, and test for crazing resistance in accordance with ANSI/ASTM C-554.

H. Fiberglass: ANSI Z124 smooth surfaced, with color selected by Architect/Engineer.

I. Aluminum: ANSI/ASTM B-209/B-221 sheet, plate and extrusions, as indicated; alloy, temper and finish as determined by manufacturer, except 0.40 mil natural anodized finish on exposed work unless another finish is indicated.

J. Synthetic Stone: High quality free from defects, glaze on exposed surfaces, stain resistant.

2.3 PLUMBING FITTINGS, TRIM AND ACCESSORIES

A. Lavatory Protective Shield Covers:

1. Fully molded enclosure “Lav Shields” as manufactured by Zurn or Truebro, Inc., complete with tamper-resistant stainless steel fasteners.

2. Shield enclosure to meet A.D.A. #4.19.4, ANSI A117.1 and BOCA P- 1203.4.

B. Water Outlets: At locations where water is supplied (by manual, automatic or remote control), provide commercial quality faucets, valves, or dispensing devices, of type and size indicated, and as required to operate as indicated. Include manual shutoff valves and connecting system pipes to permit outlet servicing without shut- down of water supply piping systems.

1. Vacuum Breakers: Provide with flush valves where required by governing regulations, including locations where water outlets are equipped for hose attachment.

C. P-traps: Include removable P-traps where drains are indicated for direct connection to drainage system. All traps shall be minimum 17 gauge.

D. Carriers: Provide cast-iron and/or steel supports for fixtures. Carriers shall be provided for all wall-hung fixtures, and/or the carrier shall be selected to support the fixture independently of the wall. Carriers shall be adjustable type, complete with all fittings and foot supports. Carrier shall be single or double, back-to-back, horizontal offset and vertical stack type. Carrier shall be selected and used as best suited within the pipe chases. Where noted or indicated, stud mount type carriers shall be used and installed within stud wall s 8" and less.

E. Fixture Bolt Caps: Provide manufacturer's standard exposed fixture bolt caps finished to match fixture finish.

F. Escutcheons: Where fixture supplies and drains penetrate walls in exposed locations, provide chrome plated sheet steel escutcheons with friction clips.

G. Aerators: Provide aerators of types approved by Health Departments having jurisdiction.

H. Comply with additional fixture requirements contained in fixture schedule attached to this section.

2.4 FIXTURE LIST

A. Refer to the "Plumbing Fixture & Equipment Schedule" as indicated on the drawings.

2.5 FLUSH VALVES & FAUCETS

A. This Contractor shall furnish and install complete and operating metered and manual faucets and manual flush valves where so indicated and noted on the drawings and schedule.

B. The Contractor shall install the system in strict conformance with the manufacturer's written instructions. The installation shall be executed with good workmanship and to be clear of any interference with the user including the installation of lavatory protective shield enclosures.

C. All faucet installations shall require a mixing valve for single water supply to handwashing faucet.

2.6 AVAILABLE MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering fixtures, trim and carriers which may be incorporated in the work include, and are limited to the following:

<u>Water Closets (Wall-Mounted Back Outlet – China)</u>

Zurn
American Standard
Kohler

<u>China/Enameled Fixtures</u>
Zurn
Kohler
American Standard

<u>Faucets/Trim (Non-Sensor Operated)</u>
Zurn
Kohler
American Standard
Delta
Moen
Elkay

Speakman
Chicago

Flush Valves
Sloan "Royal"
Coyne & Delany
Zurn
ToTo
Delta

Wall Supplies/Traps
McGuire
Brass-Craft
Kohler
American Standard
Sanitary-Dash
Teledyne
Wolverine
Pro-Flo
Keeny
Mainline

Fixture Carriers
Zurn
Josam
Wade
Watts
Smith
MIFAB

Fixture Seats
Olsonite
Sperzel
Benke
Bemis
Church
Kohler
American Standard
Centoco
Comfort Seat

Mop Receptors
Fiat
Stern-Williams
Mustee
Florestone

Note: All mop receptor installations must include the combination eyewash and service sink faucet arrangement.

Water Coolers
Elkay
Haws
Halsey-Taylor
Oasis
Acorn

Stainless Steel Sinks
Elkay
Just

Dayton
Advanced-Tabco

Emergency/Safety Equipment
Bradley
Haws
Western
Speakman
Guardian

Washer Utility Boxes
PPP, Inc.
Symmons
Guy-Gray
Oatey

B. Cross Reference Identification:

1. If the Contractor selects a manufacturer of drainage equipment products other than as identified on the Schedule but is selected from the available manufacturers listed above, a cover sheet shall be included with the submission of shop drawings indicating the cross-referenced manufacturer and model number.

2. Shop drawings shall not be reviewed or accepted if not in compliance with this requirement.

2.8 HANDICAP LAVATORY INSULATION

A. Fully molded "P" trap and angle valve insulation kit Handi-Lav Guard Truebro Model #101, 102 and 105 to suit.

B. Insulation to meet A.D.A. #4.19.4, ANSI A117.1 and BOCA P- 1203.4.

C. Self-extinguishing ASTM D635 burn characteristics, Thermal conductivity ASTM C177-K value 1.17.

PART 3 – EXECUTION

3.1 FIXTURE CONNECTIONS

A. Connections to plumbing fixtures shall be of the sizes indicated on the "Plumbing Fixture & Equipment Schedule".

B. The sizes indicated on the Schedule are for drainage and water piping serving an individual fixture; the sizes of the mains and branches shall be as indicated on the drawings.

3.2 FIXTURE SETTING HEIGHTS

A. The plumbing fixtures shall be set in accordance with the heights established by the latest edition of codes and ADA requirements.

Note: Height indicated is established as follows:

Water Closets:	From finished floor to top of seat.
Urinals:	From finished floor to rim of fixture.
Lavatories & EWC:	From finished floor to rim of fixture.
Receptor Fitting:	From finished floor to center of fitting.
Shower:	From finished floor to center of shower head.

B. Refer to Architectural drawings and sections for fixture elevations. Fixtures in various areas may be set at lower elevations. Confirm all rough-in elevations prior to any installation.

3.3 LAVATORY PROTECTIVE SHIELD ENCLOSURES

A. Installation shall conform to manufacturer's written instructions.

B. All items involved with wall-hung lavatory installations shall be roughed-in and installed within the enclosure. This includes the offset "P" trap assembly, thermostatic mixing valve, sensor faucet trim and accessories, electrical outlet. Coordinate all work required for complete concealment of all devices.

3.4 INSPECTION AND PREPARATION

A. Examine roughing-in work of domestic water and waste piping systems to verify actual locations of piping connections prior to installing fixtures. Also examine floors and substrates, and conditions under which fixture work is to be accomplished. Correct any incorrect locations of piping, and other unsatisfactory conditions for installation of plumbing fixtures. Do not proceed with work until satisfactory conditions have been corrected.

B. Install plumbing fixtures of types indicated where shown and at indicated heights; in accordance with fixture manufacturer's written instructions, roughing-in drawings, and with recognized industry practices. Ensure that plumbing fixtures comply with requirements and service intended purposes. Comply with applicable requirements of the International Plumbing Code pertaining to installation of plumbing fixtures.

C. Fasten plumbing fixtures securely to indicated supports or building structure; and ensure that fixtures are level and plumb. Secure plumbing supplies behind or within wall construction so as to be rigid, and not subject to pull or push movement.

3.5 CLEAN AND PROTECT

A. Fixture shall be thoroughly cleaned after completion of installation.

B. Protect installed fixtures from damage during the remainder of the construction period.

3.6 FIELD QUALITY CONTROL

A. Upon completion of installation of plumbing fixtures and after units are water pressurized, test fixtures to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

B. Inspect each installed unit for damage to finish. If feasible, restore and match finish to original at site; otherwise, remove fixture and replace with new unit. Feasibility and match to be judged by Architect/Engineer. Remove cracked or dented units and replace with new units.

END OF SECTION 22 01 40

SECTION 22 01 50
EQUIPMENT - PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the Work specified in this Section.

1.2 DESCRIPTION OF WORK

A. This section includes:

1. Plumbing equipment as indicated on drawings and provisions of this section, including schedules and equipment lists associated with either drawings or this section.

2. Types of plumbing equipment required for project include the following:

Recirculating Pumps-Domestic Water Return (110 degrees & 140 degrees)
Exterior Grease Interceptor Vault
Solids Interceptor
Domestic Water Heater
Thermostatic Mixing Valve

1.3 REFERENCE STANDARDS

A. Refer to Section 220000 for a general description of requirements applying to this section.

B. UL and NEMA Compliance: Provide electric motors and electrical components required as part of plumbing equipment, which have been listed and labeled by Underwriters' Laboratories and comply with NEMA Standards.

C. NEC Compliance: Comply with National Electrical Code (ANSI/NFPA 70) as applicable to installation and electrical connections of ancillary electrical components of plumbing equipment.

D. ASME Relief Valve Stamps: Provide water heaters with safety relief valves bearing ASME valve markings.

E. AWWA Compliance: Comply with applicable American Water Works Association Standards pertaining to steel water tanks.

F. CSA and NSF Labels: Provide water tanks which have been listed and labeled by CSA International and National Sanitation Foundation.

G. ASME Code Symbol Stamps: For the following equipment, comply with ASME Boiler & Pressure Vessel Code for construction and stamp with ASME Code Symbol:

Domestic Water Heater

H. 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 29CFR 1910.303 and .349 as well as NFPA Pamphlet #70 and NEC Article 90.7.

1.4 QUALITY ASSURANCE

A. Refer to Section 220010 for a general description of requirements applying to this section.

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 220000.

B. Submit the following:

1. Product data on all equipment including roughing-in data.
2. Connection diagrams for related piping and specialties.

1.6 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS

PART 2 – PRODUCTS

2.1 EQUIPMENT

A. Refer to "Plumbing Fixture & Equipment Schedule" for type, numbers, size and manufacturer of all equipment accessories.

2.2 HOT WATER CIRCULATING PUMPS

A. Provide and install where indicated on the drawings, domestic hot water circulating pumps complete with controls and piping as shown on the drawings. Each pump shall have a capacity, as noted on the drawings and schedule.

B. Pumps shall be close coupled, centrifugal type, all low lead or lead-free bronze with flexible connection to a single-phase motor.

C. Pump shall be controlled by a manual starter, furnished and installed by the Electrical Contractor. Pumps shall run continuously and be wired into night setback operations.

2.3 MASTER MIXING VALVE

A. Mixing valve shall be constructed entirely of lead-free bronze and copper and hydrostatically tested to a pressure of 300 lb. Unit shall be provided with the following features.

1. A long mixing chamber with vanes at an angle to the longitudinal axis of the valve which shall cause a thorough mixing of the hot and cold water.

2. The length of the hydraulic thermostatic element shall assure effective contact with the water.

3. The thermostatic element shall be placed in the body of the valve where the hot and cold water mix. Unit shall be sensitive to any change in water temperature and make the proper correction by opening or closing the hot and cold water inlets in the valve.

4. The sensitive parts of the thermostatic element shall be inside a heavy non-ferrous tube which shall protect them from any corrosive or scaling action caused by the continuous flow of water past them.

B. Unit shall be as sized on the drawings.

C. Temperature adjusting range shall be between 80 and 160 degrees F.

2.4 WATER HEATER

A. The water heater shall be Bradford White Model EF-100T-399-3NCA with a storage capacity of not less than

100 gallons, a minimum input of 399 BtuH, and a minimum recovery of 451 GPH at 100 deg. F. It shall be design certified by the CSA International Z21.10.3 for 180 deg. F application. The tank shall be lined with Vitraglas vitreous enamel. The tank shall have one extruded magnesium anode rod. The insulation shall be foam material of 1" nominal thickness. The entire installation shall be made in accordance with state and local codes and ordinances.

B. Vacuum Relief Valve: All bottom fed water heaters and bottom fed hot water storage tanks connected to water heaters shall be installed with a vacuum relief valve. The valve shall be installed on the (cold water) fed piping above the top of the water heater and/or storage tank and per the manufacturer's requirements. Vacuum relief valves shall comply with ANSI Z21.22.

2.5 EXTERIOR GREASE INTERCEPTOR

A. Interceptor shall be constructed of precast, reinforced concrete in accordance with the Local Plumbing Code requirements. Interceptor shall include inlet, outlet and vent piping, baffles and manhole frames and covers. All piping shall be PVC soil pipe and fittings, and manhole frames and covers shall be rated for heavy duty.

2.6 SOLIDS INTERCEPTOR

A. Solids interceptor shall be cast iron, porcelain enameled inside and outside with lumaloy sediment bucket and removable bronze screens and lumaloy gasketed cover with locking device.

2.7 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering plumbing equipment shall be limited to the following:

1. Domestic Water Heaters
   Ruud
   Bradford-White
   State

2. Hot Water Circulating Pumps
   Armstrong
   Bell and Gossett
   Taco
   Aurora
   Grundfos
   Amtrol

3. Solids Interceptors
   Zurn
   Josam
   Wade
   Ancon
   Smith

4. Exterior Interceptor Vaults (Precast)
   Tyson F. Sartin
   A.C. Miller
   Penn Cast

5. Master Mixing Valve (Domestic Hot Water System)
   Holby Valve Co.
   Acron

PART 3 – EXECUTION

3.1 INSTALLATION OF WATER HEATERS

A. Install water heaters where indicated in accordance with manufacturer's installation instructions and in compliance with applicable codes.

B. Set units where indicated, orient so controls and devices needing service and maintenance have adequate access. Level and plumb units. Each unit shall be set on a concrete housekeeping pad.

C. Existing Mechanical Room: Reconnect existing gas hot and cold piping to new unit. Alter piping to suit new connections. Connect recirculating line to unit with check valve and shutoff valve. Extend relief valve discharge to nearest floor drain. Extend and connect new flue exhaust to existing breeching.

D. New Mechanical Room: Connect gas, hot and cold and recirculating piping system and all associated equipment and devices as detailed on the drawing. Flue extension, roof penetration and weatherproof hood shall be by this Contractor.

E. Start-up, test and adjust hot water heaters in accordance with manufacturer's start-up instructions. Check and calibrate controls.

3.2 INSTALLATION OF THERMOSTATIC MIXING VALVE

A. Install mixing valve in accordance with manufacturer's installation instructions and in compliance with applicable codes.

B. At startup of domestic hot water system, mixing valve outlet temperature shall be checked to insure proper setting and operation. Following adjustments, if required, the mixing valve, if not performing. check if factory required differential temperature in/out with a minimum of 20º Delta “T” is maintained.

C. The temperature of the water delivered by the mixing valve shall be changed by turning the adjusting screw to the right or clockwise for lower temperature; and to the left or counter clockwise for higher temperatures. Maintain a uniform temperature regardless of temperature of incoming water. To facilitate adjustment, a thermometer shall be placed in the line beyond the Holby Tempering Valve as shown in the diagram and water shall be flowing through the Holby Tempering Valve while adjustment is being made.

D. Check valves shall be installed on both inlet (hot and cold) to the unit. Include a full size bypass valve arrangement.

E. The hot water return line shall always be piped through the cold water make-up side of the mixing valve.

3.3 INSTALLATION OF HOT WATER CIRCULATING PUMPS

A. Install pumps where indicated, in accordance with manufacturer's published installation instructions, with recommended clearances provided for service and maintenance.

B. Install in-line pumps, supported from piping system, located for access to oil cups, service, and maintenance.

C. Lubricate pumps before start-up. Start-up shall be in accordance with manufacturer's instructions.

D. Install pump unit as detailed on the drawing. Include a check valve and thermometer at the pump unit. The pump shall run on continuous operation. The pump shall be wired into night setback by the ATC system installer.

3.4 INSTALLATION OF EXTERIOR GREASE INTERCEPTOR

A. Install precast interceptor in accordance with manufacturer's installation instructions and in compliance with applicable codes.

B. Interceptor shall be set level on a base bed of crushed stone. Inlet, outlet and piping shall be adjusted, as required, to insure proper elevations with respect to inlet and outlet.

C. Provide all excavation and backfill as required to install the unit.

D. Install increment rings or extensions for access to finished grade. Install and set manhole frames and covers true and level flush with finished grade.

E. Install vent piping and extend up through building to 18” above roof level. The vents shall be a minimum of 4” in size and shall be connected to the vault chamber and also in the drain line prior to the inlet connection. No other system vents shall connect to the grease interceptor vent system.

END OF SECTION 22 01 50

SECTION 22 01 90
TESTING - PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other conditions, if any) and Division 1 as appropriate, apply to the work specified in this Section.

1.2 DESCRIPTION OF WORK

A. Extent of plumbing systems to be tested is indicated on the drawings and by requirements of this section.

B. Applications of tests include the following:

1. Interior Piping

a. Domestic cold, hot & hot water return piping
b. Gas piping
c. Sanitary and condensate waste drainage piping
d. Storm water drainage piping

2. Exterior Piping

a. Sanitary drainage piping
b. Gas service
c. Storm drainage piping

C. See Fire Protection Specifications for testing of Fire Protection Systems.

1.3 REFERENCE STANDARDS

A. Refer to Section 220000 for a general description of requirements applying to this section.

1.4 QUALITY ASSURANCE

A. Refer to Section 220010 for a general description of requirements applying to this section.

1.5 SUBMITTALS

A. Submit test reports in accordance with Section 220000.

1.6 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS.

PART 2 – PRODUCTS

2.1 PIPE & FITTING REPLACEMENTS

A. Refer to Section 220010 for replacement of any defective pipe or fittings. Replacement shall include all required uncovering, excavating, recovering and backfilling.

PART 3 – EXECUTION

3.1 GENERAL

A. All exterior or interior piping shall be tested and approved before backfilling or concealing. Failure to secure the approval of the Municipal Inspector, Utility Company's Inspector or the Inspector of the Architect/Engineer makes it mandatory for the Contractor to completely expose the piping for testing. All expense involved in the uncovering of the piping for the test and recovering shall be borne by the respective Contractor with no change in Contract.

B. All equipment, material and labor required for testing a plumbing system or part thereof shall be furnished by the Plumbing Contractor responsible for installing the work.

3.2 INTERIOR PIPING

A. Drainage Piping:

Rough Plumbing: The piping of all plumbing storm, condensate waste, sanitary drainage and venting systems shall be tested upon completion of the rough piping installation by water or air and proved watertight. Where required by the code official, the cleanout plugs shall be removed to ascertain if the pressure has reached all parts of the system. Either of the following methods shall be used:

1. Water Test: The water test shall be applied to the drainage system either in its entirety or in sections after rough piping has been installed. If applied to the entire system, all openings in the piping shall be closed, except the highest opening, and the system filled with water to the point of overflow. If the system is tested in sections, each opening shall be plugged except the highest opening of the section under test, and each section shall be filled with water, but a section shall not be tested with less than a 10-foot head of water.

   In testing successive sections, at least the upper 10 feet of the next preceding section shall be tested, so that a joint or pipe in the building (except the uppermost 10 feet of the system) shall not have been subjected to a test of less than a 10-foot head of water. The water shall be kept in the system or in the portion under test for a minimum of 15 minutes before inspection starts. The system shall then be tight at all points.

2. Air Test: The air test shall be made by attaching an air compressor testing apparatus to an opening, and, after closing all other inlets and outlets to the system, forcing air into the system until there is a gauge pressure of 5 pounds per square inch (5 psi) or a minimum of 10-inch column of mercury. This pressure shall be held without introduction of additional air for a minimum period of 15 minutes.

   Precautionary Note: The compressibility of air and/or other gases result in tremendous amounts of stored energy, even at lower pressures. Over-pressurizing creates a substantial hazard to personnel and property near the area should a failure occur. Consult with the Plastic Pipe Institute (PPI) for statements and alerts, along with State and local safety offices.

Finished Plumbing: Where required by the code official, after the plumbing fixtures have been set and their traps filled with water, their connections shall be tested and proved gas and water-tight by one of the following test methods.

1. The final test for gas and water-tightness of the completed drainage and vent systems shall be made by a smoke test or other approved method. The test shall be made by filling all traps with water, and then introducing into the system smoke produced by one or more smoke machines. When the smoke appears at stack openings on the roof, the stack openings shall be closed and a pressure equivalent to a 1" water column shall be built and maintained for the period of the inspection.

2. After the plumbing fixtures have been set and their traps filled with water, their connections shall be tested and proven gas and water-tight by plugging the stack openings on the roof and building drain where the drain leaves the building and with air introduced into the system equal to the pressure of a 1-inch water

column. This shall be accomplished by the use of a "U" tube or manometer inserted in the trap of a water closet. Such pressure shall remain constant for the period of inspection without the introduction of additional air.

Building sewer test: The building sewer shall be tested by insertion of a test plug at the point of connection with the public sewer or individual sewage disposal system. The building sewer shall then be filled with water under a head of not less than 10 feet. The water level at the top of the test head of water shall not drop for at least 15 minutes.

B. Domestic Water Piping: All new, altered, extended or replaced interior water piping installed shall be tested at 100 psig maintaining the pressure for four hours with not more than 1% drop in pressure. The system shall be filled with water which shall remain in the system until the water and the piping are the same temperature. If water pipe testing is under the jurisdiction of the local inspector, his requirements shall be used; however, they shall be not less than specified herein. The tests shall be performed in the presence of the representative of the Architect/Engineer and to his satisfaction.

C. Natural Gas Piping:

1. All new, altered, extended or replaced interior natural gas piping installed shall be tested in accordance with the requirements of the National Fire Protection Association, latest edition of the IFGC, Section 107, and the requirements of the local Utility Company as applicable. In the absence of a specific test required by the Authorities, or if such requirements are less stringent than the test hereinafter specified, then the interior gas piping shall be tested as follows in the presence of the representative of the Architect.

2. Before appliances are connected, piping shall be filled with air or nitrogen, to a pressure of 10 psi and proved tight with no drop in pressure for the length of time required to inspect the joints, but in no case less than 30 minutes. The source of pressure shall be isolated before the pressure tests are performed. Pressure shall be measured with a mercury manometer, or slope gauge or equivalent device so calibrated as to be read in increments of not greater than one-tenth pound. All piping which will be concealed shall be tested, prior to being closed in by construction.

3.3 EXTERIOR PIPING

A. Sanitary & Storm Water Drainage Piping:

1. All new exterior sanitary and storm water drainage installed shall be tested in a manner and in a sequence best suited to project. The test shall be performed in the presence of the Inspector of the Municipality under whose jurisdiction the installation is made and shall conform to his requirements.

2. In the absence of a specific code test, the Contractor shall perform the following testing in the presence of the representatives of the Architect.

3. Before any section of sanitary and storm water drainage has been backfilled more than 6 inches above the top of the pipes, exclusive of the joint area, the system shall be tested. Wherever possible, the section of the system shall be tested from manhole to manhole. The lower end of each section to be tested shall be plugged with a suitable device manufactured for this purpose. The section being tested shall be filled with water and the leakage observed and gauged.

4. For the gravity sanitary drainage piping to be acceptable, the water leakage after filling shall not exceed 2 gallons per 24 hours per lineal foot of pipe joints with all joints under a constant pressure of not less than 0.1 pound.

5. For the storm water to be acceptable, the water leakage after filling shall not exceed 3 gallons per 24 hours per lineal foot of pipe joints with all joints under a constant pressure of not less than 0.1 pound.

B. Gas Service:

1. All new exterior distribution piping, installed by this Contractor, for natural gas systems shall be tested in accordance with the requirements of the National Fire Protection Association, latest edition of the IFGC, Section 107, and the requirements of the local Utility Company. In the absence of a specific test required by the Authorities, or if such requirements are less stringent than the test hereinafter specified, then the exterior piping shall be tested as follows, before pressure regulating valves are installed, or connection made to interior piping.

2. Piping shall be filled with air or nitrogen, to a pressure of 100 psi, and proved tight with no drop in pressure for the length of time required to inspect the joints, but in no case less than one hour. The source of pressure shall be isolated before the pressure tests are performed. Pressure shall be measured with a gauge so calibrated as to be read in increments of not greater than one pound.

3.4 STERILIZATION

A. After final testing for leaks, all new potable water piping installed including water service piping, shall be flushed to remove foreign material.

B. Before placing domestic water systems in service, a qualified service organization shall be engaged, to sterilize the entire building including the exterior water service piping in accordance with the following procedure:

1. Contractor shall provide a 3/4" hose connection somewhere in the main entering the building, or in the Mechanical Room and/or in the meter pit, pump in sufficient sodium hypochlorite to produce a free available chlorine residual of not less than 100 PPM.

2. Proceed upstream from the point of chlorine application opening all faucets and taps until chlorine is detected. Close faucets and taps when chlorine is evident. Consult with the local code department for additional concentrations and durations.

3. When chlorinated water has been brought to every faucet and tap with a minimum concentration of 200 PPM chlorine, retain this water in the system for at least three hours.

4. At the end of the retention period, no less than 100 PPM of chlorine shall be present at the extreme end of the system.

5. Proceed to open all faucets and taps and thoroughly flush all new lines until the chlorine residual in the water is less than 1.0 PPM.

6. Obtain representative water samples from the system for analysis by a recognized Bacteriological Laboratory.

7. If all samples tested for impurities and organisms are negative, a letter and laboratory reports shall be submitted by the service organization to the contractor, certifying successful completion of the sterilization.

8. If any samples tested indicate the presence of harmful impurities and organisms, the entire sterilization procedure shall be repeated.

9. Plumbing Contractor shall provide plumbing connections and power for pumping chlorine solution into the system.

Warning: PVC and CPVC Pipe: Do not use a dry granular calcium hypochlorite as a disinfecting material for water purification in potable water piping systems. The introduction of granules or pellets of calcium hypochlorite with solvent cements and primers (including their vapors), may result in violent chemical reactions.

C. Available Service Organizations: Subject to compliance with requirements, provide the sterilization service of one of the following:

Water Chem
Arc Company, Inc.
Nova Consultants
Artesian Water Co.

END OF SECTION 22 01 90

SECTION 22 01 91
BALANCING - PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other conditions, if any) and Division 1 as appropriate, apply to the work specified in this Section.

1.2 DESCRIPTION OF WORK

A. Extent of plumbing systems to be balanced is indicated on the drawings and by requirements of this section.

B. Applications of tests include the following:

1. Interior Piping

a. Domestic hot water and hot water return

1.3 REFERENCE STANDARDS

A. Refer to Section 220000 for a general description of requirements applying to this section.

1.4 QUALITY ASSURANCE

A. Refer to Section 220010 for a general description of requirements applying to this section.

1.5 SUBMITTALS

A. Submit balancing report in accordance with Section 220000.

1.6 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS.

PART 2 – PRODUCTS

2.1 PIPE & FITTING REPLACEMENTS

A. Refer to Section 220010 for replacement of any defective pipe or fittings. Replacement shall include all required draining of system, removal and replacement and uncovering, recovering.

PART 3 – EXECUTION

3.1 GENERAL

A. All new hot water return piping installed or wherever system valves are being replaced, the system shall be tested, balanced and approved before concealing. Failure to secure the approval of the Municipal Inspector, A/E Inspector or the Inspector of the Owner makes it mandatory for the Contractor to completely expose the piping for balancing. All expense involved in the uncovering of the piping for the balancing and recovering shall be borne by the respective Contractor with no change in Contract.

B. All equipment, material and labor required for balancing a plumbing system or part thereof shall be furnished by the Plumbing Contractor responsible for installing the work.

3.2 INTERIOR PIPING

A. Domestic Hot Water Return System: Upon completion of the testing of the domestic hot water supply and recirculation systems, a final procedure is to be performed to obtain uniform circulation within each hot water loop of the domestic hot water system. At the ends of the hot water mains, or wherever a branch return line connects to the main return line, there shall be three (3) valves: ball valve, check valve and balancing valve. These valves are to be installed in an accessible space at/or above the ceiling or where indicated on the drawings.

B. Based on an Accu-Flo balancing valve, the use of a differential pressure gauge Model No. 779 shall be used to achieve the greatest accuracy.

END OF SECTION 22 01 91

SECTION 23 02 00
GENERAL PROVISIONS – HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to work of this Section.

B. This specification or drawing and the design features or resulting construction disclosed, are the property of Furlow Associates, Inc., and shall not be reproduced without written permission.

C. All Mechanical Systems shall be part of and included in all of the following: 230200 thru 230950.

1.2 WORK INCLUDED

A. Provide labor, materials, equipment and supervision necessary to install complete operating HVAC Systems, including all work at the site and within the proposed construction areas to accomplish the required work.

B. Wherever the term "provide" is used, it shall be understood to mean both "furnish" and "install".

1.3 REGULATIONS, CODES AND STANDARDS

A. Work shall be performed in accordance with latest adopted codes, regulations and ordinances by authorities having jurisdiction. Observe all safety regulations.

B. Obtain all permits and inspection certificates and pay all charges.

C. Latest editions of any referenced standards shall govern.

1.4 RELATED WORK

A. Refer to equipment shown or specified in sections of Division 1 thru 14 and 26 that will require Mechanical services and provide such service.

B. Refer to work related to HVAC as shown on the following contract drawings:

Architectural & Structural
Plumbing
Electrical

C. This Contractor shall coordinate with the work of Division 26 and the Fire Alarm System vendor for locations and mounting of all duct smoke detectors. These devices are shown on the Mechanical Drawings for reference only to show the intent of the work. All locations shall be determined based on approved shop drawings from the Fire Alarm System vendor and the Contractor for the work of Division 26, Electrical.

1.5 COORDINATION

A. The Mechanical, Plumbing and Electrical Contractors are responsible to coordinate all manufacturer's recommended circuit breakers, starters, disconnects and fuse sizes for all equipment. Submission of a shop drawing will certify that this has been completed. Any necessary changes required will be included as part of this contract.

B. Mechanical Contractor shall coordinate scheduling, submittals and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of independent work elements, with provisions to accommodate items that may be installed at a later time.

C. Mechanical Contractor shall verify utility requirements and all characteristics of operating equipment are compatible with the building utilities. Coordinate the work of all sections related and required for installing, connection and placing in service of all equipment.

D. Mechanical Contractor shall coordinate all space requirements, supports and installation of all mechanical, electrical, plumbing and fire protection work, which are indicated diagrammatically on the Drawings. Verify routing of all pipes, ducts, conduits and equipment connections. Maximize accessibility for other work, and service requirements for maintenance and repairs. Develop overall coordination drawing (all trades) and submit for review prior to fabrication/installation.

E. Obtain written confirmation from all related trade Contractors and the Owner or his representative that requirements, conflicts and coordination issues have been discussed and resolved.

F. Submit coordination drawings to verify access and clearances.

1.6 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installation within unheated shelters.

1.7 SUBMITTALS

A. Shop Drawings:

1. Shop drawings shall be submitted in accordance with Division 1 of these specifications except where herein modified.

2. Shop drawings comprising complete catalog cuts, performance test data for HVAC equipment as required by other sections of Division 23, shall be submitted for review checking. The Contractor shall review these shop drawings for conformance to contract documents prior to submission and affix contractor's signature to each submittal certifying that this review has been done. By approving and submitting shop drawings, product data, samples and similar materials, the Contractor represents that the Contractor has determined and verified materials, field measurements and field construction data that relates to the work, and has checked and coordinated this information with all of the requirements contained in the contract documents for the work of all trades.

a. The Contractor and equipment manufacturer shall clearly indentify in all submittals and shop drawings any and all applications standards which require additional work to accommodate this equipment and provide a complete and operational system as described in the contract documents.

b. The Contractor shall be completely responsible for any and all additional costs associated with the changes required by this and all other trades.

3. Submit a 1/4" scale layout of all mechanical equipment rooms. All equipment and pads shall be to scale of equipment being furnished. Obtain size information of any and all equipment from other trades and indicate on drawings. The drawings shall be fully coordinated with all trades prior to submission. Indicate coil pull areas, filter pull areas, maintenance clearances, and access as applicable.

4. All shop drawing submittals shall have the following identification data, as applicable, contained therein or permanently adhered thereto.

   a. Project name.
   b. Project number.
   c. Sub-contractor's, vendor's and/or manufacturer's name and address.
   d. Product identification.
   e. Identification of deviation from contract documents.
   f. Applicable contract drawings and specification section number.
   g. Shop drawing title, drawing number, revision number, and date of drawing and revision.

5. Resubmit revised or additional shop drawings as requested.

6. Wherever shop drawings or vendor's standard data sheets indicate work to be done "by others", it shall be the responsibility of the contractor making the submission to identify by name, the contractor who is to do this work. If the contractor named is other than the contractor making the submission, the shop drawing submission must be reviewed by the named contractor and bear his mark of approval, prior to submission to the Architect/Engineer.

7. Where equipment proposed differs from that shown on the drawings or specified, he shall submit for approval drawings showing the manner in which the layout is affected by the substitution.

8. The Contractor shall keep one copy of approved shop drawings at the job site,, filed in a suitable metal container. The shop drawings shall be cataloged and kept in good repair, and shall be available for use by the Owner, Architect and Engineer.

9. No equipment shall be ordered, fabricated, etc., before approval of shop drawings.

B. Contractor is responsible for the shop drawing coordination and interface with the work of other contracts and adjacent work. The relationship of Contractor’s work shall be verified as it relates to adjacent and critical features of the work of this and all contracts and materials.

C. The Contractor shall submit a complete schedule of all shop drawings required for the scope of work covering all materials and equipment listed in all sections of Division 23, Mechanical, including all documents required for contract closeout, Owner instructions and training, and all turnover items at the completion of the work. This schedule shall be submitted for review and approval within thirty days of contract award and before any subsequent materials are provided for review.

D. The shop drawings provided by the Contractor will be reviewed only once and resubmittals will be reviewed only once. Any other submittals will be billed to the Contractor at the Engineer’s standard rates.

1.8 SITE INSPECTION

A. The Contractor shall visit site, inspect, and become aware of all conditions which may effect the work during the estimation phase of his work prior to bid openings. Investigate utilities, protection requirements for adjacent facilities, storage locations, and access to the construction area.

B. Submission of a bid will be deemed evidence of having complied with this requirement.

1.9 SUBSTITUTIONS

A. Whenever a material, article, piece of equipment or system is identified in the following specification or indicated on the drawings by reference to manufacturers' or vendors' names, trade names, catalog numbers or the like, it is so identified for the purpose of establishing the basis of the Bid.

B. Substitution approval must be obtained and included as an addendum item prior to the submission of the bid. An approved substitution shall not be considered as an approval for the Contractor or an equipment vendor to deviate from the written portion of the specifications unless so stated in the addendum.

C. The drawings illustrate the space allocated for equipment and the Contractor shall install the equipment accordingly. If changes are required in the building or arrangement due to substitution of equipment, the Contractor making the substitution must pay for the necessary modifications.

D. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but not be limited to all: space requirements, code clearances, type-horsepower-capacities-number and size of services required from other trades including all auxiliary items provided by this Contractor and all other trades, and all manufacturer's specific equipment applications standards and requirements, for approved equipment including that which is basis of design or a substitution. The bidding related contractor and equipment manufacturers shall clearly identify in all submittals and shop drawings any and all applications standards which require additional work to accommodate this equipment and provide a complete and operational system as described in the contract documents. If the bidding contractor or manufacturer does not comply with these requirements then they shall be completely responsible for any and all additional costs associated with the changes required by this and all other trades.

1.10 LUBRICATION

A. Provide and maintain all required lubrication of any equipment operated prior to acceptance by the Owner. Lubrication shall be as recommended by the equipment manufacturer.

B. Provide one year's supply of lubricants to Owner at date of acceptance.

C. Verify that required lubrication has taken place prior to any equipment start-up.

1.11 EQUIPMENT START-UP

A. Verify proper installation by manufacturer or his representative.

B. Advise Construction Manager 2 days prior to actual start-up.

C. Verify proper operation. Obtain signed statement by manufacturer or his representative that equipment is operating within warranty requirements. Submit statement to Construction Manager.

D. Perform field mechanical balancing in accordance with Section 230950: TESTING AND BALANCING OF MECHANICAL SYSTEMS.

E. The Mechanical Contractor shall own as part of his work, the following:

Provide one (1) additional drive set, if necessary, to obtain final design balancing requirements. The Mechanical Contractor shall coordinate with Balancing Firm and equipment manufacturer for drive selection, including belts and pulleys.

1.12 OPERATION & MAINTENANCE INSTRUCTIONS

A. Properly and fully instruct Owner's personnel in the operation and maintenance of all systems and equipment.

B. Ensure that the Owner's personnel are familiar with all operations to carry on required activities.

C. Such instruction shall be for each item of equipment and each system as a whole.

D. Provide report that instruction has taken place. Include in the report the equipment and/or systems instructed, date, contractor, Owner's personnel, vendor, and that a complete operating and maintenance manual has been reviewed.

E. Manual shall include all instructions on operation, maintenance, repair parts list, lubrication requirements, brochures, catalogue cuts, complete schedule of air filters for each unit type in Excel spreadsheet format, wiring diagrams, piping diagrams, control sequences, service requirements, names and addresses of vendors, suppliers and emergency contacts. Three manuals shall be provided.

F. Submit manuals for review prior to operating instruction period. Manuals shall be 8-1/2 x 11" with hard cover, suitably bound.

G. Provide to the Owner any special tools necessary for operation and routine maintenance of any of the equipment.

H. Upon completion of the project, the Mechanical Contractor shall provide a complete set of legible as-built drawings for the Owner.

1.13 TOOLS

A. All equipment furnished by the Mechanical Contractor which requires special tools or devices other than those normally available to the maintenance or operating staff shall be furnished in duplicate to the Owner, sufficiently marked, packed or boxed for staff usage. The tools provided shall be listed by the Mechanical Contractor identified as to their use or the equipment applicable in a written transmittal to the Owner.

1.14 FILTERS (ATTIC STOCK)

A. Mechanical Contractor shall provide one (1) spare set of air filters for each unit for Owner’s attic stock.

1.15 CLEANING AND FINISHING

A. After equipment start-up and all operating tests have been made and the system pronounced satisfactory, each respective Contractor shall go over the entire project, clean all equipment, etc., installed by him and leave in a clean and working condition. Any surfaces found marred after this final cleaning shall be refinished or replaced by each Contractor at no cost to the Owner.

B. Provide for the safety and good condition of all materials and equipment until final acceptance by the Owner. Protect all materials and equipment from damage. Provide adequate and proper storage facilities during the progress of the work. Special care shall be taken to provide protection for bearings, open connections, pipe coils, pumps, compressors and similar equipment.

C. All fixtures, piping, finished surfaces and equipment shall have all grease, adhesive labels and foreign materials removed.

D. All piping shall be drained and flushed to remove grease and foreign matter. Pressure regulating assemblies, traps, and similar items shall be thoroughly cleaned. Remove and thoroughly clean and reinstall all liquid strainer screens after the system has been in operation ten (10) days.

E. Clean-up: Remove from the premises, all unused material and debris resulting from the performance of work under this section.

PART 2 – PRODUCTS

2.1 GENERAL

A. All material and equipment shall be new and of present-day manufacture, and shall conform to accepted standards of the trade where such a standard has been established for the particular type of equipment or material.

B. Whenever equipment or material is referred to in the singular, such as "the fan", it shall be deemed to apply to as many such items as necessary to complete the work.

2.2 PRODUCT DELIVERY, STORAGE AND HANDLING

A. During loading, transporting and unloading exercise care to prevent damage to material.

B. Store all materials in dry enclosures or under protective coverings out of way of work progress.

C. Material shall not be allowed to be stored directly on ground.

D. Deliver in manufacturer's original cartons or on skids.

E. Handle and protect so as to prevent damage to product or any surrounding material.

2.3 CONCRETE

A. Concrete shall be in accordance with Section 03300.

2.4 WARRANTY

A. Wherever in the specification sections of this division, reference is made to a specific warranty period, this warranty shall be in addition to and not a limitation of other rights the Owner may have against the Mechanical Contractor under the contract documents.

PART 3 – EXECUTION

3.1 PROTECTION

A. Plug or cap open ends of piping systems, conduit and ductwork.

B. Stored materials shall be covered to prevent damage by inclement weather, sun, dust or moisture.

C. Protect all installed work until accepted in place by the Owner.

D. Plates, polished metal escutcheons, thermostats and other finished devices shall not be installed until masonry, tile, and painting operations are complete unless otherwise protected.

E. Protect all work from operations which may cause damage such as hauling, welding, soldering, painting, insulating and covering.

3.2 WORKMANSHIP

A. Install all work neat, trim and plumb with building lines.

B. Install work in spaces allocated.

C. Cutting and patching shall be performed by skilled tradesmen normally employed for the work involved.

D. This Contractor shall provide a complete weathertight seal to all new systems in the building including the necessary caulking, weather-stripping and insulation.

3.3 EQUIPMENT SETTING

A. Provide as a minimum, a 4-inch concrete pad beneath all floor-mounted equipment. Install anchor bolts in pour.

B. Provide as a minimum, spring vibration isolation under any equipment 10 HP and over and rubber in shear vibration isolation on any equipment up to 10 HP. For further specifications and additional requirements, refer to other sections.

C. Concrete shall be 3,000 psi, 28 day compressive strength in accordance with ACI-613. Reinforce with No. 4 rod 12" on centers both ways or as otherwise detailed.

3.4 FASTENERS, HANGERS AND SUPPORTS

A. Provide all hangers and supports required to suspend, mount, or hang the work.

B. Provide all miscellaneous steel angles, channels, beams, clips, brackets and anchors necessary to hang or support the work. Provide submissions for review.

C. Install concrete inserts before concrete is poured.

D. Drilled inserts shall not be loaded more than 1/4 rated capacity.

E. Power-driven fasteners shall not be allowed for piping larger than 2 inch, or equipment. When used they shall not be loaded more than 1/8 rated capacity or 200 pounds.

F. All hangers, miscellaneous steel, braces and supports shall be galvanized, cadmium plated, or primed steel. Copper tubing shall be supported with copper hangers.

G. Piping shall be supported from adjustable clevis type hangers with insulation pipe saddles or pipe shields in accordance with piping support spacing table on the drawings. Where hangers are 18" or longer provide lateral bracing at every fourth hanger.

H. Support vertical piping at floor levels. Piping shall have split rings.

I. Any lintels required for openings for this work if not indicated on Architectural or Structural drawings shall be provided under this Section.

3.5 SLEEVES

A. Provide each pipe, duct or conduit passing through a masonry or concrete wall, floor or partition with a sleeve made from standard weight steel pipe for pipe or conduit and No. 12 gauge galvanized steel for ducts, with smooth edges, securely and neatly cemented in place. Provide each pipe, duct or conduit passing through a

frame or metal partition with a sleeve made from No. 22 gauge galvanized sheet metal, securely fastened in place.

B. Be responsible for the proper location and alignment of all sleeves.

C. Provide hydrostatic seals for sleeves passing through outside walls, either above or below grade, or through hydrostatically sealed slabs or floors on grade. Provide fire-rated seals for all sleeves which penetrate fire-rated walls.

D. Install both piping and sleeve seals so as to maintain integrity of seals with expansion and contraction of piping.

E. Extend wall and partition sleeves through and cut flush with each surface unless otherwise indicated or specified.

F. Select sleeves two pipe sizes larger than any pipe or conduit that is to remain uncovered, unless otherwise required by the sealing method specified. Where pipes are to be covered, provide sleeves large enough to allow the covering to pass through the sleeves with sufficient clearance for sealing as specified hereinafter.

G. Select duct sleeve sizes to suit requirements of fire dampers and sealing methods as specified.

H. Place sleeves imbedded in concrete floors or walls in the forms before concrete is poured; sleeves shall have integral waterstop flanges, where they are to receive either watertight or hydrostatic seals.

I. Hydrostatic Sealing Method: Provide compressible synthetic rubber seals, equivalent to LINK SEAL, manufactured by the Thunderline Corporation, or THRUWALL manufactured by O.Z. Gedney. Install seals in accordance with the manufacturer's recommendations to provide air tightness aboveground and hydrostatic sealing belowgrade. Caulking or other type mastic is not acceptable.

J. Fire-Rated Sealing Method:

1. Sleeves, openings and sealants shall comply with applicable codes, recommended practices and standards, and manufacturer's instructions. Fire sealants shall have ability to prevent spread of flame, smoke or water throughout the penetration and shall pass 3 hour test, UL test ASTM E814 and UL 1479.

2. Products: Chase Corporation CTC PR-855, O. Z. Gedney CRS/CAFS, 3M Electro-Products Division Putty 303 or Caulk CP25 penetration sealing kits, General Electric Company sealants type RTV-850, 6428 or 7403, Thunderline Corporation "Link-Seal Pyro-Pak". Installation and type of sealant to be used as recommended by the manufacturer.

3.6 PLATES

A. Provide chrome plated plates wherever piping passes into finished area.

B. Plates shall be securely fastened to piping or building construction.

C. Floor plates shall cover 1-inch sleeve extension.

3.7 OFFSETS, TRANSITIONS, MODIFICATIONS

A. Provide all offsets necessary to install the work and to provide clearance for other trades.

B. Maintain adequate headroom and clearance.

C. Incidental modifications necessary to the installation of the systems shall be made as necessary and as approved by the Architect.

3.8 RECESSES

A. Furnish information to the Construction Manager as to sizes and locations of recesses required to install panels, boxes, and other equipment or devices which are to be recessed in walls.

B. Make offsets or modifications as required to suit final locations.

3.9 LABELING

A. All HVAC equipment such as pumps, fans, air handling units, and devices requiring identification for operating procedures shall be provided with permanent black laminated micarta white core labels with 3/8 inch letters.

B. This shall also apply to all controllers, remote start/stop pushbuttons and equipment cabinets.

C. This shall not apply to individual room thermostats.

D. All Mechanical Rooms shall be identified with a permanent placard of red-white-red laminated, commercial grade, plastic construction. Letters shall be minimum one inch high and read in capital letters: WARNING – MECHANICAL EQUIPMENT ROOM – LIMITED ACCESS. Placard shall be centered on each door leading into the mechanical room at five feet above the floor and attached at each corner with brass screws.

E. At all fire damper locations, access doors in ductwork shall be identified with a permanent placard of red-white-red laminated commercial grade plastic construction, minimum one-half inch high capital letters, reading, "FIRE DAMPER" as appropriate for the installation. Attach securely to face of access door with brass screws at each corner, sealed airtight.

3.10 FLASHING AND COUNTERFLASHING

A. Roof curbs, etc., shall have counterflashing fittings. General Contractor shall provide flashing.

B. Piping and conduit thru the roof shall be flashed by the General Contractor. Provide counterflashing.

C. Provide curbs with base features required to match roof materials, finishes and configuration; e.g., flat, sloped, raised seam, etc.

3.11 ACCESS

A. Locate all equipment, valves, devices and controllers which may need service in accessible places.

B. Where access is not available, access panels shall be provided. Furnish access panels to the Construction Manager for installation.

C. Access panels shall be Nailor-Hart Industries, Karp Co., or Controlled Air Manufacturing Limited, with 16-gauge frames and 14-gauge steel door, prime painted.

D. Maintain access clearances for tube or fan removal, coil pulls, and filter removal.

3.12 WIRING AND MOTOR CONTROLS

A. Packaged equipment shall be furnished with disconnect switches, starters, overloads, factory furnished and wired by the unit manufacturer.

B. Roof-mounted exhaust fans, except utility sets, rated less than 1/2 HP at 115 volts, single phase, shall be furnished with disconnect switches, factory furnished and wired by unit manufacturer.

C. Rooftop equipment shall be furnished with starters, disconnect switches, overloads, factory furnished and wired by unit manufacturer.

D. All wiring shall be in accordance with the National Electrical Code and as recommended by the equipment manufacturer.

3.13 OPENINGS – CUTTING, REPAIRING

A. This Contractor shall cooperate with the work to be done under other sections in providing information as to openings required in walls, slabs and footings for all piping, ductwork and equipment, including sleeves where required.

B. Any drilling or cutting required for the performance of work under this Section, shall be the responsibility of this Contractor and the cost thereof shall be borne by him.

C. Holes in Concrete: Sleeves shall be furnished, accurately located and installed in forms before pouring of concrete. This Contractor shall pay all additional costs for cutting of holes as the result of the incorrect location of sleeves. All holes through concrete shall be either core drilled or saw cut. All holes required shall have the approval of the Structural Engineer prior to cutting or drilling.

D. It shall be the responsibility of this Contractor to ascertain that all chases and openings are properly located.

3.14 PAINTING

A. Refer to the Construction Manager's Scope of Work.

3.15 GUARANTEE

A. All work shall be guaranteed to be free from defects for a period of two years of operation from date of acceptance by the Owner.

B. Guarantee shall be extended on an equal time basis for all non-operational periods due to failure within the guarantee period.

C. All materials and equipment provided and/or installed under this section of the specifications shall be guaranteed for a period of two years from date of acceptance of the work by the Owner unless otherwise specified in Division 1. Should any trouble develop during this period due to defective materials or faulty workmanship, the Mechanical Contractor shall furnish necessary labor and materials to correct the trouble without any cost to the Owner. Any defective materials or inferior workmanship noticed at time of installation and/or during the guarantee period shall be corrected immediately to the entire satisfaction of the Owner.

D. In the event of occupancy by the Owner prior to final acceptance of the project, the guarantee date for equipment placed in operation shall be mutually agreed to by the Mechanical Contractor and the Owner's representative.

3.16 DRAWINGS

A. The Mechanical Systems are indicated on the Contract Drawings. Certain pertinent information and details required by the Mechanical Work appear on the Architectural, Structural and Electrical Drawings; become familiar with all drawings, and incorporate all pertinent requirements.

B. Drawings are diagrammatic and indicate the general arrangement of systems and requirements of the work. Do not scale drawings. Exact locations of fixtures and equipment, not specifically shown, shall be obtained before starting work.

3.17 TESTING AND BALANCING OF MECHANICAL EQUIPMENT

A. The Mechanical Contractor shall own as part of his work, the following:

Provide one (1) additional drive set, if necessary, to obtain final design balancing requirements. The Mechanical Contractor shall coordinate with Balancing Firm and equipment manufacturer for drive selection, including belts and pulleys.

END OF SECTION 23 02 00

SECTION 23 02 10
BASIC MATERIALS AND METHODS – HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions.

C. Refer to other sections in Division 23 for materials and methods not specified herein.

1.2 DESCRIPTION OF WORK

A. Included in this Section are the following:

1. Steel Pipe and Fittings
2. Copper Tubing & Fittings
3. Grooved End Pipe (Gruvlok) or (Victaulic)
4. Strainers
5. Thermometers
6. Gauges
7. Test Stations - Pressure/Temperature
8. Isolating Fittings
9. Pipe Saddles
10. Anchors and Guides
11. Flexible Expansion Loop (Manufactured)
12. Unions
13. Motors

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

B. Install work to meet the requirements of the following:

1. New Castle County Dept. of License and Inspections
2. International Mechanical Code
3. Gas Utility Company
4. NFPA
5. OSHA
6. ASHRAE
7. Manufacturer’s Standardization Society (MSS) of the valve and Fittings Industry, Inc.:
   SP-58 Pipe Hangers and Supports Materials, Design and Manufacture.
   SP-69 Pipe Hangers and Supports Selection and Application

C. Appliances and materials governed by UL requirements shall meet such requirements and bear the label.

1.4 QUALITY ASSURANCE

A. Provide adequate supervision of labor force to assure that all aspects of the specifications are being fulfilled.

B. Verify that all work and equipment is installed in accordance with manufacturer's warranty requirements.

PART 2 – PRODUCTS

2.1 STEEL PIPE AND FITTINGS

A. Water Piping:

1. ASTM A53, Schedule 40.

2. Fittings up to 2 inch shall be 150 lb. malleable iron, screwed pattern ASME B16.3. Butt weld , ASME B16.9, same thickness as pipe.

3. Fittings 2-1/2" and larger shall be butt weld ASME B16.9, same thickness as pipe.

4. Weld-O-Lets and Thread-O-Lets shall be maximum of two sizes smaller than main size; i.e., maximum of a 2-inch Weld-O-Let on a 3-inch pipe.

5. Thread tape shall be teflon tape, 3 mils minimum thickness.

2.2 COPPER TUBING & FITTINGS

A. Refrigeration Piping:

1. Copper tubing: Type ACR, hard drawn temper.

2. Fitting: Wrought-copper, solder joints, ASME B16.22 or ASME B16.26.

3. Joints: Brazed, American Welding Society (AWS) Class BCUP-5 for brazing filler metal.

B. Water Piping:

1. Tubing: Hard drawn seamless ASTM B-88 Type "L" aboveground.

2. Soft seamless ASTM B-88 Type "K" below-ground.

3. Joint Material: Brazed joints, low temperature silver-bearing solder.

   a. Flux shall be non-toxic type and non-corrosive.

4. Fittings: ASME B16.15, B16.18, B16.22, or B16.26.

C. Condensate Drain Piping:

1. Pipe: Copper tubing Type DWV.
2. Fittings: Wrought copper solder type drainage fittings, ASME B16.23 or B16.29.

2.3 GROOVED END PIPE (VICTAULIC)

<u>NOTE</u>: GROOVED END PIPE SHALL BE ALLOWED IN THE BOILER ROOM AND BETWEEN THE AIR-COOLED CHILLER AND MECHANICAL ROOM.

A. All pipe shall be prepared in accordance with (ANSI/AWWA C-606). (CSA B242-M1980). (MIL-P-11087C Grooved End Pipe), or Victaulic (manufacturer's) published specifications as appropriate according to pipe materials, wall thickness, size and method of joining, as further detailed in Paragraph G: Pipe Preparation. In the event of conflict, Victaulic data shall prevail.

1. Iron Pipe Size: Pipe shall conform in size (outside diameter) to ANSI B-36.10 (API-5L) and/or to Victaulic (Manufacturer's) published outside diameter tolerances.

    a. Steel Pipe (CSI-15061): Steel pipe shall be black, conforming to ASTM A-53, Grade B, 3/4 - 1-1/2" (20-40 mm) Type F and 2 - 24" (50-600mm) Type E or S or hot-dip galvanized.

B. Couplings shall consist of two ductile iron cast housings, a synthetic rubber gasket of a central cavity pressure-responsive design, with nuts, bolts, locking toggle or lugs to secure unit together.

1. Coupling Housings: Shall be cast of ductile iron conforming to ASTM A-536 (Grade 65-45-12) enamel coated, hot dip galvanized to ASTM A-153 or zinc electroplated to ASTM B-633, as manufactured by Victaulic Company of America. Refer to Victaulic product specifications for other materials.

    a. Coatings: Shall consist of an enamel paint or hot dip galvanizing to ASTM A-153, or zinc electroplating to ASTM B-633 as specified.

2. Couplings for End Steel Pipe: Shall be Victaulic couplings for grooved and steel pipe prepared under "Grooved End Pipe". Couplings shall comply with ASTM F1476 Standard Specification for the Performance of Gasketed Mechanical Couplings for Use In Piping Applications.

    a. Sizes 2” through 12”: Coupling housings cast with offsetting, angle pattern bolt pads shall be used to provide system rigidity and support and hanging in accordance with ANSI B31.1 and B31.9.

        (1) Victaulic Style 107N, Installation-Ready, for direct stab installation without field disassembly, with grade EHP gasket, suitable for water service to +250 deg F.

    b. Flexible Type: For use in locations where vibration attenuation and stress relief are required, thermal expansion and contraction, in riser piping, and for elimination of flexible connectors. Victaulic Installation-Ready Style 177N or Style 77.

    c. 14” and Larger: AGS Series, with lead-in chamfer on housing key and wide width FlushSeal gasket. Victaulic Style W07 (rigid) with Coupling housing key designed to fill the wedge shaped AGS groove and provide system rigidity, and Style W77 (flexible).

    d. Reducing Joints: Shall be Victaulic Style 750 Reducing couplings for pipe to pipe joints or to create reducing fittings using straight fitting configurations.

    e. Outlets: All joints designed Outlet Couplings or where feasible to replace reducing outlet tees, shall be Victaulic Style 72 Outlet couplings male threaded outlet.

    f. Flanged Connections: Shall be Victaulic Style 741 /W741 (2 - 24") Vic-Flange adapters, engaging directly into grooved pipe and bolting directly to ANSI Class 125 cast iron or Class 150 steel flanged components.

C. Couplings for Grooved End Ductile Iron Pipe: Shall be Victaulic couplings for radius cut grooved ductile iron pipe preparation.

1. Line and Fittings Joints: Shall be Victaulic Style 31 couplings.

2. Flanged Connections: Shall be Victaulic Style 341 (4-24") (100-600mm) Vic-Flange adapters, engaging directly into grooved end pipe and bolting directly to ANSI Class 125 cast iron or Class 150 steel flanged components. Installer to supply standard flange bolts.

3. For direct connection to IPS steel pipe sizes, couplings shall be Victaulic Style 307 transition couplings.

D. Coupling Components:

1. Gaskets shall be molded of synthetic rubber in a central cavity, pressure-responsive configuration conforming to the pipe outside diameter and couplings housing, of elastomers having properties as designated in ASTM D-2000. Reference always shall be made to the latest published selection guide for Victaulic gaskets for proper gasket selection for the intended service.

    a. Water Service: Gasket supplied for water services from -30 deg. F to +230 deg F (-34 deg. C to +110 deg. C) shall be a Grade "E" EPDM compound, with green color code, molded of materials conforming to ASTM D-2000, designation 2CA615A25B24F172, recommended for hot water service within the specified temperature range, plus a variety of dilute acids, oil-free air, and many chemical services. Not recommended for petroleum services.

2. Bolts and Nuts shall be heat treated carbon steel, track head, conforming to physical properties of ASTM A-449 and A-183 minimum tensile 110,000 psi, zinc electroplated to ASTM B-633, as supplied or specified.

    a. Other Fasteners: Fasteners to certain products may vary from the specification as noted with each product.

E. Fittings: Shall be Victaulic full flow cast fittings, steel fittings or segmentally welded fittings with grooves or shoulders designed to accept Victaulic grooved end couplings and AGS couplings 14” through 24”.

1. Standard Fittings: Shall be cast of ductile iron conforming to ASTM A-536 (Grade 65-45-12) painted with enamel or hot dip galvanized to ASTM A-153 or zinc electroplated to ASTM B-633 as required.

2. Standard Steel Fittings: Including large size elbows (16-24"/400-600mm) shall be forged steel conforming to ASTM A-234 Grade WPB (0.375" wall), painted with enamel or hot-dip galvanized to ASTM A-153.

3. Standard Segmentally Welded Fittings: Shall be factory-fabricated of Schedule 40 carbon steel pipe as follows: 3/4 - 1-1/2" (20-40mm) conforming to ASTM A-53 Type F, 2 - 10" (50 - 250mm) Schedule 40 conforming to ASTM A-53, Type E or S, Grade B, 12 - 24" (300 - 600mm) 0.375" wall conforming to ASTM A-53, Type E or S, Grade B, painted with enamel or hot-dip galvanized to ASTM A-153.

F. Branch outlets for hole cut steel pipe: Shall be Victaulic hole cut products, cast of materials as in Paragraph 4a, with gasket as detailed in Paragraph 3c, on pipe preparation in Paragraph G.

G. Gauge, Meter Outlets for Hole Cut Steel Pipe: Shall be Victaulic strapless mechanical outlet products Style 923 Vic-Let, or 924 Vic-O-Well and shall provide a pipe outlet without a need for a strap or lower housing to wrap around the pipe.

H. Pipe Preparation: Shall be prepared in accordance with the latest published Victaulic specifications, ANSI/AWWA C-606, CSA B-242, UL, FM, NFPA or other standards as applicable. Pressure ratings and end loads for cut grooved pipe are based upon tests on pipe prepared in accordance with Victaulic specifications.

I. Steel Pipe: Shall be steel pipe conforming to ASTM A-53 Grade "B", 1-1/2" (25-40 mm) Type F, 2-14" (50 - 600 mm) Type E or S.

1. Grooved End Pipe: Shall be grooved in accordance with Victaulic Standard Specifications.

    a. Standard Weight Pipe shall be roll grooved or square cut grooved.

J. Assembly: Couplings, fittings, valves and pipe shall be assembled in accordance with latest published instructions from Victaulic Company of America for the particular product installed.

1. Pipe: Shall be checked to be certain it is sufficiently free of indentations, projections, grooves, weld seams, or roll marks on the exterior of the pipe over the entire gasket seating area to assure a leak-tight seat

for the gasket, that pipe ends are square cut and that preparation is in accordance with Victaulic pipe preparation standards.

2. Gasket: All gaskets shall be of the central cavity pressure-responsive design. Gasket style and elastomeric material (grade) shall be checked to be certain gasket supplied is suited for the intended service.

3. Lubrication shall always be used for proper coupling/fitting assembly as follows:

   a. Thorough lubrication of the gasket exterior including the lips and/or pipe ends and housing interiors, is essential to prevent pinching the gasket. Lubrication assists proper gasket seating and alignment during installation.

   b. Use Victaulic Lubricant for installation. Other compatible materials such as silicone and others may be used; however, petroleum-based lubricants must not be used on Grade "E" or "M" gaskets.

   c. A thin coat of Victaulic lubricant shall be applied by brush or by hand by: 1) brushing on the gasket lips (ID) and the entire exterior of the gasket; 2) brushing lubricant on the pipe ends around the entire pipe circumference and inside the coupling housing.

4. The coupling manufacturer's factory trained representative shall provide on-site training for the contractor's field personnel in the use of grooving tools. installation of product and visual inspection of properly installed couplings. The representative shall periodically visit the job site to ensure best practices in grooved product installation are being followed. (A distributor's representative is not considered qualified to conduct the training.)

K. Support:

1. The requirements of MSS-SP-69 "Pipe Hangers and Supports"- Selection and Application: shall, in general, govern the installation of hangers and supports, in accordance with the following recommendations:

   a. Piping joined with grooved type couplings, like all other piping systems, requires support to carry the weight of pipes and equipment. Like all other methods of jointing pipes, the support or hanging method must be such as to eliminate undue stresses on joints, piping and other components. Additionally, the method of support must be such as to allow movement of pipes where required and to provide for other special requirements such as drainage, etc., as may be required by the designer. The support system for mechanical grooved type pipe couplings must consider some of the special requirements of these couplings.

OR

2.3 GROOVED END PIPE

A. Couplings, fittings, valves and other grooved components may be used as a proprietary piping method, or listed as an option to welding, threaded or flanged piping methods.

B. Grooved Piping products shall comply with ISO 9001 Certified standards. Grooved piping installation shall meet ANSI B-31.1 – ANSI B-31.9 standards for horizontal and vertical pipe support design criteria. Grooved products shall meet national and local piping and/or building codes. Grooved products shall conform to ASTM, ANSI Standards, and other applicable Product Piping standard. All mechanical commercial and industrial piping products shall have a minimum 300 psi working pressure with 3 to 1 or greater safety working pressure.

C. Couplings and grooved flange adapters shall conform to ASTM A-536 Ductile Grade 65-45-12 or to ASTM A-47 malleable grade 32510. Coupling track head bolts shall conform to ASTM A-183 Grade 2. Hex nuts shall conform to ASTM A-563 Grade A. Bolts and nuts are zinc electroplated. Fittings shall conform to cast ductile ASTM A-536 or cast malleable ASTM A-47. Forged steel fittings shall conform to ASTM A-234 or A-106 Gr

B. Segmental welded fittings shall conform to ASTM A-53. Coatings shall be standard (orange) Alkyd-enamel rust inhibiting lead-free paint. Hot dipped galvanized fittings shall conform to ASTM A-153. Standard coupling gaskets for building services shall be Grade "E" EPDM conforming to ASTM D-2000 with operating temperature range from -30°F to +230°F.

D. Coupling gaskets shall be lubricated with approved lubricant as provided by the piping system manufacturer. "Extreme Temperature Lubricant" shall be used for all systems below minus 20°F, and above 180°F and systems subject to continuous cycle temperature.

E. Black steel pipe conforming to ASTM A-53, Grade A or B, Standard Schedule 40 may be roll or cut grooved. Grooving must conform to Manufacturer's Standards.

1. Manufacturer's Standard (rigid) couplings shall be used including flange adapters. Manufacturer's Standard (flexible) couplings may be used for vibration attenuation and noise suppression at equipment locations.

   a. Optional: Combination rigid, flexible and outlet couplings may be used for complete systems to aid in providing vibration, noise suppression and seismic tremor. Clamp type couplings may be used for branch outlets. Grade "E" EPDM gaskets. Flexible or other style couplings designed for axial motion or other movements must be engineered and supported in strict accordance with factory recommendations.

2. Transition flange adapter from flange to groove shall conform to ANSI class125 or 150 lb. bolt pattern. Sizes 2" – 20" 300 psig. Sizes 24" 250 psig. Style 7013 2" – 12" available for ANSI Class 250/or 300 lb. bolt pattern. 750 psig. Flanges are designed with internal anti-rotation "tangs" designated as a rigid connection 2" – 12". Series 7012 flange adapters require sealing rings when used with certain flanged products.

3. Fittings shall be cast ductile, malleable, forged steel, and/or segmentally welded steel fittings. Cast ductile conforms to ASTM A-536 or ASTM A-47. Forged steel conforms to ASTM A-234. Segmentally welded conforms to ASTM A-53. Fittings shall be coated with an Alkyd-enamel non-toxic paint. Zinc electroplated fittings conform to ASTM B-633. Hot dip galvanized fittings conform to ASTM A-153. Standard Fittings are Schedule 40 or standard wall. Other fittings are schedule 80 or lightwall as specified.

4. Grooved x grooved or grooved x thread insulating nipples. Inhibits the formation of a galvanic cell between dissimilar metals. Housing: Steel Tube to ASTM A513. Liner: Polypropylene to ASTM D4140. Operating temperature -40°F to +230°F. Size range is 2" – 6" diameter.

5. Branch outlets shall be Clamp T Branch and Clamp T Cross with grooved or threaded outlets. Sizes 2" – 8". Branch outlets from ½" – 4" diameter. Designated as a bolted-on positive pipe engagement branch outlet. Working pressure to 500 psi.

6. Outlet couplings shall have grooved or threaded outlets. Run sizes 1-1/2" – 6". Branch outlets from ½" – 2" diameter. Working pressure to 500 psig.

7. Plain end couplings and fittings shall be Manufacturer Standard coupling and plain-end fittings to match. Size range is 2" – 8" diameter. Materials conform to ASTM A-536 and A-47. Fittings are cast or forged steel. Intended for working pressures 300 – 750 psig with factory recommended torque requirement on plain-end standard wall pipe. Fittings match coupling working pressure.

8. Plain end method shall be Manufacturer's Standard fitting. Size range is 1" – 2" diameter. Material conforms to ASTM A-126 Class A cast iron. Working pressures from 175-300 psi UL/ULC listed FM approved.

F. Gaskets shall be Grade "E" EPDM pressure responsive design for all water and non-oily air service. EPDM gaskets are color-coded green. Material conformance to grooved industrial standards ASTM D-2000,

designation 2CA615A25B24F17Z. Temperature operating range minus 30° to +230°F. Non-toxic lubricant must be used to insure non-pinching of gaskets during product installation. "Extreme Temperature Lubricant" must be used for all system installations, below -20°F, installations above 180°F and installations that are subject to temperature cycles.

G. Standard products shall be furnished with alkyd enamel, rust inhibiting non-toxic paint. Galvanized material conforms to ASTM A-153. Bolts and nuts are zinc electroplated to ASTM A-164.

H. Couplings shall be furnished with heat treated, oval neck track head bolts conforming to ASTM A-183 Grade 2. Bolts meet minimum tensile strength of 110,000 psi. Hex nuts are carbon steel conforming to ASTM A1-563 Grade A. Bolts and nuts are electroplated.

I. Assembly: Couplings, fittings, valves and pipe shall be assembled in accordance with latest published instructions from the piping system manufacturer for the particular product installed.

1. Pipe: Shall be checked to be certain it is sufficiently free of indentations, projections, grooves, weld seams, or roll marks on the exterior of the pipe over the entire gasket seating area to assure a leak-tight seat for the gasket, that pipe ends are square cut and that preparation is in accordance with pipe manufacturer's preparation standards.

2. Gasket: All gaskets shall be of the central cavity pressure responsive design. Gasket style and elastomeric material (grade) shall be checked to be certain gasket supplied is suited for the intended service.

3. Lubrication shall always be used for proper coupling/fitting assembly as follows:

a. Thorough lubrication of the gasket exterior including the lips and/or pipe ends and housing interiors, is essential to prevent pinching the gasket. Lubrication assists proper gasket seating and alignment during installation.

b. Use manufacturer's lubricant for installation. Other compatible materials such as silicone and others may be used; however, petroleum-based lubricants must not be used on Grade "E" or "M" gaskets.

c. A thin coat of lubricant shall be applied by brush or by hand by: 1) brushing on the gasket lips (ID) and the entire exterior of the gasket; 2) brushing lubricant on the pipe ends around the entire pipe circumference and inside the coupling housing.

J. Support:

1. The requirements of MSS-SP-69 "Pipe Hangers and Supports"- Selection and Application: shall, in general, govern the installation of hangers and supports, in accordance with the following recommendations:

a. Piping joined with grooved type couplings, like all other piping systems, requires support to carry the weight of pipes and equipment. Like all other methods of jointing pipes, the support or hanging method must be such as to eliminate undue stresses on joints, piping and other components. Additionally, the method of support must be such as to allow movement of pipes where required and to provide for other special requirements such as drainage, etc., as may be required by the designer. The support system for mechanical grooved type pipe couplings must consider some of the special requirements of these couplings.

K. Manufacturers: Anvil Gruvlok or Tyco Grinnell.

2.4 STRAINERS (WATER)

A. Perforations: .033" pipe size to 2", .057" pipe size 2-1/2" to 4", 1/8" pipe size 6" and up.

B. Self-cleaning "Y" type screwed end up to 2 inch with machined seats with blow-off outlet, stainless steel screen, iron body.

C. Self-cleaning "Y" type flanged 2-1/2 inch and up, with bolted cover flange, blow-off outlet, 125 psi ANSI, brass screen.

D. Manufacturer: Muesco, Sarco, Hoffman Specialties, Metraflex, Armstrong, Watson McDaniel.

2.5 THERMOMETERS

A. Separable socket, inserted into fluid flow, adjustable, hermetically sealed, red or blue indicating fluid, non-toxic, die-cast, baked enamel finish, double strength glass lens, white scale and black graduations.

B. Scale: Heating Water - 30 deg. to 240 deg. F
Chilled Water - 0 deg. to 100 deg. F
Dual Temperature Water – 30 deg. to 240 deg. F.

C. Manufacturer: U.S. Gauge, H.O. Trerice, Moeller, Duro, Miljoco Corp., Winter Instruments.

2.6 GAUGES

A. Phosphor bronze bourdon tube, polypropylene case, gasketed glass crystal, aluminum dial, black graduations 4-1/2 inch diameter.

B. Range: 0 to 60 psi, 5-pound intervals, 1/2-pound graduations.

C. Install with bronze gauge cock.

D. Manufacturers: Danton, U.S. Gauge, H.O. Trerice, Moeller, Miljoco Corp., Winter Instruments, Weksler Instruments.

2.7 TEST STATIONS – PRESSURE/TEMPERATURE

A. Provide a SISCO 1/4" or 1/2" NPT fitting (Test Plug) of solid brass at desired indicated locations. Test plug shall be capable of receiving either a pressure or temperature probe 1/8" o.d. Dual seal core shall be neoprene for temperature to 200 degrees F. Nordel to 350 degrees F and shall be rated zero leakage from vacuum to 1000 psig. P/T plug to have grooved cap and chain.

B. P/T plugs shall be provided with extensions as required by insulation.

C. Mechanical Contractor shall also provide the following: pressure gauge adapters with 1/8" o.d. probe, 5" stem pocket testing thermometers for 25° to 125° F (tower and chilled water) for 0° to 220° F (hot water) for 50° - 500° F (temperatures above 220° F).

D. One (1) Master Test Kit shall be furnished to the Owners. Kit shall contain one (1) 2-1/2" test gauge of suitable range, one (1) Gauge Adapter 1/8" o.d. probe, and 5" stem pocket testing thermometers - one (1) 0° - 220° F and one (1) 50° - 550° F.

E. Manufacturer: Sisco P/T Plugs.

2.8 ISOLATING FITTINGS

A. Provide isolating fittings between all sections of dissimilar piping materials or piping and equipment where one material is ferrous and the other is non-ferrous.

B. Manufacturer: Epco Sales, Inc., or insulated unions by Central Plastic Co.

2.9 PIPE SADDLES

A. Steel pipe saddles shall be welded to all black ferrous pipe, 2-1/2" pipe size and larger, at hanger locations, for systems of hot water and other heat conveying systems.

B. Steel pipe saddles shall be welded to all black ferrous hot piping at the pipe support location when roll type hangers or pipe roll supports are employed.

C. The saddles shall be packed with plastic insulating cement, and the saddle shall finish flush with the surface of the specified insulation.

2.10 ANCHORS AND GUIDES

A. Anchors and guides shall be provided to support and maintain pipes in position and properly distribute expansion. The anchors and guides must be securely fastened to the building structure, and must be completely installed before the system is tested.

B. Factory made cast semi-steel or fabricated steel, consisting of a bolted two-section outer cylinder and base with two-section guiding spider bolted or welded tight to the pipe.

C. Guide and spider shall be of sufficient size to clear pipe insulation and long enough to prevent over travel of spider and cylinder. Guides shall not be used as pipe supports.

D. Guides shall be as manufactured by J.J. McNally, Inc., Flexonics, Inc., Metraflex, Hyspan, Twin City Hose, Inc.

2.11 FLEXIBLE EXPANSION LOOP (MANUFACTURED)

A. Provide flexible expansion loops of size and type noted on drawings.

B. Flexible expansion loops shall consist of two (2) flexible sections of hose and braid, two 90° elbows, and a 180° return assembled in such a way that the piping does not change direction, but maintains its course along with a single axis.

C. Flexible expansion loops shall have a factory supplied, center support nut located at the bottom of the 180° return, and a drain/air release plug.

D. Flexible expansion loops shall impart no thrust loads to system support anchors or building structure. Loops shall be installed in a neutral, pre-compressed or pre-extended condition as required for the application. Install and guide per manufacturer's recommendations.

E. Materials of construction and end fitting type shall be consistent with pipe material and equipment/pipe connection fittings.

F. Manufacturers: Metraflex Company, Metraloop.

OR

A. Provide flexible expansion loops of size and type noted on drawings.

B. Construction shall be three (3) equal length sections of annular corrugated 321 stainless steel close-pitch hose with stainless steel overbraid which will absorb or compensate for pipe movements in all six degrees of freedom (three coordinate axes, plus rotation about those axes) simultaneously.

C. The corrugated metal hose, braid(s), and a stainless-steel ring-ferrule/band (material gauge not less than .048") must be integrally seal-welded using a 100% circumferential, full-penetration TIG weld. End fittings shall be flat-face plate steel flanges with 150# ANSI drilling and outside diameter. Fittings must be attached using a 100% circumferential TIG weld.

D. Braided stainless steel loops must be suitable for operating temperatures up to 850°F, must be designed for pressure testing to 1.5 times their maximum rated working pressure and a minimum 4:1 (burst to working) safety factor.

E. Each braided stainless steel loop shall be individually leak tested by the manufacturer using air-under-water or hydrostatic pressure. Loops shall be prepared for shipment using a cut-to-length metal shipping bar, tacked securely between the elbows of the two parallel legs, to maintain the manufactured length during shipping. Shipping bar must be removed prior to system start up.

F. Braided loops will be covered by three (3) year full replacement warranty when installed in accordance with all specifications and installation instructions as described in the manufacturer's Installation and Maintenance Instructions.

G. End fittings shall be consistent with pipe material and equipment/pipe connection fittings.

H. Manufacturers: Flex Hose Co. Tri-Flex Loop.

2.12 UNIONS

A. Up to and including 2-inch pipe size: Screwed pattern, bronze-to- bronze seat.

B. Above 2-inch pipe size: Flanged pattern, A.S.A. forged steel, with gaskets, bolts and nuts.

C. Copper tubing unions shall have sweated type ends. Flanged unions on copper tubing may be soldered connections.

D. Materials and pressure ratings shall be the same as specified for the respective pipe and fitting system unless otherwise specified.

2.13 MOTORS

A. All single phase and polyphase motors shall be manufactured to incorporate the latest NEMA standards.

B. All single phase and polyphase motors shall have steel frames with ball bearings and copper windings. All motors to have a Class "F" insulation system with a service factor of 1.15.

C. All motors shall be 1725 RPM, 4 pole design, unless otherwise noted on the drawings, or in the equipment specifications.

D. Motors installed indoors and not exposed to moisture shall be open, dripproof, Class B temperature rise based on 40 deg. C maximum ambient temperature.

E. Motors installed outdoors and exposed to moisture shall be totally enclosed, fan cooled, Class B temperature rise based on 40 deg. C maximum ambient temperature.

F. Based on NEMA Standards, motors shall comply with the following minimum nominal efficiencies at full load.

Nominal Efficiencies for "NEMA Premium ™" Induction Motors Rated 600 Volts or Less (Random Wound)						
	Open Drip-Proof			Totally Enclosed Fan-Cooled		
HP	3500 RPM	1800 RPM	1200 RPM	3500 RPM	1800 RPM	1200 RPM
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7

G. Motor Characteristics: Refer to Equipment Schedules for specific data.

277/480 Volt System: Motors 1/2HP & Larger - 480V, 3 Phase, 3 Wire
Motors Less than 1/2HP-120/277V, 1 Phase, 2 Wire.

H. All motors rated less than 1/2HP shall have thermal protection of the auto-reset type as an integral part of the motor.

I. All motors rated 1/2HP and larger shall have thermal protection provided by an external device.

J. Whenever a variable frequency PWM drive is installed to control an AC motor, a maintenance-free, circumferential, conductive micro fiber shaft grounding ring shall be installed on the AC motor drive end to discharge shaft currents to ground. Recommended part: AEGIS SGR™ Bearing Protection Ring, as made by Electro Static Technology. Install in accordance with the manufacturer's written instructions.

PART 3 – EXECUTION

3.1 PIPING SYSTEMS

A. All piping to drain to low points. Low points shall be provided with drain valves with hose thread.

B. All piping shall be arranged to have air vents at high points.

1. Air vents shall be automatic in operation when located in Mechanical Equipment Rooms. All air vents shall be provided with a PVC drain line which shall be routed to the nearest floor drain. Several air vents may be tied together.

2. Air vents shall be manual in operation in all other locations.

C. Do not install trapped lines where water cannot be drained or air can accumulate without being vented.

D. Piping shall run square with building lines.

E. Piping shall not be insulated or covered until tested and until building is enclosed.

F. Necessary drains, off-sets, vents and drips shall be provided for coordination of the work as part of the contract.

G. Running or close nipples are not permitted.

H. Piping shall not be installed over electrical transformers, panels, switchgear, substations, and control panels. No piping shall be installed in elevator machine rooms.

I. Exposed insulated piping risers in unfinished spaces shall be covered with 22-gauge galvanized steel sleeves from floor to ceiling. Refer to Section: Insulation & Covering – HVAC for additional requirements.

J. Allow clearance for expansion and contraction.

K. Install eccentric piping fittings where change in sizes occurs in piping systems. Tops of pipes shall remain level for hydronic systems.

L. Install isolating fittings between sections of ferrous and non-ferrous pipe or connected equipment.

M. Do not support piping from other piping, conduits or equipment.

N. Strainers shall be installed on suction of all pumps, inlets of control valves, and where indicated on drawings.

O. Thermometers and gauges shall be installed where indicated on the drawings, required by equipment specifications and where indicated elsewhere in the specifications.

P. Flexible connectors shall be provided on suction and discharge piping of all base mounted pumps.

Q. Unions shall be provided adjacent to all valves, at equipment connections, and where necessary to facilitate dismantling of the piping system.

R. Install expansion loops, anchors and guides in piping systems as shown on the drawings and in accordance with manufacturer's written instructions.

1. Remove all shipping blocks, stays, setscrews, etc., from all loops and moment guides. Pipe centerlines shall be aligned.

2. During initial system pressurization, all pipe guides and anchors must be secure and functioning.

S. Material Requirements for Systems:

1. Heating Hot Water Supply & Return Piping:

a. Schedule 40 black steel.
b. Type L hard copper.
c. Grooved End black steel (Only permitted in Mechanical Room)

2. Chilled Water Supply & Return Piping:

a. Schedule 40 black steel.
b. Type L hard copper.
c. Grooved End black steel (Only permitted in Mechanical Room)

3. Make-up Water: Type L hard copper.

4. Dual Temperature Water Supply & Return Piping:

a. Schedule 40 black steel.
b. Type L hard copper.
c. Grooved End black steel (Only permitted in Mechanical Room .)

5. AC Condensate Drain (including pumped condensate):

   a. Type DWV copper.

6. Refrigerant Piping: Type ACR hard copper.

3.2 TAGS, CHARTS AND IDENTIFICATION

A. See Paragraph "Labeling" in GENERAL PROVISIONS for equipment labeling.

B. Identify each valve in all systems with black, numbered and stamped 1- 1/2" brass or aluminum tags fastened to valve by brass chain and S-hook.

C. Provide 1/8" scale diagrams showing location, number and service or function of each tagged item.

1. Frame diagrams in approved metal frames with clear acrylic front, hinges, and locks.

2. Secure to wall in Mechanical Room.

3. Provide two additional separate copies permanently covered and bound.

   a. Include one (1) copy in the Operation and Maintenance Manuals.

D. Piping Identification: Identify piping with Seton "Setmark" or Brimar, semi-rigid plastic, wraparound pipe markers with flow arrows and conforming to ANSI A13.1. Locate marker at each valve, changes in direction, where pipes pass thru barriers and every 25' of horizontal runs. Lettering on background shall be in accordance with the following colors:

Legend		Background	Lettering
1.	Chilled Water Supply	- Green	- White
2.	Chilled Water Return	- Green	- White
3.	Gas	- Yellow	- Black
4.	Heating Water Supply	- Yellow	- Black
5.	Heating Water Return	- Yellow	- Black
6.	Dual Temperature Water Supply	- Yellow	- Black
7.	Dual Temperature Water Return	- Yellow	- Black
8.	Refrigerant Liquid	- Yellow	- Black
9.	Refrigerant Gas	- Yellow	- Black
10.	Cold Water Make-up	- Green	- White
11.	Vent	- Yellow	- Black

E.Provide color coded 1” diameter markers on ceiling tile grids to indicate system and valve locations.

Chilled Water: - Blue
Hot Water: - Red
Dual Temperature Water: - Red

F. Manufacturers: Seton “Setmark”, Brimar, B-Line MSI.

3.3 WELDING

A. All concealed and inaccessible black steel piping shall be welded.

B. All black steel piping larger than 1-1/4 inch may be fusion welded.

C. All elbows, tees and branch connections shall be made with welding fittings ANSI B16.9.

D. Welding shall be in accordance with the ASME Boiler and Pressure Vessel Code Section IX.

E. Furnish welder test certificate for review. Certificates of successful qualification by the following organizations shall be acceptable.

1. ASME Boiler and Pressure Vessel Code
2. ANSI Code for Pressure Piping
3. National Certified Pipe Welding Bureau
4. Military Specification MIL-STD-248

3.4 SOLDERING/BRAZING

A. Connections between copper tubing and copper fittings shall be made with the appropriate filler metal. Flux shall be non-corrosive type as recommended by the manufacturer of the filler metal, and conforming to AWS A5.8.

B. Tubing shall be cut square and then reamed and deburred. End of tubing and inside of fitting cup shall be cleaned with steel wool and the flux shall be applied to the clean surface before joining. After joining, the excess filler metal shall be wiped off while still plastic.

C. Silver brazing alloy shall be equal to Easy-Flo by Handy and Harmon or Sta-Brite silver solder and shall be used for joints in:

1. Hot water heating piping
2. Chilled water piping
3. Air conditioning condensate drain piping
4. Dual temperature water piping
5. Cold water fill and make-up piping

D. Where the silver brazing is performed in a confined non-ventilated space, a non-toxic, cadmium-free brazing alloy such as braze 560 by Handy & Harman shall be used.

E. Refrigerant piping shall be silver brazed using Harris Sil-Fos 15 or equivalent, with nitrogen purge.

F. Bring joint to solder temperature or brazing temperature in as short a time as possible.

G. Form continuous solder bead or brazing filler bead around entire circumference of joint.

H. Wipe excess solder from joint area while solder is still plastic.

END OF SECTION 23 02 10

SECTION 23 02 15
VALVES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions.

C. Refer to other sections in Division 23 for materials and methods not specified herein.

1.2 DESCRIPTION OF WORK

A. This Section includes the following:

1. General
2. Chilled Water Systems
3. Hot Water Heating System and Dual Temperature System
4. Refrigerant Valves and Specialties
5. Grooved End Specialties

1.3 QUALITY ASSURANCE

A. Provide adequate supervision of labor force to assure that all aspects of the specifications are being fulfilled.

B. Verify that all work and equipment is installed in accordance with manufacturer's warranty requirements.

PART 2 – PRODUCTS

2.1 GENERAL

A. All gate and globe valves shall be designed for repacking under pressure when fully opened, and shall be equipped with packing suitable for the intended service. When the valve is fully opened, the back seat shall protect the packing and the stem threads from the fluid. All gate and globe valves shall have a gland follower. The pressure- temperature rating of valves shall be not less than the design criteria applicable to all components of the system.

B. Insofar as possible, all valves of the same type shall be of the same manufacture.

C. Valves installed above 7 ft. in Mechanical Rooms shall have chain operators.

D. All valves shall be provided with stem extensions. Valve handle shall be clear of insulation jacket.

E. Manufacturers:

Stockham
Milwaukee
Hammond
Apollo
Watts
Walworth
Nibco

Jamesbury

2.2 CHILLED WATER SYSTEMS

A. Gate Valves - 2" and smaller:

Valves 2" and smaller shall be of Class 125, body and bonnet shall be of ASTM-B-62 cast bronze composition, threaded or solder ends, solid disc, copper-silicon alloy stem, brass packing gland, Teflon-impregnated packing and malleable handwheel.

Recommended Valves:

Threaded:		Solder:
Stockham B-100 (RS)		Stockham B-108 (RS)
or	or	
Stockham B-103 (NRS)		Stockham B-104 (NRS)

	RS	NRS		RS	NRS
Hammond	IB690	IB609	Nibco	S111	S113
Milwaukee	148	105	Hammond	IB691	IB613

B. Gate Valves - 2-1/2" and Larger:

Valves 2-1/2" and larger shall be Class 125 iron body, bronze mounted, with body and bonnet conforming to ASTM A-126 Class B cast iron, flanged ends with Teflon-impregnated packing and two-piece packing gland assembly.

Recommended valves:

Stockham G-623 OS&Y RS
Stockham G-612 NRS

	OS&Y	NRS
Hammond	IR1140	---
Nibco	F617-0	F639-31

C. Ball Valves - 3" and Smaller:

Valves 3" and smaller shall be 600 psi CWP, have cast brass bodies, replaceable reinforced Teflon seats, conventional port, blowout proof stems, chrome plated brass ball, and threaded or solder ends. Provide extended valve handle to accommodate up to 2” of insulation with non-thermal conductive material, insulation plug, cap and protective sleeve.

Recommended valves:

Threaded:	Solder:
Stockham S-216-BR-RT	Stockham S-216-BR-RS
NIBCO T-580-70BR	NIBCO S-580-70BR-R
Jamesbury II 1100TT	----
Apollo 70-100	Apollo 70-200
Inline 334	----

Alternative is Stockham S-217-BR-RT (threaded).

Drain valves, ½" or ¾" shall be 600 psi CWP, with stainless steel trim, cast bronze body, 2-piece with cap and chain, full port stainless steel ball and stem, RTFE ball seat, threaded or soldered inlet connection, cap rated for 150 psi.

Recommended valve:

Stockham S-285-BR-R-66-HC.

D. Globe Valves - 2" and Smaller:

Valves 2" and smaller shall be of Class 125, body and bonnet of ASTM B-62 cast bronze composition, threaded or soldered ends, copper silicon alloy stem, brass packing gland, Teflon-impregnated packing, and malleable handwheel.

Recommended valves:

Threaded:	Solder:
Stockham B-13T (Teflon Disc)	Stockham B-14T (Teflon Disc)
Stockham B-16 (Bronze Disc)	Stockham B-17 (Bronze Disc)
Nibco T211B	Jenkins 1200
Hammond IB440	Nibco S211Y

E. Globe Valves - 2-1/2" and Larger:

Valves 2-1/2" and larger shall be Class 125 iron body, bronze mounted with body and bonnet conforming to ASTM A-126 Class B cast iron, flanged ends, with Teflon-impregnated packing and two-piece packing gland assembly.

Recommended valves:

Stockham G-512 (Bronze disc)
Stockham G-514T (Teflon disc)

Bronze Disc:	Comp. Disc.:
Hammond IR116	---
Nibco F718B	---

F. Butterfly Valves - 2-1/2" and Larger: (Chilled Water)

Valves 2-1/2" and larger shall be high performance, bubble-tight, lug-wafer type body or grooved-end, 200 psi CWP, conforming to ASTM A-126 Class B cast iron, drilled and tapped, field replaceable EPDM sleeve, with ductile nickel-plated disc, 410 stainless steel stem, and EPDM O-ring stem seals. Sizes 2 - 6" shall be lever operated and 8 - 24" shall have gear operators.

Recommended valves:

Stockham LG-712-DS3-E Lever operated
Stockham LG-722-DS3-E Gear operated
Victaulic 300 Masterseal and AGS VIC300-grooved-end

Lever:	Gear:
Demco NE-150-5215351	NE-150-5215359-2097
Norris R3020-13SS-1F	R3010-13SS-2K
Keystone Fig. 129	129
Center Line Series LT	Series LT
Grinnell LC8201-1	LC8202-1

Alternative for above is Stockham LD-712-DS3-E and LD-722-DS3-E ductile iron body butterfly valves (ASTM A-395 Ductile).

NOTE: For dead end service, butterfly valves require flanges both upstream and downstream for proper shutoff and retention.

G. Check Valves - 2" and Smaller:

Valves 2" and smaller shall be of Class 125, threaded or solder ends, body and caps shall be ASTM B-62 cast bronze composition, swing type disc.

Recommended valves:

Threaded:	Solder:
Stockham B-319	Stockham B-309
Hammond IB490	IB941
Milwaukee 509	1509

If composition disc is preferred, specify Stockham B-320B - threaded end, or B-310B - solder end, for Class 125 service.

H. Check Valves - 2-1/2 and Larger:

Valves 2-1/2" and larger shall be iron body, bronze mounted with body and cap conforming to ASTM A-126 Class B cast iron, flanged or grooved ends, swing type disc.

Recommended valves:

Stockham G-931

Hammond IR1124
Milwaukee F2974
Victaulic 716, 779, or W715 – Grooved end

2.3 HOT WATER HEATING SYSTEM AND DUAL TEMPERATURE SYSTEM

A. Gate Valves - 2" and smaller:

Valves 2" and smaller shall be of Class 150 with body and union bonnet of ASTM B-62 cast bronze composition, threaded or solder ends, solid disc, copper-silicon stem, brass packing gland, Teflon-impregnated packing, and malleable handwheel.

Recommended valves:

Threaded:	Solder:
Stockham B-120 (RS)	Stockham B-124
Stockham B-130 (RS)	----
Hammond IB629	IB648
Nibco T134	S134

B. Ball Valves - 3" and smaller:

Valves 3" and smaller shall be 600 psi CWP, have cast brass bodies, replaceable reinforced Teflon seats, conventional port, blowout proof stems, chrome plated brass ball, and threaded or solder ends with extended solder cups. Provide extended valve handle to accommodate up to 2” of insulation with non-thermal conductive material, insulation plug, cap and protective sleeve.

Recommended valves:

Threaded:	Solder:
Stockham S-216-BR-RT	Stockham S-216-BR-RS
Worcester 4112 RT	---
Jamesbury II 1100TT	----
Apollo 70-100	Apollo 70-200
Nibco T580-70BR	S580-70BR-R
Inline 334	----

Drain valves, ½” or ¾”, shall be 600 psi CWP, with stainless steel trim, cast bronze body, 2-piece with cap and chain, full port stainless steel ball and stem, RTFE ball seat, threaded or soldered inlet connection, cap rated for 150 psi.

Recommended valve:

Stockham S-285-BR-R-66-HC

C. Gate Valves - 2-1/2" and larger:

Valves 2-1/2" and larger shall be Class 125 iron body, bronze mounted, with body and bonnet conforming to ASTM A-126 Class B cast iron, flanged ends, with Teflon-impregnated packing and two-piece packing gland assembly.

Recommended valves:

Stockham G-623 (OS&Y) RS
Stockham G-612 (NRS)

	OS&Y	NRS
Nibco	F618-0	F639-31
Hammond IR1140		

D. Globe Valves - 2" and smaller:

Valves 2" and smaller shall be of Class 150 with body and union bonnet of ASTM B-62 bronze, copper-silicon alloy stem, brass packing gland, Teflon-impregnated packing and malleable handwheel.

Recommended valves:

Threaded:	Solder:
Stockham B-22 (Teflon Disc)	Stockham B-24 (Teflon Disc)

Stockham B-29 (Stainless trim) ----

Comp. Disc.:	S.S. Trim:
Nibco T-235-Y	Milwaukee 591A

E. Globe Valves - 2-1/2" and Larger:

Valves 2-1/2" and larger shall be Class 125 body, bronze mounted, with body and bonnet conforming to ASTM A-126 Class B cast iron, flanged ends, with Teflon - impregnated packing and two-piece packing gland assembly.

Recommended valves:

Stockham G-512 (bronze disc)
Stockham G-514 (Teflon disc)

Hammond IR 116
Nibco F7181B

F. Butterfly Valves - 2-1/2" and Larger:

Valves 2-1/2" and larger shall be high performance, bubble-tight, lug-wafer type body or grooved-end, 200 psi CWP, conforming to ASTM A-126 Class B cast iron, drilled and tapped, replaceable EPDM sleeve, with ductile nickel-plated disc, 410 stainless steel stem, and EPDM O-ring stem seals. Sizes 2 - 6" shall have lever operators and 8 - 24" shall have gear operators.

Recommended valves:

Stockham LG-712-DS3-E	Lever operated
Stockham LG-722-DS3-E	Gear operated

Victaulic 300 Masterseal and AGS VIC300 – Grooved end

Lever:	Gear:
Demco NE-150-5215351	NE-150-5215359-2097
Norris R3010-13SS-1F	R3010-13SS-2K
Keystone Fig. 129	129
Center Line Series LT	Series LT
Grinnell LC8201-1	LC 8202-1

TREATED SYSTEM:

Recommended Valves:

Stockham LG-712-BS3-E	Lever operated
Stockham LG-722-BS3-E	Gear operated

Victaulic 300 Masterseal and AGS VIC300 – Grooved end

Alternative for above is Stockham Ductile Iron Butterfly Valves conforming to ASTM-A-395 ductile iron.

Ductile Valves:

Stockham LD-512-DS3-E or LD-512-BS3-E
(lever operated-wafer body)

Stockham LD-522-DS3-E or LD-512-BS3-E
(gear operated-wafer body)

Stockham LD-712-DS3-E or LD-712-BS3-E
(lever operated-lug body)

Stockham LD-722-DS3-E or LD-712-BS3-E
(gear operated-lug body)

Note: Butterfly valves in dead end service require both upstream and downstream flanges for proper shutoff and retention.

G. Check Valves - 2" and smaller:

Valves 2" and smaller shall be Class 150 with bodies and caps of ASTM B-62 bronze composition and threaded ends. Class 150 valves shall have lift-type Buna-N-disc and union caps, and are to be used in lines with globe valves.

Recommended valves:

Stockham B-322-B
Hammond IB948
Milwaukee 510

For backflow prevention in lines with gate valves, Y-pattern valves with swing-type disc are recommended.

For Class 150 Service, threaded ends:

Stockham B-321

H. Check Valves - 2-1/2" and Larger:

Valves 2" and larger shall be iron body, bronze mounted, with body and cap conforming to ASTM A-126 Class B cast iron, flanged or grooved ends, and swing-type disc.

Recommended valves:

Stockham G-931
Hammond IR1124
Nibco F918-B
Victaulic 716, 779, or W715 – Grooved end

2.4 REFRIGERANT VALVES & SPECIALTIES

A. Service Valves:

1. Globe Shutoff Valves: Forged brass, packed, back seating, winged seal cap, 300 degrees F (149 degrees C) temperature rating, 500 psi working pressure.

2. Check Valves: Forged brass, accessible internal parts, soft synthetic seat, fully guided brass piston and stainless-steel spring, 250 degrees F (121 degrees C) temperature rating, 500 psi working pressure.

3. Manufacturers:

   Henry Valve Co.
   Parker Hannifin Corp., Refrigeration & Air-Conditioning
   Sporlan Valve Co.

B. Solenoid Valves:

1. 2-way Solenoid Valves: Forged brass, designed to conform to ARI 760, normally closed, teflon valve seat, NEMA 1 solenoid enclosure, 24-volt, 60 Hz., UL-listed, 1/2" conduit adapter, 250 degrees F (121 degrees C) temperature rating, 400 psi working pressure.

2. Manufacturers:

   Alco Controls Div., Emerson Electric Co.
   Automatic Switch Co.
   Sporland Valve Co.

C. Specialties:

1. Refrigerant Strainers: Brass shell and end connections, brazed joints, monel screen, 100 mesh, UL listed, 350 psi working pressure.

2. Moisture-Liquid Indicators: Forged brass, single port, removable cap, polished optical glass, solder connections, UL listed, 200 degrees F (93 degrees C) temperature rating, 500 psi working pressure.

3. Refrigerant Filter-Driers: Steel shell, ceramic fired desiccant core, solder connections, UL listed, 500 psi working pressure.

4. Evaporator Pressure Regulators: Provide corrosion-resistant, spring loaded, stainless steel springs, pressure operated, evaporator pressure regulator, in size and working pressure indicated, with copper connections.

5. Refrigerant Discharge Line Mufflers: Provide discharge line mufflers as recommended by equipment manufacturer for use in service indicated, UL listed.

6. Manufacturers:

   Alco Controls Div., Emerson Electric Co.
   Henry Valve Co.
   Parker-Hannifin corp., Refrigeration & Air Conditioning Div.
   Sporlan Valve Co.

2.5 GROOVED-END SPECIALTIES

A. Strainers

1. T-Type Strainer: 2” and larger sizes, 300 PSI (2065 kPa) T-Type Strainer shall consist of ductile iron (ASTM A-536, Grade 65-45-12) or carbon steel (ASTM A-53) body, Type 304 stainless steel frame and mesh removable basket with No. 12 mesh, 2”-3” strainer sizes, or No. 6 mesh, 4”-16” strainer sizes, 57% free open area. Victaulic Style 730. For 14” through 24”, use T-Type W730 AGS with stainless steel removable basket.

2. Y-Type Strainer: 2” through 12” sizes, 300 PSI (2065 kPa) Y-TypeStrainer shall consist of ductile iron body, ASTM A-536, Grade 65-45-12, Type 304 stainless steel perforated metal removable baskets with 1/16” (1.6mm) diameter perforations and 41% open area 2”-3” strainer sizes or 1/8” (3.2mm) strainer sizes diameter perforations and 40% open area 4”-12” strainer sizes. Victaulic Style 732.

B. Suction Diffuser – Grooved/Flanged End. Rated to 300 psi (2065kPa). Ductile iron (ASTM A-536) body. 304 stainless steel frame and perforated sheet diffuser with 5/32” (4.0mm) diameter holes 3”-12” inlet sizes or 3/16” (4.8mm) diameter holes 14” and 16” inlet sizes. Removable 20 mesh 304 stainless steel start-up prefilter, outlets for pressure/temperature drain connections, and base supports boss. Victaulic Series 731-G. For sizes 14” thorugh 24”, use W731G AGS.

PART 3 – EXECUTION

3.1 PIPING SYSTEMS

A. All piping to drain to low points. Low points shall be provided with drain valves with hose thread.

B. Valve body construction shall match piping system material.

C. Install isolating fittings between sections of ferrous and non-ferrous pipe or connected equipment.

D. Valves shall be installed with stems above horizontal.

E. Valves shall be installed on all sides of equipment and control valves to allow isolation for repair.

F. Unions shall be provided adjacent to all valves, at equipment connections, and where necessary to facilitate dismantling of the piping system.

3.2 TAGS, CHARTS AND IDENTIFICATION

A. Identify each valve in all systems in accordance with requirements of Section 230210.

END OF SECTION 23 02 15

SECTION 23 02 30
INSULATION & COVERING – HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the contract, including the conditions of the contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions

C. Refer to Section 230210 for HVAC Basic Materials & Methods.

1.2 DESCRIPTION OF WORK

A. This Section includes insulation and covering provided on the following piping and equipment:

1. Cold Water Make-Up Piping
2. Hot Water Heating Piping
3. Chilled Water Piping
4. Condensate Drain Lines
5. Dual temperature water piping.
6. Refrigerant Piping.
7. Cold Equipment Surface
8. Hot equipment surfaces.
9. Exterior Piping
10. Acoustic Duct Liner
11. Reusable Valve Covers
12. Insulated Pipe Saddles

B. Insulation shall be installed on the following duct systems:

1. All supply ductwork.
2. All return ductwork.
3. All outside air intake and relief ductwork.
4. All ductwork connected to energy recovery units.

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

1.4 QUALITY ASSURANCE

A. Refer to Section 230210 for a general description of requirements applying to this section.

B. Install insulation in accordance with manufacturer's recommendations.

C. Provide adequate supervision of labor force to assure that all aspects of the specifications are being fulfilled.

1.5 SUBMITTALS

A. Submit shop drawings, installation instructions, and manufacturer's literature of all materials specified in accordance with Section 230200.

B. Submit fabrication instructions for pipe fitting and valve insulation.

C. Submit manufacturer's joining recommendations for butt joints and longitudinal seams.

1.6 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, General Requirements.

PART 2 – PRODUCTS

2.1 PIPE INSULATION MATERIAL

A. Fiberglass:

1. Material: Preformed fiberglass bonded with resin to form circular pipe sleeves with factory applied, white all service jacket bonded to reinforced foil vapor barrier jacketing. The jacket shall have factory applied double pressure-sensitive, self-sealing, adhesive closure and vapor sealing of longitudinal joints. Thermal conductivity: 0.24 Btu/Hr./SF/inch at 100 degrees F. Flame spread of 25 and developed smoke of 50 or less.

2. All Valves and Fittings:

a. Glass fiber insert and pre-molded PVC cover, Johns Manville Corp. "Zeston" and "Hi-Lo Temp Inserts" for fittings. Glass fiber or prefabricated elastomeric foam fittings must fill the entire space within the cover completely.

b. Factory molded fibrous glass fitting covering for fittings. Coat ends with Fosters 30-36 lagfast adhesive

c. Mitered sections of pipe covering for valves.

3. Manufacturers: Johns Manville Corp., Certain-Teed, Owens- Corning, Knauf, Armacell.

B. Closed Cell:

1. Material: Black flexible elastomeric foamed closed cell structure insulation 25/50 rated with a flame spread rating of 25 or less and a smoke developed rating of 50 or less with both a moisture seal and a reinforced elastic foam lap seal closure system.

2. Flexible pipe insulation shall be a foamed elastomeric closed cell structure material, with a thermal conductivity of not more than 0.27 Btu/Hr./Sq. Ft./Inch at a mean temperature of 75 degrees F. The insulation shall have an average density of at least 2 pounds per cubic foot, shall be self-extinguishing, and shall have a water vapor transmission rating of not more than 0.1 perms. Between temperature limits of -40 degrees F and plus 220 degrees F, the insulation shall not indicate any deviation from its original state.

3. Specification Compliance:

ASTM-E-84
ASTM-C-534 Type I – Tubular, Type II – Sheet.
ASTM-D-1056, 2B1 – Tubular, Sheet.
MIL-C-3133B (MIL STD 670B) Grade SBE-3
MIL-P-15S280J, Form T, Form S.

4. Manufacturers: Armacell, Nomaco, K-Flex, Rubatex.

C. Covering of Pipe Insulation Outdoors:

1. Wrapping: Wrap insulation with embossed 0.016" aluminum jacket.
2. Fastenings: Cover shall be held in place with soft aluminum bands on 12" centers.
3. Valves and Fittings: Weatherproof all valves and fittings.

D. Manufacturers: Johns Manville Corp.., Certain-Teed, Owens- Corning, Knauf.

2.2 DUCT INSULATION

A. Concealed Supply, Return, Relief, and Outside Air Ductwork, and all ductwork connected to energy recovery units: Fiberglass duct wrap bonded with resins, 3/4 pound density, aluminum foil facing reinforced with fiberglass scrim, laminated to Kraft, 2" thick.

1. Thermal Conductivity: 0.27 Btu/Hr./SF/Inch at 75 degrees F. Min. installed "R" value w/25% compression shall be 5.6.

2. Duct wrap shall be cut to stretch-out dimensions as provided in manufacturer's instructions. Remove a 2" piece of insulation from the facing at the end of the piece of insulation to form an overlapping staple and tape flap. Install with facing outside so tape flap overlaps insulation and facing at other end. Insulation shall be tightly butted and not compressed excessively at duct corners. Seams shall be stapled 6" on center with outward clinching staples. All seams, tears, punctures and other penetrations of the insulation facing shall be sealed with foil tape or vapor proof mastic. Where rectangular ducts are 24" in width or greater, duct wrap shall be secured to the bottom of the duct with mechanical fasteners; i.e., stick pins spaced 18" on center.

B. Exposed supply, return, relief, and outside air ductwork, and all ductwork connected to energy recovery units, shall be insulated in finished conditioned spaces, penthouse, mechanical rooms, mezzanine areas, equipment closets, and non-conditioned spaces with 2" thick rigid fiberglass board. Insulation shall be 6 P.C.F. density with a "K" value of 0.25 Btu/Hr./SF/Inch at 75 degrees F. mean temperature and shall be U.L. listed at 25 maximum for flame spread, and 50 maximum for smoke developed. Insulation shall be applied using Graham Pins or Stik-Clips and all seams, edges and breaks shall be sealed with 4" matching tape and sealed with Vicryl CP-10 to match ASJ jacket. Insulation shall be provided with all-service jacket facing.

C. Manufacturers: Johns Manville Corp., Certain-Teed or Owens- Corning, Knauf.

D. Outdoor Installation:

1. Pre-manufacturer panel system consisting of four (4) piece, interlocking panels.

2. The interlocking panels shall be constructed of Dow Thermax Polyisocyanurate insulation, ASTM D-1622, nomina 2 pcf; water vapor tramission as permeance less than 0.03, per ASTM E-96; water absorption less than 0.3% (24 hours), per ASTM C-209; flexure strngeth more than 40 psi, per ASTM C-203.

3. Operating temperature range of -100°F to +250°F.

4. Insulation shall be laminated in two (2) layers to provide R-14 at 2" thickness, per ASTM C-236/C-518.

5. The insulation shall be jacketed with 0.032" thick embossed aluminum and sealed with vapor barrier compound, All joints shall interlock to ensure a thermal seal.

6. Panels shall be secured with #10 self-tapping stainless screws with weather seal washers.

7. Manufacturers: Techna-Duc Insulation System as made by P.T.M. Manufacturing, L.L.C., Newark, Delaware.

2.3 KITCHEN HOOD DUCT INSULATION & FIRE RATED AIR DUCTWORK

A. Materials: Non-mineral wool, passive, low biopersistant fiber, ceramic blanket insulation totally encapsulated on all sides with aluminum foil scrim on kitchen hood exhaust duct.

B. Installation shall be 2 layer, 1-1/2" thick to provide 2-hour protection on grease duct. Apply directly to the duct with zero clearance to combustibles through the length of the assembly.

C. Secure with metal bands per manufacturer's recommendations on type and spacing. For ducts spacing 24" or greater, secure with insulation pins on the bottom of horizontal runs and on vertical runs to prevent sagging.

D. Manufacturers: Thermal Ceramics - Firemaster Duct Wrap XL or Plus, Pyroscat Ductwrap XL, or Unifrax Fyre Wrap ®.

2.4 ACOUSTIC DUCT LINER

A. Duct liner shall be designed for use as an acoustical insulation to absorb air conditioning noise in sheet metal ducts and plenums operating at velocities up to 6000 fpm and temperatures up to 250 deg. F.

B. Duct liner shall be a bonded mat of glass fibers coated with an EPA registered biocide and a black pigmented fire-resistant coating on the air stream side or flexible elastomeric closed cell foam made with an EPA approved anti-microbial.

C. Duct liner shall comply with the requirements of NFPA 90A and 90B. Surface burning characteristics shall comply with UL Standard 723 for 25/50 flame and smoke development.

D. Duct liner shall comply with the property requirements of ASTM Specification C1071 Type 1, or ASTM C1534. Material shall resist fungal and bacterial growth when subjected to ASTM G21 and G22 test methods.

E. Material thickness, name of manufacturer and type shall be printed on the air stream side of the liner for ease of identification.

F. Duct liner shall be 2" thick, unless otherwise noted on the drawings.

G. Manufacturers: Owens Corning QuietR® AcousticR™ Duct Liner, Certainteed, Evonik Industries Solcoustic, Johns Manville Linacoustic® RC, Armacell.

2.5 REUSABLE VALVE COVERS

A. All valves, strainers, combination valves, etc. in chilled water and heating hot water systems shall be insulated with a factory fabricated removable and reusable cover. (This product shall not be used for pipe and fittings.)

B. Insulation shall be either fiberglass blanket or flexible elastomeric thermal insulation as listed in Paragraph 3.2 of this specification, or prefabricated fitting from the supplier. Flame and smoke spread shall be 25/50 per ASTM 84.

C. Outer jacket shall be made of material equal to Tychem QC, overlap and completely cover the insulation, with seams joined by tabs made from Velcro or fabric straps per manufacturer's standards.

D. Outer jacket shall overlap adjoining sections of pipe insulation, and shall be non-combustible, impermeable to water, and prevent mold, mildew and condensation.

E. Installation shall not require the use of any special hand tools.

F. Manufacturers: Corick Valve Covers, NoSweat Valve Wraps.

2.6 INSULATED PIPE SADDLES

A. Insulation and facing shall each meet 25/50 flame and smoke ratings per ASTM E-84 on a component basis.

B. A section of rigid insulation shall be used at all cold pipe hangers or support locations and shall consist of:

1. A rigid 3.75 PCF phenolic foam pipe insulation designed to support pipe sizes up to and including 6” iron pipe size.

2. A rigid 5 PCF phenolic foam pipe insulation designed to support pipe sizes from 8” to 30” iron pipe size.

3. For all hot pipe hanger or support locations, the insert material shall be either rigid calcium silicate per ASTM C303 or perlite silicate per ASTM C303 with all service jacket and laminated to a steel support saddle.

C. The insulation jacket shall contain a vapor retarding material to provide low moisture vapor permeability and resistance to mold, mildew and fungus growth.

D. The insulation shall be free of any CFC or HCFC materials.

E. The insulation shall have a minimum K-factor of 0.13 at 75 deg. F mean temperature, and self-sealing lap joint with high performance acrylic pressure sensitive adhesive tape.

F. Integral insulation saddle shall be made of G-90 carbon steel, with full 180 deg. Coverage, flared edges to protect the vapor barrier jacket and insulation, and short rib surface to center the saddle inside the hanger and prevent movement.

G. Preformed insulation shall extend beyond the saddle by a minimum of 1-1/2” to accommodate a tape joint seal at the butt edges of adjoining insulation sections.

H. Minimum product dimensions shall be as follows:

Nominal pipe size (inches)	Insulation density (PCF)	Insulation length (inches)	Saddle length (inches)	Saddle gauge
½ - 3-1/2	3.75	9	6	20
4 – 6	3.75	12	9	18
8 – 18	5.0	18	12	16
20 – 30	5.0	24	18	14

I. Manufacturer: Tru-Balance insulated saddles as made by Buckaroos, Inc.

PART 3 – EXECUTION

3.1 INSTALLATION – GENERAL

A. Do not install until systems have been tested and meet requirements.

B. Do not install until building is enclosed.

C. Heavy work which may damage insulation shall have been completed in the vicinity of the insulation work.

D. Provide non-compressible insulation saddles at all piping hanger locations, and at all piping hanger locations where piping is insulated with flexible closed cell insulation.

Option: Provide insulation coupling system as made by Klo-Shure Co.

E. All installations shall be made by skilled craftsmen regularly engaged in this type of work.

F. Insulation shall be continuous thru-wall, ceiling and floors.

G. Metal shields, 16 gauge galvanized, shall be installed between hangers and pipe insulation.

H. Pipe, ductwork and equipment shall be clean and dry prior to insulating.

I. Install all insulation per manufacturer's instructions.

J. To avoid undue compression of insulation, provide solid core inserts at all supports as recommended by the insulation manufacturer. Provide insulation shields between the insulation jacket and the hanger.

K. Ductwork treated with internal acoustic duct liner does not require external insulation.

L. Apply vapor proof mastic as recommended by the insulation manufacturer on all longitudinal and butt joints of sectional pipe insulation. Apply similar mastic to the end of every third length of sectional pipe insulation on all chilled water and dual temperature pipe insulation to prevent the migration of condensation that might occur.

M. For pre-manufactured expansion loops, provide a second layer of insulation with air gap to maintain loop flexibility. Install in accordance with the loop manufacturer’s written instructions.

N. Provide insulation on all piping, equipment, and fixtures that are part of a factory assembly package not otherwise insulated by the manufacture of such packaged equipment. Insulation type and thickness shall comply with all of the requirements of this section.

3.2 PIPE INSULATION – TYPES & THICKNESSES

A. Provide fiberglass insulation of thickness specified on:

1. Cold Water Make-Up:

   1/2" for piping 1-1/4" and below.
   1” for piping 1-1/2” and over

2. Heating Hot Water: (Up to 140°F)

   1" for piping 1-1/4" and below
   1-1/2" for pipes 1-1/2" and over.

3. Heating Hot Water: (141°F to 200°F)

   1-1/2" for piping 1-1/4" and below
   2" for pipes 1-1/2" and over.

4. Chilled Water:

   1” for piping 1-1/4” and below. Option: Flexible closed cell insulation
   1” for piping 1-1/2” and over

5. Dual Temperature Water:

   1-1/2” for piping 1-1/4” and below. Option: Flexible closed cell insulation
   2” for piping 1-1/2” and larger

6. Refrigerant Piping: Interior locations, exposed and concealed for suction lines and hot gas bypass lines, if applicable. (NOTE: Insulate liquid line if metering device is mounted at the condensing unit.) Option: Flexible closed cell insulation

   a. Suction Line:
      1/2" for piping 1-1/4" and below
      1" for piping 1-1/2" and larger

   b. Liquid Line:
      1” for piping 1-1/4” and below
      1-1/2” for piping 1-1/2” and larger

   c. Hot Gas Bypass: (Liquid Line)
      1" for piping 1-1/4" and below
      1-1/2" for piping 1-1/2" and larger

7. Freeze protection of outdoor piping (over heat tracing tape): 3” thick insulation, with metal jacket.

B. Provide flexible closed cell insulation of thickness specified on:

1. Refrigerant Piping: Exterior Locations for suction lines and hot gas bypass lines, if applicable. (NOTE: Insulate liquid line if metering device is mounted at the condensing unit.)

   a. Suction Line:
      1/2" for piping 1-1/4" and below
      1" for piping 1-1/2" and larger

   b. Liquid Line:
      1” for piping 1-1/4” and below
      1-1/2” for piping 1-1/2” and larger

   c. Hot Gas Bypass: (Liquid Line)
      1" for piping 1-1/4" and below
      1-1/2" for piping 1-1/2" and larger

2. Cold surfaces of refrigeration equipment, air separators for chilled and heating hot water, and chilled water pumps. 3/4" thickness

3. Hot and chilled water expansion tanks. 3/4" thickness

4. 1” thickness for all water piping within terminal unit cabinets.

5. ½” thickness for condensate drain lines.

3.3 PIPE COVERING (FOAMED PLASTIC TYPE)

A. All joints and seams shall be sealed with a compatible adhesive. Approved adhesives are as follows:

Armstrong World Industries	No. 520
Benjamin Foster Company	No. 85-75 up to 200 degrees F.

Contractor may use Armstrong Self-Seal Armaflex 2000 insulation in lieu of the above wherever 1/2" is specified.

B. Fitting covers shall be fabricated from the foamed plastic pipe insulation or from sheet insulation of the identical material. The fabrication shall be in accordance with manufacturer's instructions, and all seams mitered joints shall be joined using the adhesives described hereinbefore.

C. Pipe insulation in concealed spaces shall require no finish coatings.

D. Pipe insulation in all other areas shall receive two coats of finish of color selected by Architect. Approved finishes are as follows:

Armstrong World Industries WB Armaflex Finish

3.4 EXTERIOR PIPE COVERING

A. Wrapping: Wrap insulation with embossed 0.016" aluminum jacket, orient seam down.

B. Fastenings: Cover shall be held in place with soft aluminum bands on 12" centers.

C. Valves and Fittings:

1. Weatherproof all valves and fittings.
2. Finish: Apply two coats of vapor resistant mastic reinforced with glass fabric over wrapping.

3.5 INTERIOR PIPE COVERING

A. Provide premolded PVC cover on all interior insulated piping exposed in finished spaces. Orient seams up in overhead piping and toward the wall in vertical runs.

B. Provide factory molded fitting covering for fittings and accessories, sealed and held in place by manufacturer’s recommended sealing system.

C. Provide mitered sections of covering for valves.

3.6 ACOUSTIC DUCT LINER

A. All portions of duct designated on the drawings to receive duct liner shall be completely covered with duct liner, adhered to the sheet metal with a 100% coverage of adhesive complying with ASTM C916.

B. Transverse joints shall be neatly butted and there shall be no interruptions or gaps. All transverse joints and all exposed leading edges shall be coated. The black coated surface of the duct liner shall face the airstream.

C. Duct liner shall be secured with mechanical fasteners which shall compress the duct liner sufficiently to hold it firmly in place.

D. Duct liner shall be cut to assure overlapped and compressed longitudinal joints.

E. After installation is complete, blow out the duct system prior to operation to remove any cutting scraps and foreign material remaining in the duct.

3.7 INSULATED PIPE SADDLES

A. Insulated pipe saddles shall be installed at all hangers, rollers or supports in accordance with manufacturer’s written instructions.

B. All piping shall be clean and free of oil, rust and moisture prior to and during support installation.

C. All insulated saddles and accessories shall be stored in a dry area protected from weather before and during installation

D. Seal adjoining butt edges of pipe insulation with approved mastic and tape to insure continuity of the insulation jacket and vapor barrier, especially on cold piping system installations.

END OF SECTION 23 02 30

SECTION 23 03 00
VIBRATION AND SOUND ISOLATION – HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the contract, including the conditions of the contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions

C. Refer to Section 230210 for HVAC Basic Materials & Methods.

1.2 DESCRIPTION OF WORK

A. This Section includes providing the following vibration and sound isolation material on items furnished and installed under HVAC work:

1. Pump-mounted inertia pads
2. Piping, Inline Pumps
3. Fans and AHU's
4. Suspended Exhaust Fans
5. Rooftop AHU's
6. Ductwork

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

1.4 QUALITY ASSURANCE

A. Refer to Section 230210 for a general description of requirements applying to this section.

1.5 SUBMITTALS

A. Submit shop drawings, installation instructions, and manufacturer's literature of all materials specified in accordance with Section 230200.

B. Submit the following:

1. Shop drawings
2. Product data

1.6 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, General Requirements.

PART 2 – PRODUCTS

2.1 GENERAL

A. All vibration control apparatus shall be furnished by a single recognized manufacturer. The manufacturer shall submit to the Architect/Engineer evidence affirming that he has been a supplier of vibration control devices of the type required for the past five years.

B. The vibration control apparatus manufacturer shall supervise, inspect, measure, and approve the installation and shall submit a report to the Architect/Engineer substantiating that all the equipment has been adequately isolated.

C. Any requests for changes in the specifications must be submitted in writing in time for review and approval through a written addendum to the specifications prior to bid closing.

D. Unless otherwise indicated or specified, all equipment mounted on vibration isolator bases shall have a minimum operating clearance of 1 inch between the base and the floor or housekeeping and beneath. Clearance space shall be checked to insure that no scrap, rubbish, hardware, etc., has been left to possibly short circuit isolated base.

E. In connecting isolated HVAC equipment to rest of system, care must be exercised to insure proper installation.

1. Equipment connected to water piping shall be erected on isolators or isolated foundations to correct operating height prior to making piping connections to avoid misalignment problems. To facilitate this, equipment shall be blocked-up with temporary shims to final operating height. When full load is assembled and water is in system, isolators shall then be adjusted to take up load just enough to allow removal of shims.

2. Air handling equipment such as centrifugal fans shall be erected on isolators and leveled with fan operating before flexible duct connection is made. Insure that duct position is in proper alignment and providing proper clearance in proportion to flexible duct connector length. When fan is shut off, misalignment with ductwork is allowable providing it does not strain or damage flexible duct connector. In cases of high static pressure, fans requiring position stabilizers are to be adjusted when fan is operating to achieve the results as described above with isolator adjustment.

F. Vibration isolator sizes and location shall be determined by the vibration control products manufacturer or as specified herein.

G. Model numbers of Amber/Booth Co., are given for identification. Products of specified manufacturers will be acceptable, provided they comply with all of the requirements of this specification.

2.2 ISOLATOR TYPES

A. Pump Mounted Inertia Pads:

1. Frame to be structural steel with built-in height saving bracket for recessing into a CPF concrete inertia block for side access.

2. Spring to be adjustable, free-standing, open-spring mounting with combination leveling bolt and equipment fastening bolt. The spring shall be rigidly attached to the spring mounting baseplate and compression plate. The isolator shall be designed for a minimum Kx/Ky (Horizontal-to-Vertical spring rate) of 1.0. A neoprene pad having a minimum thickness of 1/4" shall be bonded to the baseplate. Amber/Booth Type CPF with RSW-1.

B. Piping in Mechanical Room, In-Line Pumps:

1. Type PBSR: for first two hangers in horizontal piping adjacent to isolated equipment and for all hangers on 8" and larger pipe, except the first two hanger points adjacent to riser shall be Type BS.

2. Type BSR for remaining hangers in horizontal piping.

3. Type SW for pipe risers. Isolator base plates shall be provided with holes for bolting and isolation grommets.

4. Type SW for floor supports except Type CT for first floor support adjacent to equipment isolated on CT isolators.

C. Fans and Air Handling Units:

1. For slab on-grade installations, provide:

a. Type SP – NR = Double Deflection Neoprene: Shall include neoprene covered steel support plated (top and bottom), friction pads, and necessary bolt holes. Design isolators to support loads up to 50 pounds per square inch.

2. For floors above-grade, up to 40 ft. span, provide:

a. Type SW = Spring Isolators: Shall be free-standing, laterally stable and include acoustical friction pads and leveling bolts. Isolators shall have a minimum ratio of spring diameter-to-operating spring height of 1.0 and an additional travel to solid equal to 50 percent of rated deflection.

b. Type PBSRA - Combination Neoprene and Spring: Vibration hanger shall contain a spring and double deflection neoprene element in series. Spring shall have a diameter not less than 0.8 of compressed operating spring height. Spring shall have a minimum additional travel of 50 percent between design height and solid height. Spring shall permit a 15 degree angular misalignment without rubbing on hanger box.

c. Thrust Restraints: Restraints shall provide a spring element contained in a steel frame with neoprene pads at each end attachment. Restraints shall have factory preset thrust and be field adjustable to allow 1/4" maximum movement when the fan starts and stops. Restraint assemblies shall include rods, angle brackets and other hardware for field installation.

D. Suspended Exhaust Fans

1. For floors above-grade, up to 40 ft. span, provide:

a. Type SW = Spring Isolators: Shall be free-standing, laterally stable and include acoustical friction pads and leveling bolts. Isolators shall have a minimum ratio of spring diameter-to-operating spring height of 1.0 and an additional travel to solid equal to 50 percent of rated deflection.

b. Type PBSRA - Combination Neoprene and Spring: Vibration hanger shall contain a spring and double deflection neoprene element in series. Spring shall have a diameter not less than 0.8 of compressed operating spring height. Spring shall have a minimum additional travel of 50 percent between design height and solid height. Spring shall permit a 15 degree angular misalignment without rubbing on hanger box.

c. Thrust Restraints: Restraints shall provide a spring element contained in a steel frame with neoprene pads at each end attachment. Restraints shall have factory preset thrust and be field adjustable to allow 1/4" maximum movement when the fan starts and stops. Restraint assemblies shall include rods, angle brackets and other hardware for field installation.

E. Rooftop AHU's:

1. Type RTIR: Provide an extruded aluminum rail base for rooftop air conditioning units consisting of a pair of weatherproofed aluminum rails for fastening to equipment and to roof curb incorporating wind restraints and a continuous air and water seal which is protected from accidental puncture and direct sunlight by an aluminum weather shield. Rails shall incorporate non-adjustable Type SW spring isolators properly spaced around perimeter and sized for 1" deflection. To prevent leaks, rails shall be factory assembled (to the limits of freight carriers) and shipped as a one- piece unit.

F. Ductwork Lagging:

1. The barrier shall be constructed of 0.10” thick barium sulphate loaded limp vinyl sheet bonded to a thin layer of reinforced aluminum foil on one side.

2. The barrier shall have a nominal density of 1 psf and shall have a minimum STC rating of 28.

3. The barrier shall exhibit minimum flammability ratings of 0.0 seconds for flame out and after glow and 0.2 inches for char length when tested in accordance with Federal Test Standard No. 191-5903.

4. The barrier shall have a minimum thermal conductivity “K” value of 0.29 and a rated service temperature range of 40°F to 220°F. When tested for Surface Burning Characteristics per ASTM E84, the barrier will have a flame spread index of no more than 10 and a smoke development index of no more than 40.

5. The decoupling layer shall be a combination of 1” fiberglass batting, non-woven porous scrim-coated glass cloth, quilted together in a matrix of 4” diamond stitch pattern which encapsulates the glass fibers. The barrier shall be Type KNM-100-ALQ-1 and the decoupling layer shall be type KFA by Kinetics. The composite material shall be fabricated to include a nominal 6” wide barrier overlap tab extending beyond the quilted fiberglass to facilitate a leak-tight seal around field joints. Nominal barrier width 54”, nominal decoupler width 48”.

6. Sound Transmission Loss: Tested as a free hanging barrier (ASTM E-90-90)

	Frequency, Hz						
Product	125	250	500	1000	2000	4000	STC
KNM 100ALQ-1	13	16	24	33	43	49	28

H. Manufacturers: Amber/Booth, Kinetics Noise Control, Mason Industries, Vibration Mounting & Controls, Vibration Eliminator, Inc., Vibro-Acoustics.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's specifications and instructions.

1. No metal-to-metal contact will be permitted between fixed and floating parts.

2. Connections to Equipment: Allow for deflections equal to or greater than equipment deflections. Electrical, drain, piping connections, and other items made to rotating or reciprocating equipment (pumps, compressors, etc.) which rests on vibration isolators, shall be isolated from building structure for first three hangers or supports.

3. Common Foundation: Mount each electric motor on same foundation as driven machine. Hold driving motor and driven machine in positive rigid alignment with provision for adjusting motor alignment and belt tension. Bases shall be level throughout length and width. Provide shims to facilitate pipe connections, leveling and bolting.

4. Provide heat shields where elastomers are subject to high temperatures.

5. Extend bases for pipe elbow supports at discharge and suction connections at pumps. Pipe elbow supports shall not short circuit pump vibration to structure.

6. Ensure that the outer surface of the equipment or duct is clean and free of dust, dirt or similar foreign matter. If desired, the outside surface can be painted with a rust-resistant paint in order to minimize potential corrosion.

a. Field cut and apply the insulation decoupler to the outside of the duct. Obtain a uniform thickness by butting all seams together (do not overlap). At elbows or similar transitions, field measure and miter cut the insulation to fit. Ensure that the insulation is not compressed by the fastener used, if any.

b. Wrap the noise barrier around the insulation-wrapped duct. At all seams, overlap the barrier by a minimum of 2" and adhere using adhesive. Alternately, the barrier can be butted together at joints with the seam covered by a 2" (50 mm) wide cut piece of the barrier material. This strip is then adhered to the barrier on either side of the seam using adhesive.

c. If desired, metal or nylon bands can be wrapped around the outside of the barrier to guard against the potential of adhesive failure. If used, this banding should be placed on either side of all radial seams in addition to the midpoint on longer sections. Ensure that the banding is snug only and does not result in compression of the insulation decoupler beneath.

d. In lieu of banding, insulation "stick pins" can be used to reinforce the seams in the noise barrier. Ensure that the pin does not compress the insulation or barrier material beneath.

B. Inspection and Adjustments: Check for vibration and noise transmission through connections, piping, ductwork, foundations, and walls. Adjust, repair or replace isolators as required to reduce vibration and noise transmissions to specified levels.

END OF SECTION 23 03 00

SECTION 23 04 00
HEATING GENERATION EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions.

C. Refer to Section 230210 for HVAC Basic Materials and Methods.

D. Refer to Section 230230 for Insulation and Covering – HVAC

1.2 DESCRIPTION OF WORK

A. This Section includes labor, material, and equipment necessary to provide a complete boiler system as specified herein and shown on the drawings:

1. Boilers - General
2. Boilers – (Condensing Type)

B. Refer to other Division 23 sections for related work.

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this Section.

B. See specifications in this Section for specific compliance with NFPA, UL, ASME, etc.

C. Underwriters Laboratories:

1. UL 795: Commercial-Industrial Gas Heating Equipment.

D. American Society of Mechanical Engineers:

1. ASME Section IV: Boiler and Pressure Vessel Code - Heating Boilers
2. ASME CSD-1: Controls and Safety Devices for Automatically Fired Boilers

E. American Society of Heating, Refrigeration and Air Conditioning Engineers:

1. ASHRAE: Standard 90.1 Energy Standard for Buildings

F. American National Standards Institute

1. ANSI Z21.13: Gas Fired Low Pressure Steam and Hot Water Boilers

G. Hydronics Institute, Division of Air Conditioning, Heating and Refrigeration Institute:

1. BTS-2000: Testing Standard to Determine Efficiency of Commercial Space Heating Boilers

H. National Fire Protection Association:

1. NFPA 54: National Fuel Gas Code (ANSI Z223.1).

1.4 QUALITY ASSURANCE

A. Refer to Section 230210 for a general description of requirements applying to this section.

B. Quality Assurance:

1. Manufacturers: Firms regularly engaged in manufacture of boilers, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

2. Regulatory Requirements:

a. NFPA Compliance: Install boilers in accordance with National Fire Protection Association (NFPA) Code 54 "National Fuel Gas Code".
b. NFPA 211 Compliance: Heating equipment burning gas, solid or liquid fuels, Section 60.
c. ASME, CSD-1

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 230200.

B. Submit the following:

1. Shop Drawings
2. Product Data
3. Evidence of specified code or other compliance.

1.6 SUBSTITUTIONS

A. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but not be limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items furnished and installed by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, this Contractor shall be responsible for any and all additional costs associated with the changes required by other trades.

1.7 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS. In addition, the following special guarantee applies:

1. Start-up and two years of factory service on boilers.

2. The stainless-steel heat exchanger shall carry a 10-year limited warranty.

3. Pressure vessel and flue collector are covered against failure due to fireside flue gas corrosion: upper and lower pressure vessel headers shall carry a 10-year limited warranty and flexible boiler tubes and flue collector sides, top and bottom, shall carry a 5-year limited warranty.

4. The burner shall carry a 2-year limited warranty.

5. All other parts shall have a 2-year limited warranty.

PART 2 – PRODUCTS

2.1 BOILERS - GENERAL

A. Provide factory packaged type boiler, burner units for hot water heating units arranged for automatic firing with natural gas. Each unit shall include an internal, header type boiler, insulated metal jacket, pre- engineered combustion system consisting of a special vertical gas burner with forced draft wind box, refractory type combustion chamber and precut block insulation, factory wired NEMA 1 control panel for combustion programming and flame failure protection, integral draft inducer and all operating and limit controls in accordance with CSD-1. Each unit shall be provided with all castings, fittings, accessories and appurtenances necessary for assembly, connection and operation, including safety/relief valves, water column type pump control and lower water cutoff with precut piping and necessary fittings, prefabricated return yoke together with gauges and instruments as hereinafter described. Boiler/Burner package shall be a standard product of the manufacturer.

2.2 BOILER – CONDENSING TYPE

A. Boiler

1. The boiler shall be factory assembled & packaged as a complete unit and shipped on a heavy steel frame or knockdown configuration. Packaged unit shall be complete with jacket, gas manifold, burner and controls mounted and wired, as specified in this Section. The boiler shall be factory fire tested prior to shipment. Knockdown unit is fully assembled and fire tested as a package then dissembled & labeled for shipment. Boiler connections shall be limited to the water supply & return, relief valve and boiler drains, fuel input, electrical power, exhaust vent and air inlet (as specified/shown in contract documents).

2. The boiler shall be constructed in conformance to ASME Section IV and UL 795. The boiler shall bear the ASME “H” stamp and be National Board Listed for 160 psi MAWP at 210°F. The gas train and safety controls shall conform to requirements of UL 795 and ASME CSD-1.

3. Pressure vessel shall be constructed of 316L stainless steel non-welded flexible serpentine water tubes connected to 316L stainless steel headers. All tubes:

   a. Shall be easily removed and or replaced in field without welding or rolling and may be demonstrated upon request;

   b. Shall not require ASME “R” stamp for tube replacement; and

   c. Shall provide lifetime, shockproof seal on tube to header attributed to unequal expansion.

4. Boiler shall be equipped with a hinged front door for easy access to control devices, wiring connections and BMS interface cables/wires.

5. The boiler shall be furnished with an adequate number of tappings and full size inspection openings to facilitate internal boiler inspection and cleaning.

6. The boiler shall be complete with a 16 gauge metal jacket, steel casing, finished with a suitable heat resisting powdered coated finish. It shall be constructed on a structural steel frame and properly insulated with 1 inch thick insulation. The complete jacket shall be easily removable and reinstalled. The boiler shall incorporate individually removable jacket doors, with handles providing easy access to combustion chamber access panels. The entire tube area shall be easily accessible for fireside cleaning from one side.

7. The boiler furnace and convection chamber shall include access door opening to allow for inspection of the interior chamber and burner assembly. The interior walls of the furnace chamber shall be lined with high temperature ceramic fiber blanket insulation.

8. The operating sound level for the boiler shall not exceed 60 dBA

9. Electrical input to the boiler shall be 480v/3ph/60hz. Single-point electrical hook-up for the boiler shall be provided.

B. Combustion System

1. The burner shall be a metal fiber mesh burner with no moving parts capable of operating low NOx operation without additional components. The burner shall fire in a full 360-degree pattern providing uniform heat transfer. A viewing port shall be provided for visual observation of burner performance.

2. Burner operation shall provide infinite Modulation with minimum 5:1 turn down utilizing a Variable Speed Combustion Blower and air-fuel ratio control gas valve for dependable, repeatable modulation and precise combustion control. The gas valve design shall incorporate two safety valves in a single body and include the gas pressure regulator.

3. The ignition system shall be direct spark ignition with a UV scanner.

4. The entire ignition and firing control sequence shall be monitored by a UL approved commercial-type microprocessor based integrated flame safeguard burner control with first out fault annunciation and operating sequence and diagnostic indicator lights. The burner control shall incorporate both pre-purge and post-purge timing functions

5. The gas train shall be UL/CSD-1 compliant with a supply gas pressure range of 4”wc - 14” wc using Natural Gas. The gas train shall consist of high and low gas pressure switches (each with manual reset), a manual shut off valve upstream of burner and downstream of last gas valve. A single main gas valve body shall perform the functions of safety shutoff, constant pressure regulation and air-fuel ratio control.

6. The boiler electrical control circuit shall include a 120V limit string containing a low water cut off, water flow switch, high limit manual reset, blocked condensate switch, burner fuse, low gas pressure switch, high gas pressure switch, blocked vent switch, combustion air/fuel proving switch. Operating Control will use UL listed water temp. sensors (UL353) and include both a supply sensor and return sensor.

C. Boiler Control System

1. Scope of Supply: Boiler Control System shall provide safety interlocks and water temperature control. The control system shall be fully integrated into the boiler control cabinet and incorporate single and multiple boiler control logic, inputs, outputs and communication interfaces. The control system shall coordinate the operation of up to eight (8) fully modulating hot water boilers and circulation pumps. The control system shall simply control boiler modulation and on/off outputs based on the boiler water supply temperature and an operator-adjusted setpoint. The control system shall allow the boiler to respond to energy management system (EMS) firing rate demand, remote setpoint or remote start/stop commands.

D. Water Trim

1. Water trim devices including an ASME rated pressure relief valve set at 50 psi, combination water pressure and temperature gauge and water flow switch & LWCO to prevent burner operation during low water flow conditions shall be provided.

E. Vent & Intake Air Connections

1. The boiler shall be designed to accommodate sealed, direct, or other positive pressure venting options.

F. Guarantee: The boiler shall be provided with start-up by factory trained personnel.

G. Manufacturers: Hydrotherm, Aerco, Lochinvar Corp., Buderus, RBI, Thermal Solutions.

1. Any listed equivalent manufacturer and the Mechanical Contractor shall be completely responsible to comply with all requirements on the contract documents. This shall include, but not be limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades.

PART 3 – EXECUTION

3.1 BOILER-BURNERS

A. Install per Manufacturer's Written Instructions:

1. Properly level.

2. Set bottom of framework on concrete pad. The Contractor shall construct level concrete pad and foundations according to the manufacturer's erecting instructions. Mount boilers on 6" high concrete pads. Provide pads, with beveled edges.

3. Pipe all relief valves, blowoffs and drains to the floor drains. Pipe size shall not be less than tapping on boiler, low water cutoff, etc.

4. Adequately protect boiler-burner unit during construction.

5. Pipe all gas vents to exterior in accordance with CSD-1 and utility company requirements. Terminate with screened vent head.

6. Insulate all factory installed piping for hot water as applicable.

B. Start-up, Contractor shall:

1. Employ the services of approved water treatment consultant who shall:

a. Test water before filling boiler and prescribe proper water treatment to prevent corrosion or deterioration due to oxygen, acid or scaling.

b. Immediately after internal inspection and refilling of boiler, check water conditions at that time and prescribe proper water treatment again.

2. Be responsible for:

a. Supplying and using prescribed ingredients. (initial water treatment)

b. Maintain proper water conditions until acceptance of boiler. After acceptance of boiler, water treatment will be provided by the Owner.

c. Cleaning systems as specified.

d. Not filling boiler until firing equipment is operable.

3. As soon as boiler is filled, ready for testing, or final acceptance.

C. Testing and Cleaning:

1. Bring water up to 210°F and circulate for two hours to drive off air.

2. Demonstrate all safety devices in presence of Owner's Representative and Engineers before final acceptance.

3. Set maximum firing rate of boiler.

4. Skim off impurities until boiler water is clear.

D. Services of Factory mechanic:

1. Arrange to have services of a factory representative trained field mechanic on site to start up the boiler(s).

2. Mechanic shall check out entire installation, including all pumps and feed apparatus and controls, shall start the units into operation and shall make all necessary tests and adjustments to have said equipment operate to his and to the Engineer's satisfaction.

3. Manufacturer shall issue a letter stating that the installation has been checked and adjusted and is ready to turn over to the Owner following the completion of this work.

4. Manufacturer is to forward three (3) copies of the starting reports to the Owner.

5. Factory mechanic shall be at the job for the initial start-up for not less than two (2) consecutive calendar days.

6. Factory mechanic shall conduct demonstration and combustion tests in the presence of the Owner for each boiler for gas firing and oil fire and shall submit written report to the Owner.

7. The same factory mechanic shall make two more trips to the job within the succeeding eight months from the date of the above-mentioned letter for the purpose of further adjusting and checking and shall be immediately available in the event of operating failure of the units within a period of one year from the date of the letter.

E. Tools and spare Parts for Each Boiler: Furnish and obtain receipt for complete set of gaskets, flue brush and scraper with light weight handles and all special tools that may be required.

END OF SECTION 23 04 00

SECTION 23 04 10
HEATING GENERATION AUXILIARY EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions.

C. Refer to Section 230210 for HVAC Basic Materials and Methods.

D. Refer to Section 230400 for Heating Generation Equipment.

1.2 DESCRIPTION OF WORK

A. This Section includes labor, material, and equipment necessary for a complete boiler system as specified and shown on the drawings:

1. Gas Vent Pipe & Pipe Fittings
2. Miscellaneous Breeching Materials

B. Provision for boiler vent and combustion air piping.

C. Refer to other Division 23 sections for related work.

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

1.4 QUALITY ASSURANCE

A. Refer to Section 230210 for a general description of requirements applying to this section.

B. Quality Assurance:

1. Manufacturers: Firms regularly engaged in manufacture of equipment types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

2. Regulatory Requirements:

a. NFPA Compliance: Install gas-fired cast-iron boilers in accordance with National Fire Protection Association (NFPA) Code 54 "National Fuel Gas Code".

b. NFPA 211 Compliance: Heating equipment burning gas, solid or liquid fuels, Section 60.

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 230200.

B. Submit the following:

1. Shop Drawings
2. Product Data
3. Evidence of specified code or other compliance.

1.6 SUBSTITUTIONS

A. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but not be limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items furnished and installed by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, this Contractor shall be responsible for any and all additional costs associated with the changes required by other trades.

1.7 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS

PART 2 – PRODUCTS

2.1 GAS VENT PIPE & FITTINGS

A. The gas vent system shall be so engineered and constructed as to develop a positive flow adequate to exhaust all flue gases to outside atmosphere, without condensation within the vent.

B. All parts of vent system shall be of Underwriters' Laboratories, Inc., listed Metal-Fab Type CORR/Guard Model CG, double wall gas vent piping, and such piping shall be continuous from the appliance outlets into Metal-Fab vent terminal. Venting System shall be rated at 6” W.C. and tested to 15” W.C. per UL Standard 1738.

C. The Metal-Fab gas vent piping shall be installed in full compliance with the terms of its listing, with the manufacturer's installation instructions, and with nationally recognized building codes representing good practice for such installations.

D. For vent sizes 6” to 12” inside diameter, inner wall thickness shall be 0.015”, Type AL29-4C stainless steel.

Outer casing shall be 0.018”, aluminized steel.

E. Inner and outer walls shall be connected by means of spacer clips that maintain concentricity of the annular space and allow differential thermal expansion of the inner and outer walls.

F. All supports, wall penetration, terminal with miter cut and birdscreen, boiler connector and condensate drain fitting shall be included.

G. All joints shall be sealed using manufacturer’s approved sealant. Joints exposed to the weather shall be sealed to prevent rainwater from entering the annular space between inner and outer walls.

H. Provide adequate accessibility, head room and dimensions so that all vent connections can be correctly sized, spaced and supported.

I. Manufacturers: Metal-Fab, Metalbestos, Heat Fab, Inc., American Metal Products, Van-Packer Co.

2.2 MISCELLANEOUS BREECHING MATERIALS

A. Provide miscellaneous materials and products of types and sizes to comply with boiler requirements including proper connection of equipment.

B. Provide PVC combustion air intake pipe and accessories:

1. Pipe: ASTM D-1785 Schedule 40, Type 1, Grade 1.
2. Fittings: ASTM D-2466, Schedule 40.
3. Solvent Cement: ASTM D-2564, Schedule 40 and DWV.
4. Uniformity: To ensure installation uniformity, all piping components shall be of one manufacturer.
5. Flux shall be non-toxic type and non-corrosive.

PART 3 – EXECUTION

3.1 BOILER GAS VENT PIPE

A. Gas vent pipe shall be installed in accordance with the latest International Mechanical Code.

3.2 GAS VENT PIPE (PRE-ENGINEERED)

A. The manufacturer shall warrant the complete system against functional failure due to defects in material and workmanship for 10 years from date of delivery. The system manufacturer shall be responsible for checking the sizing, design, and installation of the system. If any component fails to perform its intended function of exhausting combustion by-products from the boiler equipment, for any reason, within 10 years of shipment, the system supplier shall, at no expense to the Owner, provide a replacement part or parts FOB jobsite.

END OF SECTION 23 04 10

SECTION 23 04 50
REFRIGERATION EQUIPMENT – HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the contract, including the conditions of the contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions

C. Refer to Section 230210 for HVAC Basic Materials & Methods.

1.2 DESCRIPTION OF WORK

A. This Section includes labor, material, equipment and supervision to for the following:

1. Air-Cooled Water Chiller
2. Split System Heat Pump Units
3. Condensing Unit (10-20 tons)

B. Provide complete refrigeration system including chillers, cooling towers, aboveground piping and all required accessories.

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

B. Comply with applicable provisions of:

1. International Mechanical Code
2. ASME Codes for Pressure Vessels
3. A.R.I. Capacity Ratings
4. NFPA Pamphlets
5. ASHRAE Standard 15
6. ASHRAE Standard 90.1, Section 6, Table 6.8.1A thru J, minimum equipment efficiency.

1.4 QUALITY ASSURANCE

A. Refer to Section 230210 for a general description of requirements applying to this Section.

B. Whenever a variable frequency PWM drive is installed to control an AC motor, a maintenance-free, circumferential, conductive micro fiber shaft grounding ring shall be installed on the AC motor drive end to discharge shaft currents to ground. Recommended part: AEGIS SGR™ Bearing Protection Ring, as made by Electro Static Technology. Install in accordance with the manufacturer's written instructions.

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 230200.

B. Submit the following:

1. Shop drawings and product data for all equipment in this section.
2. 1/4" = 1'-0" scale layout of all equipment in Mechanical Room and adjoining tower enclosure.

1.6 SUBSTITUTIONS

A. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but not be limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items furnished and installed by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, this Contractor shall be responsible for any and all additional costs associated with the changes required by other trades.

1.7 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, General Requirements. In addition, the following special guarantee applies:

1. Manufacturer shall guarantee all refrigeration equipment including parts, for five (5) years from start-up.

PART 2 – PRODUCTS

2.1 AIR-COOLED WATER CHILLER

A. Provide as shown on the schedules of the contract documents a factory assembled, charged, and tested air-cooled scroll compressor chillers as specified herein. Chiller shall be designed, selected, and constructed using a refrigerant with flammability rating of 1, as defined by ANSI/ASHRAE STANDARD 34 Number Designation and Safety Classification of Refrigerants. Chiller shall include not less than two refrigerant circuits above 50 tons with scroll compressors, direct-expansion type evaporator, air-cooled condenser, refrigerant, lubrication system, interconnecting wiring, safety and operating controls including capacity controller, control center, motor starting components and special features as specified herein or required for safe, automatic operation.

1. Cabinet: External structural members shall be constructed of heavy gauge, galvanized steel coated with baked on power paint which, when subject to ASTM B117, 1000-hr, 5% salt spray test, yields minimum ASTM 1654 rating of 6.

2. Operating Characteristics: Provide low and high ambient temperature control options as required to ensure unit is capable of operation from 30˚F to 115˚F ambient temperature.

3. Service Isolation Valves: Discharge ball-type isolation valves factory installed per refrigerant circuit. Includes a system high-pressure relief valve in compliance with ASHRAE 15.

4. Pressure Transducers and Readout Capability

   a. Discharge Pressure Transducers: Permits unit to sense and display discharge pressure.
   b. Suction Pressure Transducers: Permits unit to sense and display suction pressure.
   c. High Ambient Control: Allows units to operate when the ambient temperature is above 115˚F. Includes discharge pressure transducers.

B. COMPRESSORS: Compressors shall be hermetic, scroll-type, including:

1. Compliant design for axial and radial sealing.
2. Refrigerant flow through the compressor with 100% suction cooled motor.
3. Large suction side free volume and oil sump to provide liquid handling capability.
4. Compressor crankcase heaters to provide extra liquid migration protection.
5. Annular discharge check valve and reverse vent assembly to provide low-pressure drop, silent shutdown, and reverse rotation protection.
6. Initial oil charge.
7. Oil level sight glass.

8. Vibration isolator mounts for compressors.
9. Brazed-type connections for fully hermetic refrigerant circuits.
10. Compressor Motor overloads capable of monitoring compressor motor current. Provide extra protection against compressor reverse rotation, phase-loss and phase-imbalance.

C. Refrigerant Circuit Components: Each refrigerant circuit shall include: a discharge service ball-type isolation valve, high side pressure relief, liquid line shutoff valve with charging port, low side pressure relief device, filter-drier, solenoid valve, sight glass with moisture indictor, electronic expansion valves, and flexible, closed-cell foam insulated suction line and suction pressure transducer.

D. Evaporator:

1. Evaporator shall be brazed-plate, stainless-steel construction capable of refrigerant working pressure of 650 psig and liquid side pressure of 150 psig.

2. Brazed plate heat exchangers shall be UL listed.

3. Exterior surfaces shall be covered with 3.4” flexible, closed cell insulation, thermal conductivity of 0.26k ([BTU/HR-Ft2 - ˚F]in.) maximum

4. Water nozzles shall be provided with grooves for field provided ANSI/AWWA C-606 mechanical couplings.

5. Evaporator shall include vent and drain fittings and thermostatically controlled heaters to protect to -20˚F ambient in off-cycle.

6. A 20-mesh, serviceable wye-strainer and mechanical couplings shall be provided for field installation on evaporator inlet prior to startup.

7. Evaporator shall be provided with piping extension kit and mechanical couplings to extend liquid connection from evaporator to edge of unit. Thermal dispersion type flow switch shall be factory installed in the evaporator outlet pipe extension and wired to the unit control panel. Extension kit nozzle connections shall be ANSI/AWWA C-606 grooved pipe.

E. Air-Cooled Condenser

1. Coils: Condenser coils shall be constructed of a single material to avoid galvanic corrosion due to dissimilar metals. Coils and headers shall be brazed as one-piece. Integral sub cooling is included. Coils shall be designed for a design working pressure of 650 PSIG. Condenser coil shall be washable with potable water under 100 psi pressure.

2. Fan Motors: High efficiency, direct drive, 6 pole, 3 phase, insulation class “F”, current protected, Totally Enclosed Air-Over (TEAO) , rigid mounted, with double sealed, permanently lubricated, ball bearings.

3. Ultra-Quiet Fans with Variable Speed Drives. All fans shall be powered by VSDs. Fans shall provide vertical air discharge from extended orifices. Fans shall be composed of corrosion resistant aluminum hub and glass-fiber-reinforced polypropylene composite blades molded into a low-noise airfoil section. Fan impeller shall be dynamically balanced for vibration-free operation. Fan guards of heavy gauge, PVC (polyvinyl chloride) coated or galvanized steel.

F. CONTROLS

1. General: Automatic start, stop, operating, and protection sequences across the range of scheduled conditions and transients.

2. Power/Control Enclosure: Rain and dust tight NEMA 3R powder painted steel cabinet with hinged, latched, and gasket sealed door.

3. Microprocessor Control Center:

   a. Automatic control of compressor start/stop, anti-coincidence and anti-recycle timers, automatic pumpdown at system shutdown, condenser fans, evaporator pump, evaporator heater, unit alarm contacts, and chiller operation from 0°F to 125°F ambient. Automatic reset to normal chiller operation after power failure.

   b. Software stored in non-volatile memory, with programmed setpoints retained in lithium battery backed real-time-clock (RTC) memory for minimum 5 years.

   c. Forty-character liquid crystal display, descriptions in English, numeric data in English units. Sealed keypad with sections for Setpoints, Display/Print, Entry, Unit Options & clock, and On/Off Switch.

   d. Programmable Setpoints (within Manufacturer limits): display language; chilled liquid temperature setpoint and range, remote reset temperature range, daily schedule/holiday for start/stop, manual override for servicing, low and high ambient cutouts, low liquid temperature cutout, low suction pressure cutout, high discharge pressure cutout, anti-recycle timer (compressor start cycle time), and anti-coincident timer (delay compressor starts).

   e. Display Data: Return and leaving liquid temperatures, low leaving liquid temperature cutout setting, low ambient temperature cutout setting, outdoor air temperature, English or metric data, suction pressure cutout setting, each system suction pressure, liquid temperature reset via a 4-20milliamp or 0-10 VDC input, anti-recycle timer status for each compressor, anti-coincident system start timer condition, compressor run status, no cooling load condition, day, date and time, daily start/stop times, holiday status, automatic or manual system lead/lag control, lead system definition, compressor starts/operating hours (each), status of hot gas valves, evaporator heater and fan operation, run permissive status, number of compressors running, liquid solenoid valve status, load & unload timer status, water pump status.

   f. System Safeties: Shall cause individual compressor systems to perform auto shut down; manual reset required after the third trip in 90 minutes. System Safeties include: high discharge pressure, low suction pressure, high pressure switch, and motor protector. Compressor motor protector shall protect against damage due to high input current or thermal overload of windings.

   g. Unit Safeties: Shall be automatic reset and cause compressors to shut down if low ambient, low leaving chilled liquid temperature, under voltage, and flow switch operation.

   h. Alarm Contacts: Low ambient, low leaving chilled liquid temperature, low voltage, low battery, and (per compressor circuit): high discharge pressure, and low suction pressure.

   i. BAS Communications: BACnet MS/TP communication capabilities are standard.

4. Manufacturer shall provide any controls not listed above, necessary for automatic chiller operation. Mechanical Contractor shall provide field control wiring necessary to interface sensors to the chiller control system.

G. POWER CONNECTION AND DISTRIBUTION

1. Power Panels: NEMA 3R/12 rain/dust tight, powder painted steel cabinets with hinged, latched, and gasket sealed outer doors. Provide main power connection(s), control power connections, compressor and fan motor start contactors, current overloads, and factory wiring.

2. Power supply shall enter unit at a single location, be 3-phase of scheduled voltage, and connect to individual terminal blocks per compressor. Separate disconnecting means and/or external branch circuit protection (by Contractor) required per applicable local or national codes.

3. Compressor, control and fan motor power wiring shall be located in an enclosed panel or routed through liquid tight conduit.

H. ACCESSORIES AND OPTIONS

1. Microprocessor controlled, Factory installed Across-the-Line type compressor motor starters as standard.

2. Outdoor Ambient Temperature Control

3. Power Supply Connections: Single Point Circuit Breaker: Single point Terminal Block with Circuit Breaker and lockable external handle (in compliance with Article 440-14 of N.E.C.) can be supplied to isolate power voltage for servicing. Incoming power wiring must comply with the National Electric Code and/or local codes.

4. Control Power Transformer: Converts unit power voltage to 120-1-60 (500 VA capacity). Factory-mounting includes primary and secondary wiring between the transformer and the control panel.

5. Protective Chiller Panels (Factory or Field Mounted): Wire Panels (full unit): Heavy gauge, welded wire-mesh, coated to resist corrosion, to protect con- denser coils from incidental damage and restrict unauthorized access to internal components.

6. Thermal Dispersion Flow Switch (Factory installed and wired in piping extension kit): Normally open, 30bar pressure rating, stainless steel 316L construction, IP67, -4°F to 158°F ambient rating.

7. Hot Gas By-Pass: Permits continuous, stable operation at capacities below the minimum step of unloading to as low as 5% capacity (depending on both the unit & operating conditions) by introducing an artificial load on the evaporator. Hot gas by-pass is installed on only one refrigerant circuit.

8. Sound Reduction (Factory installed): Compressor Acoustic Sound Blankets

I. Approved Manufacturers: Trane, York, Carrier, Daikin McQuay, Quantech.

1. Any listed equivalent manufacturer and the Mechanical Contractor shall be completely responsible to comply with all requirements on the contract documents. This shall include, but not be limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services.

2.2 SPLIT SYSTEM HEAT PUMP UNIT

A. Air conditioning system shall be a ducted or ductless split system heat pump. The system shall consist of a compact packaged evaporator section and matching outdoor air-cooled condensing unit. The units shall be listed by and bear the ETL label. All wiring should be in accordance with the National Electrical Code (N.E.C.). The units shall be rated in accordance with ARI Standard 240 and bear the ARI label. A full charge of refrigerant for 100 feet of refrigerant tubing shall be provided in the condensing unit. A dry nitrogen holding charge shall be provided in the evaporator. System SEER shall meet or exceed 2018 IECC Code.

B. The indoor unit shall be factory assembled and wired. The evaporator fan shall be an assembly with line flow fans direct driven by a single motor. The supply fan motor shall be multi-speed, permanent-split capacitor type with thermal overload protection and sealed, lifetime bearing. The fan shall be backward curved, centrifugal design, statically and dynamically balanced and run on permanently lubricated bearings.

C. The evaporator coil shall be nonferrous construction with smooth plate fins bonded to copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with

phoscopper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil. The unit shall be furnished with integral condensate pump with 27" minimum lift, factory mounted and wired.

D. The unit shall be constructed from galvanized steel that is insulated internally and externally with fire-resistant acoustic insulation.

E. The control system shall be microprocessor based. The wall-mounted remote-control enclosure shall include an LCD display providing a continuous display of operating status and condition. A keypad for setpoint/program control, unit ON/OFF, and fan speed shall be located below the display.

1. The auto restart feature shall automatically restart after a power failure.

2. The control shall have temperature control setpoint for cooling function with a minimum 2 deg. F differential. The temperature control setpoint range shall be 60 deg. F to 85 deg. F.

3. The LCD display shall provide an ON/OFF indication, fan speed indication, operating mode indication (cooling, dehumidifying) and current day, time, temperature and humidity (if applicable) indication.

4. Fan to have the ability to cycle ON/OFF.

F. Direct Expansion System Components:

1. The evaporative coil shall be constructed of copper tubes and aluminum fins. The coil shall be provided with a drain pan.

2. The refrigeration system shall consist of a hermetic compressor, pressure safety switches, externally equalized expansion valve, and a refrigerant sight glass and moisture indicator.

3. Low ambient control will allow cooling to 0 deg. F outdoor temperature.

G. Remote Air-Cooled Condenser: The condenser coil shall be constructed of copper tubes and aluminum fins, and a direct-drive centrifugal fan. No piping, brazing, dehydration or charging shall be required. Condenser electrical connection shall be by a factory wired plug. Fan shall be sized to provide full rated cooling capacity at 95 deg. F entering air. Provide wire guards on condenser coil and fan discharge.

H. Factory installed controls shall include connections for 24-volt, hard-wired, wall-mounted thermostat, control board featuring anti-short cycle timer, 60 second post purge fan relay, and relays and connectors for condensing unit control. Provide wall-mounted solid-state thermostat for field mounting and wiring to the indoor unit; the thermostat shall be capable of one-stage cooling, one-stage heating with manual changeover, as scheduled on the drawings.

I. Manufacturers: Carrier, Daikin McQuay, LG HVAC, Trane/Mitsubishi, Panasonic, Samsung.

1. Any listed equivalent manufacturer and the Mechanical Contractor shall be completely responsible to comply with all requirements on the contract documents. This shall include, but not be limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades.

2.4 CONDENSING UNIT (10-20 Tons)

A. General:

1. Furnish air-cooled condensing unit in accordance with the performance schedule shown on the plans.

2. Install them as shown on the plans in accordance with:

- The manufacturer's recommendations and
- All applicable national and local codes.

3. UL (CSA) approved.

4. Completely assembled for one-piece shipping and rigging.

5. Leak, pressure and functionally tested at the factory to assure a trouble-free start-up after installation.

6. In current production with published literature available to check performance, limitations, specifications, power requirements, dimensions, operation and appearance.

B. Unit Enclosure:

1. A steel angle frame to provide the rigid support required for shipping, rigging and years of dependable operation.

2. Exterior panels of 18-gauge galvanized sheet steel which have been bonderized and finished with baked enamel to provide a long-lasting quality appearance.

3. Removable panels to provide easy access to all internal components for maintenance, service and adjustment.

C. Each compressor shall be mounted on spring isolators and shall be enclosed in a separate compartment to minimize the transmission of sound and vibration.

D. Condenser Coils:

1. Shall be draw-thru, with manufacturer’s standard wire guards.

2. Shall be constructed of copper tubes arranged in staggered rows and mechanically expanded into aluminum fins, and
3. Shall have a separate circuit which will provide at least 19 degrees F of liquid sub-cooling at design conditions.

E. Condenser Fan Motors:

1. Shall be directly connected to the condenser fans,
2. Shall have permanently lubricated ball bearings, and
3. Shall have inherent overload protection.
4. Motors shall be of the permanent split-capacitor type.
5. Condenser fans shall be arranged for vertical discharge of the condenser air, with manufacturer’s standard wire guards.

F. The wiring for each unit shall include:

1. A crankcase heater (one per compressor).
2. A 24-volt temperature control circuit.
3. High and low-pressure circuits.
4. Condenser fan motor controls to assure stable operation of ambient temperatures down to 0 degrees F.
5. Condenser fan and compressor contactors factory wired to pressure lugs or terminal block for power wiring.
6. Factory mounted and wired fused disconnect switch.

G. The refrigerant piping for each system shall include:

1. A strainer-drier,
2. A moisture indicating sight glass, and
3. Service access valves.
4. Locking type, tamper resistance caps on all refrigerant access ports.

The strainer-drier and sight glass may be shipped separately for field installation.

H. Manufacturers: York, Carrier, Trane, Lennox, Daikin McQuay.

1. Any listed equivalent manufacturer and the Mechanical Contractor shall be completely responsible to comply with all requirements on the contract documents. This shall include, but not be limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades.

PART 3 – EXECUTION

3.1 REFRIGERATION EQUIPMENT

A. All equipment to be installed in accordance with manufacturer's recommendations.

3.2 AIR-COOLED CHILLER

A. Install in accordance with manufacturer's recommendations. Unit shall be properly supported and vibration isolated.

B. Provide pipe insulation and jacketing over freeze protection electric heaters on all exterior water piping. Coordinate with the work of Division 26.

3.3 SPLIT SYSTEM HEAT PUMP

A. Install split system units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

B. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory mounted.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements. Do not proceed with equipment start-up until wiring installation is acceptable.

3.4 FIELD QUALITY CONTROL

A. Start-up all units in accordance with manufacturer's start-up instructions. Replace damaged or malfunctioning controls and equipment.

B. Manufacturer's Field Services

1. Manufacturer shall furnish a factory trained service engineer without additional charge to start the unit(s). Representatives shall provide leak testing, evacuation, dehydration, and charging of the unit(s) as required. Chiller manufacturers shall maintain service capabilities to promptly respond within 24 hours or less to service calls at the site.

2. A start-up log shall be furnished by the manufacturer to document the chiller's start-up date and shall be signed by the owner or his authorized representative prior to commissioning the chillers.

3. The manufacturer shall furnish complete submittal wiring diagrams of the chiller(s) starter(s) and associated components such as pumps, interlocks, etc. as applicable.

END OF SECTION 23 04 50

SECTION 23 05 00
PIPING SYSTEMS & ACCESSORIES – HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the contract, including the conditions of the contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions

C. Refer to Section 230210 for HVAC Basic Materials & Methods.

1.2 DESCRIPTION OF WORK

A. This Section includes the following equipment:

1. In-Line Circulator Pumps
2. Base-Mounted End Suction Pumps
3. Suction Diffusers
4. Diaphragm-Type Expansion Tanks (Vertical)
5. High Efficiency Air Eliminator/Dirt Separator
6. Water Feeders
7. Relief Valve (Water Systems)
8. Balancing Valves
9. Combination Valve Package for Pumps
10. Flexible Pump Connectors

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

1.4 QUALITY ASSURANCE

A. Refer to Section 230210 for a general description of requirements applying to this Section.

B. Whenever a variable frequency PWM drive is installed to control an AC motor, a maintenance-free, circumferential, conductive micro fiber shaft grounding ring shall be installed on the AC motor drive end to discharge shaft currents to ground. Recommended part: AEGIS SGR™ Bearing Protection Ring, as made by Electro Static Technology. Install in accordance with the manufacturer's written instructions.

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 230200.

B. Submit the following:

1. Shop Drawings
2. Manufacturers Product Data
3. Test Reports on Piping System Tests

1.6 SUBSTITUTIONS

A. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but not be limited to,

space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items furnished and installed by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, this Contractor shall be responsible for any and all additional costs associated with the changes required by other trades.

1.7 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, General Requirements.

PART 2 – PRODUCTS

2.1 IN-LINE CIRCULATOR PUMPS

A. Provide in-line circulator pumps where indicated, and of capacities as scheduled.

B. End suction with vertically split casing, close coupled, single stage, designed for 175 psi working pressure.

C. Cast iron body, 125 psi ANSI flanges of equal size, tappings for gauge and drain fittings.

D. Steel shaft with replaceable shaft sleeve and standard mechanical seal with ceramic seal seat.

E. Enclosed type impeller hydraulically and dynamically balanced, keyed to shaft and secured with locking screw.

F. Manufacturers: Subject to compliance with requirements, provide pumps of one of the following:

Armstrong Pumps
Aurora
Bell & Gossett
Ingersoll Rand
Peerless
Patterson
Paco
Taco

2.2 BASE-MOUNTED END SUCTION PUMPS

A. Provide frame-mounted end suction pumps where indicated, and of capacities and having characteristics as scheduled.

B. Horizontal mount, single stage, flexible coupling, base-mounted, designed for 175 psi working pressure.

C. Cast iron casing 125 psi ANSI flanges, tappings for gauge and drain connections.

D. Steel shaft with replaceable shaft sleeve, regreasable ball bearings and mechanical seals with carbon seal ring and ceramic seat.

E. Non-overloading motor at any point on pump curve, open, drip-proof, ball bearings, 15,000 hours bearing life, with lifting lug on top of motor.

F. Provide open drip-proof motor with regreasable ball bearings.

G. Enclosed type impeller hydraulically and dynamically balanced, keyed to shaft and secured with locking screw.

H. Structural steel baseplate with welded cross members, and open grouting area.

I. Flexible coupling capable of absorbing torsional vibration, equipped with coupling guard.

J. Manufacturers: Subject to compliance with requirements, provide pumps of one of the following:

Armstrong Pumps
Bell & Gossett
Aurora
Ingersoll Rand
Peerless
Patterson
Paco
Taco

2.3 SUCTION DIFFUSERS

A. Provide at each base-mounted pump, a suction diffuser of size required for pump connection. Units shall consist of angle type body with straightening vanes and combination diffuser-strainer-orifice cylinder with 3/16" diameter openings for pump protection. A permanent magnet shall be located within the flow stream and shall be removable for cleaning. The orifice cylinder shall be equipped with a disposable fine mesh strainer which shall be removed after system start-up. Orifice cylinder shall be designed to withstand pressure differential equal to pump shutoff head and shall have a free area equal to five times cross section area of pump suction opening. Straightening vanes shall extend the full length of the orifice cylinder and shall be replaceable. Unit shall be provided with adjustable support foot to carry weight of suction piping.

B. Manufacturers: by pump manufacturer.

2.4 DIAPHRAGM-TYPE EXPANSION TANKS (VERTICAL)

A. Fabricate tank of continuously welded steel plate of the size shown conforming to ASME Section VIII Standards, maximum working pressure of 125 psi.

B. Provide air charging valve, drain-offs, system connection and other piping connections. Paint outside of tank with a zinc chromate primer.

C. Provide a standard cleanout hole located in the tank head.

D. Tank shall have a sealed-in heavy-duty butyl diaphragm suitable for operation from 40 to 240 degrees F.

E. Tank shall be furnished with an ASME stamp.

F. The tanks shall be manufactured by Amtrol, Bell and Gossett, Patterson, Stover Tanks, Taco, Wheatley, John Wood.

2.5 HIGH EFFICIENCY AIR ELIMINATOR / DIRT SEPARATOR

Provide as shown on the drawings a combination full flow coalescing type high efficiency air eliminator / dirt and sediment separator on the hot and chilled water systems.

A. All units shall be selected at the point of peak efficiency per the manufacturer’s recommendations.

B. Air eliminators / separators shall be fabricated steel, rated for 150 psig working pressure with entering velocities not to exceed 4 feet per second at specified GPM. Designated models specifically designed for high velocity systems may have an entering velocity of up to 10 feet per second.

C. Vessel diameter shall be a minimum of two times pipe size. Vessel height above the nozzle center-line shall be a minimum of 3 times pipe size for standard units and 4.5 times pipe size for high velocity units. Vessel shall extend below nozzle center-line the same distance for dirt separation.

D. Units shall include an internal bundle filling the entire vessel to suppress turbulence and provide high efficiency. The bundle shall consist of a copper core tube with continuous wound copper medium permanently affixed to the core. A separate copper medium shall be wound completely around and permanently affixed to each internal element.

E. Each eliminator shall have a separate venting chamber to prevent system contaminants from harming the float and venting valve operation. At the top of the venting chamber shall be an integral full port float actuated brass venting mechanism.

F. Units shall include a valved side tap to flush floating dirt or liquids and for quick bleeding of large amounts of air during system fill or refill.

G. Unit shall include a blow down valve at bottom for removal of collected dirt and sediment.

H. Air eliminator function shall be capable of removing 100% of the free air, 100% of the entrained air, and up to 99.6% of the dissolved air in the system fluid during continuous circulation.

I. Dirt and sediment separator function shall be capable of removing 80% of particles 30 micron and larger within 100 passes. A properly selected strainer shall be installed upstream to collect large debris that may be left in the piping.

J. (Optional) Provide removal head to facilitate internal element inspection or cleaning if required. Elements shall include tube sheets top and bottom and be manufactured as a bundle for ease or removal. Verify space required for bundle removal.

K. Manufacturer: Spirovent®, Bell & Gossett, Taco.

2.6 WATER FEEDERS

A. Each water circulating system shall have make-up water introduced through a pressure regulating valve provided with a three-valve bypass and a strainer.

B. The pressure regulating valve shall be manufactured by McDonnell and Miller, A.W. Cash, Bell and Gossett.

2.7 RELIEF VALVE (WATER SYSTEMS)

A. Each water circulating system of the closed type shall be provided with a pressure relief valve selected to suit the system heat generation capacity and set at 75 psig. Valves shall have casts bronze or cast steel body suitable for 250 PSIG and 450°F, stainless steel bushing, ring pin, and nickel alloy compression screw.

B. This discharge from the relief valves shall be piped to a drain.

C. Relief valves shall be manufactured by McDonnell and Miller, Bell and Gossett, A.W. Cash Company.

2.8 BALANCING VALVES

A. Balancing valves shall be installed where indicated.

B. Provide, as shown on the plans, balancing valves with provision for connecting a portable differential (Ft. of Head) pressure meter. Each meter connection shall have pressure/temperature readout ports.

C. The balancing valves shall be either a bronze body/brass ball valve, or a Y-pattern globe valve style design and all metal parts of non-ferrous, pressure die-cast, nonporous Ametal copper alloy. Each valve can be installed in any direction without affecting flow measurement and shall provide four (4) functions:

1. Precise flow measurement
2. Precision flow balancing
3. Positive shut-off with no drop seat and teflon disc
4. Drain port suitable for hose bib fitting.

D. The valves shall have four (4) 360 deg. adjustment turns of handwheel for maximum setting with hidden memory feature to program the valve with precision tamperproof balancing setting.

E. Design Pressure/Temperature:

1/2" - 3" NPT connections 300 psig at 250 deg. F.
1/2" and 3/4" sweat connections 200 psig at 250 deg. F.
2" – 4" flanged or grooved connections 250 psig at 250 deg. F
4" flanged connections 175 psig at 250 deg. F.

F. Flow sensor: For installation in piping 5" and larger, a precision wafer type orifice insert installed between standard 125 psi at 250 deg. F ANSI flanges to monitor system flow; cast iron body with integral brass EPT check valves to accommodate a differential pressure meter; furnish with calibrated nameplate with flow range through a range of differential head pressures; provide globe valve at each sensor to adjust flow to design conditions.

G. Manufacturers: Tour & Andersson, Armstrong, Bell & Gossett, Nexus Valve, Taco, Victaulic, Wheatley.

OR

A. Furnish and install, as shown on the plans, Balancing Valves with provisions for connecting a portable differential (Ft. of Head) pressure meter. Each meter shall have pressure/temperature probes.

B. The balancing valves shall be Y-pattern globe style design and all metal parts of nonferrous, pressure die cast, nonporous Ametal. Each valve shall provide four (4) functions:

1. Precise flow measurement
2. Precision flow balancing
3. Positive shut-off with no drip seat, eliminating the need of as additional isolation valve
4. Drain connection using ¾" NPT hose end thread

C. These valves shall have four (4) 360° adjustment turns of the handwheel for precise setting with hidden memory to provide a tamper-proof balancing setting. Handwheel shall have digital readout. The handwheel can be installed in any position without affecting performance.

D. Connections shall be ½" to 2" NPT or solder end

E. Manufacturers: Armstrong, Tour and Andersson, Wheatley, Nexus Valve, Vitaulic

OR

A. Furnish and install, as shown on the plans, balancing valves with provisions for connecting a portable differential (Ft. of Head) pressure meter. Each meter connection shall have pressure / temperature probes.

B. The balancing valves shall be Y-pattern globe style design with ductile iron body all other wetted parts of nonferrous, pressure die cast Ametal. Each valve shall provide (3) functions:

1. Precision flow measurement
2. Precision flow balancing
3. Shut-off feature, eliminating the need of an additional isolation valve

C. These valves shall have eight (8), twelve (12), sixteen (16), twenty (20) or twenty-two (22) 360° adjustment turns of the handwheel for precise setting with hidden memory feature to program the valve with precision tamper-proof balancing setting. Handwheel shall have digital readout. The handwheel can be installed in any position without affecting performance.

D. Connections shall be 2½" and larger flanged or grooved ends.

E. Manufacturers: Armstrong, Tour and Andersson, Wheatley, Nexus Valve, Vitaulic

2.9 COMBINATION VALVE PACKAGE FOR PUMPS

A. Each centrifugal pump shall be provided with the following valve assemblies:

1. Combination silent check valve, balancing valve and shut-off valve on pump discharge.

B. The combination units shall be flanged assemblies of 125 lb. ASA Class, 175 psi. W.O.G. @ 300 degrees F. The combination units shall be suitable for vertical or horizontal installation with the stem pointing up.

C. The body and bonnet shall be cast semi-steel; and the stem, seat and disc shall be bronze. The valve shall be designed for repacking under pressure.

D. The unit shall be provided with a calibrated stem indicator, and the check valve shall have a stainless-steel spring and be provided with disc designed for quiet operation at low flow rates.

E. Manufacturers: by Pump Manufacturer.

2.10 FLEXIBLE PUMP CONNECTORS

A. Provide braided stainless-steel pump connector(s) manufactured with annular corrugated stainless steel close-pitch hose with stainless steel overbraid. The corrugated metal hose, braid(s), and a stainless-steel ring-ferrule/band (material gauge not less than .048") must be integrally seal-welded using a 100% circumferential, full-penetration TIG weld.

B. End fittings shall be flat-face plate steel flanges with 150# ANSI drilling and outside diameter. Fittings must be attached using a 100% circumferential TIG weld. Braided stainless steel pump connector(s) must be suitable for operating temperatures up to 850°F. The rated working pressure of the braided metal hose must have a minimum 4:1 safety factor.

C. Each braided stainless-steel pump connector shall be individually leak tested by the manufacturer using air-under-water or hydrostatic pressure. Flanged pump connectors shall be prepared for shipment using cut-to-length spacers, securely positioned between the flanges to prevent axial compression damage and maintain the manufactured length. Spacers must be removed prior to system start-up.

D. Manufacturers: Amber/Booth, Flex-Hose Co., Inc., Mason Industries, Metra-Flex, Patterson, Proco Products, Inc., Twin City Hose, Inc.

PART 3 – EXECUTION

3.1 CIRCULATING PUMPS

A. Pump shall be installed in accordance with recommendations of the Hydraulic Institute.

B. Suction reducers shall be eccentric and located at the pump suction. Discharge increasers shall be concentric and located at the pump discharge.

C. Suction and discharge piping shall be adequately supported without imposing any load on the pump casing.

D. Pressure gauges shall be installed at the suction and discharge of each pump.

E. Vibration isolation equipment shall be provided where noted.

F. Impeller diameter used shall be approximately 85% of the maximum impeller diameter capable of being supplied for each pump.

G. The motor nameplate horsepower shall not be exceeded under any conditions of pump operation.

H. Prior to shipment, each pump shall be tested to insure its capability to produce the required capacity at the design head, and when requested written verification of this test shall be supplied.

I. Before grouting and piping the pump, the Contractor shall check to insure pump alignment is satisfactory, and where required, realign the pump. Fill baseplate with non-shrink grout to the top of the base rail.

J. Start-up service shall be provided by the pump manufacturer or his representative. This service shall include the following:

1. Check alignment
2. Check absence of pipe strain
3. Check lubrication
4. Check rotation
5. Take suction and discharge pressure gauge readings and compare with pump nameplate for operating head.
6. Take voltage and current readings and compare with motor nameplate.
7. Insure proper maintenance manuals are available if required.

3.2 PIPING SYSTEM DRAINS

A. All piping shall be graded or pitched toward drain locations which shall be provided with gate valve unless otherwise indicated on drawings or specified. Individual risers may be drained through removable plugs or caps.

B. Drain valves shall be provided at all major components in systems including boilers, pumps, heat exchangers, cooling towers, and similar equipment.

3.3 ECCENTRIC PIPE FITTINGS

A. Eccentric pipe fittings shall be furnished and installed in all piping and circulated water piping where a change in pipe size occurs in a horizontal run. In water systems the top of the adjacent pipe sections shall be maintained level.

3.4 CHEMICAL CLEANING

A. New boilers shall be boiled out with an alkaline type boiling out compound to remove grease, oil, mil scale and other foreign matter. The compound should be used at the rate of 1-1/2 pounds per 20 boiler horsepower. After the boiling out period, the boiler shall be completely drained, flushed and refilled with fresh water.

B. Closed re-circulating systems shall be filled and sufficient detergent and dispersant added to remove all dirt, oil and grease. System shall be circulated for at least 48 hours after which a drain valve at the lowest point shall be opened and allowed to bleed while the system continues to circulate. The automatic make-up valve shall be checked to be sure it is operating. Bleeding shall continue until water runs clear and all detergent is removed. A

sample of water shall be tested and if pH exceeds 8.0, draining should be resumed.

C. Drain all detergent solution from system piping and equipment to nearest floor drain or indirect waste point connected to the building's sanitary system.

END OF SECTION 23 05 00

SECTION 23 05 10
WATER TREATMENT (HVAC)

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provision of the contract, including the conditions of the contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions.

C. Refer to Section 230210 for HVAC Basic Materials & Methods.

1.2 DESCRIPTION OF WORK

A. This Section includes labor, material, equipment and supervision to provide a complete water treatment system for the following:

1. Cleaning and treatment of circulating HVAC chilled water system, hot water and steam system.

a. Cleaning Compounds.
b. Chemical Treatment for Closed Loop Systems.
c. Chemical Cleaning of New Systems

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

B. Requirements established within the portions of the Project Manual titled Division 1, General Requirements, are collectively applicable to the work of this section.

C. Technical Services: Provide the services of an experienced water treatment chemical engineer or technical representative to direct flushing, cleaning, pre-treatment, training, debugging, and acceptance testing operations; direct and perform chemical limit control during construction period and monitor systems for a period of 12 months after acceptance, including not less than four service calls and written status reports. Minimum service during construction/start-up shall be 8 hours.

D. Field Quality Control and Certified Laboratory Reports: During the one-year guarantee period, the water treatment laboratory shall provide not less than 12 reports based on on-site periodic visits, sample taking and testing, and review with Owner, of water treatment control for the previous period. In addition to field tests, the water treatment laboratory shall provide certified laboratory test reports. These monitoring reports shall assess chemical treatment accuracy, scale formation, fouling and corrosion control, and shall contain instructions for the correction of any out-of-control condition.

E. Log Forms: Provide one year supply of preprinted water treatment test log forms.

1.4 SUBMITTALS

In accordance with Section 230200 provide the following:

A. Manufacturer's Literature and Data:

1. Cleaning compounds and procedures.

2. Chemical treatment for closed systems.

B. Water analysis verification.

C. Materials Safety Data Sheet for all proposed chemical compounds.

D. Maintenance and operating instructions.

PART 2 – PRODUCTS

2.1 CLEANING COMPOUNDS:

A. Alkaline phosphate or non-phosphate detergent/surfactant/specifically to remove organic soil, hydrocarbons, flux, pipe mill varnish, pipe compounds, iron oxide, and like deleterious substances, with or without inhibitor, suitable for system wetted metals without deleterious effects.

B. Refer to Section, PIPING SYSTEMS & ACCESSORIES - HVAC, PART 3, for flushing and cleaning procedures.

2.2 CHEMICAL TREATMENT FOR CLOSED LOOP SYSTEMS:

A. Inhibitor: Provide sodium silicate, sodium nitrite/borate, or other approved proprietary compound suitable for make-up quality and make-up rate and which will cause or enhance bacteria/corrosion problems or mechanical seal failure due to excessive total dissolved solids. Shot feed manually. Maintain inhibitor residual as determined by water treatment laboratory, taking into consideration residual and temperature effect on pump mechanical seals.

B. pH Control: Inhibitor formulation shall include adequate buffer to maintain pH range of 8.0 to 10.0.

C. Performance: Protect various wetted, coupled, materials of construction including ferrous, and red and yellow metals. Maintain system essentially free of scale, corrosion, and fouling. Corrosion rate of following metals shall not exceed specified mills per year penetration; ferrous, 0.5; brass, 0.2; copper, 0.15. Inhibitor shall be stable at equipment skin surface temperatures and bulk water temperatures of, respectively, not less than 250- and 125-degrees Fahrenheit. Heat exchanger fouling and capacity reduction shall not exceed that allowed by fouling factor 0.0005.

D. Pot Feeder: By-pass type for chemical treatment schedule 10 gauge heads, 3/4-inch system connections and large neck opening for chemical addition. Feeder shall be bypass filter feeder, minimum five gallon, installed per detail on the drawings, for chilled water system, and for hot water system.

E. Water Analysis: Confirm raw water analysis or provide analysis if none is furnished.

Description	Year (Avg.)
Silica ($Si0_2$)	_____
Insoluble	_____
Iron & Aluminum	_____
Calcium (Ca)	_____
Magnesium (Mg)	_____

Sodium & Potassium (Na & K) _____

Carbonate (CO_3) _____

Bicarbonate (HCO_3) _____

Sulfate (SO_4) _____

Chloride (Cl) _____

Nitrate (NO_3) _____

Turbidity _____

pH _____

Residual Chlorine _____

Total Alkalinity _____

Non Carbonate Hardness _____

Total Hardness _____

Dissolved Solids _____

Fluorine _____

F. Conduct performance test to prove capacity and performance of treatment system.

Raw water total hardness, ppm.

Concentration cycles.

Raw water, pH.

System water, pH.

Chemical solution used.

Acid solution used, obe.

Quantity or chemical solution injected into system per cycle.

Quantity of acid injected into system per cycle.

Make up water required.

Waste to drain requirement.

G. Recommended Conditions

1. Buffered Nitrite:

a. For temperatures 140ºF to 180ºF - 1000 ppm as sodium nitrite.

2. Molybdate:

a. 50 - 100 ppm as molybdate (chilled water).

3. pH - 7.0 to 10.0

2.3 CHEMICAL CLEANING OF NEW SYSTEMS

A. Boil out boilers with an alkaline type boiling out compound to remove grease, oil, mill scale and other foreign matter. Compound should be used at the rate of 1-1/2 lbs. per 20 boiler HP. After boiling out period, completely drain, flush and refill boiler with fresh water.

B. Fill closed recirculating systems and add sufficient detergent and dispersant to remove all dirt, oil and grease. Circulate system for at least 24 hours, after which open a drain valve at lowest point, open the make-up water valve and allow to bleed while system continues to circulate. Check the automatic make-up valve to be sure it is operating. Bleeding shall continue until water runs clear and all detergent is removed. Test sample of water and if pH exceeds the pH of the makeup water, flushing shall be resumed.

C. Drain all detergent solution from system piping and equipment to nearest floor drain or indirect waste point connected to the building's sanitary system.

PART 3 – EXECUTION

3.1 INSTALLATION:

A. Delivery and Storage: Deliver all chemicals in manufacturer's sealed shipping containers. Store in designated space and protect from deleterious exposure and hazardous spills.

B. Install equipment furnished by the chemical treatment supplier and charge systems according to the manufacturer's instructions and as directed by the Technical Representative.

C. Perform tests and report results.

D. Instruct owner personnel in system maintenance and operation.

3.2 INSPECTIONS AND MAINTENANCE:

A. Furnish complete inspection and maintenance service on water treatment equipment for a period of one year after completion and acceptance of the water treatment equipment installation. This maintenance service shall begin concurrently with the guarantee. Maintenance work shall be performed by skilled personnel directly employed and supervised by the same company that provided the water treatment equipment specified herein.

B. The maintenance service shall include the following:

1. Monthly systematic examination of equipment.

2. Cleaning, lubricating, adjusting, repairing and replacing of all parts as necessary to keep the equipment in first-class condition and proper working order.

3. Furnishing all lubricant, cleaning materials and parts required.

4. The operational system shall be maintained to the manufacturer's standards specified including any changes and/or adjustments required to meet varying conditions.

5. Provide 24-hour emergency call-back service which shall consist of promptly responding to calls within two hours for emergency service should a shutdown or emergency trouble develop between regular examinations. Overtime emergency call-back shall be limited to minor adjustments and repairs required to protect the immediate safety of the equipment.

6. Service personnel shall report to the owner or his authorized representative upon arrival and again upon completion of the required work. A copy of the work ticket containing a complete description of the work performed shall be given to the owner.

7. The Contractor shall maintain a log in the boiler room. The log shall list the date and time of all monthly examinations and all trouble calls. Each trouble call shall be fully described including the nature of the call, necessary correction performed and/or parts replaced.

END OF SECTION 23 05 10

SECTION 23 06 00
AIR DISTRIBUTION & ACCESSORIES – HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the contract, including the conditions of the contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions

C. Refer to Section 230210 for HVAC Basic Materials & Methods.

D. This Contractor shall coordinate with the work of Division 26 and the Fire Alarm System vendor for locations and mounting of all duct smoke detectors. These devices are shown on the Mechanical Drawings for reference only to show the intent of the work. All locations shall be determined based on approved shop drawings from the Fire Alarm System vendor and the Contractor for the work of Division 26, Electrical. Mount smoke detectors in the supply and return air stream at each unit in accordance with NFPA 72.

1.2 DESCRIPTION OF WORK

A. This Section includes labor, material, equipment and supervision to provide a complete air distribution system as specified herein and as shown on drawings.

1. Ductwork – Single Wall, Square and Rectangular
2. Ductwork - Single Wall, Spiral Round
3. Double Wall Round Duct
4. Flexible Air Duct
5. Flexible Connections
6. Dampers
7. Fire Dampers
8. Air Diffusers, Registers and Grilles
9. Prefabricated Roof Curbs and Equipment Supports
10. Sound Attenuation
11. Duct Access Doors (Interior)
12. Fabric Air Dispersion Ductwork

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

B. Requirements established within the portions of the Project Manual titled Division 1, General Requirements, are collectively applicable to the work of this section.

C. IMC (International Mechanical Code).

D. SMACNA (Sheet Metal and Air Conditioning Contractors National Association, Inc.)

E. American Society of Heating, Refrigerating and Air Conditioning Engineers' recommendations in ASHRAE Guide shall apply to this work.

F. ARI Standard 885 - Standard for Estimating Occupied Sound Levels in the Applications of Air Terminals and Air Outlets.

G. UL (Underwriter's Laboratories, Inc.)

H. NFPA 90A and 96 shall apply to this work.

I. State Fire Prevention Regulations.

1.4 QUALITY ASSURANCE

A. Refer to Section 230210 for a general description of requirements applying to this Section.

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 230200.

B. Submit the following:

1. Shop drawings of all sheet metal. Indicate all steel, piping, conduit, and Architectural/Structural features to demonstrate complete coordination. Scale shall not be less than ¼".

a. Shop drawings shall indicate the sizes and lengths of each section of ductwork as well as all system components such as coils, access doors, dampers, diffusers and register locations. Also indicate the type of joints used and where internal acoustic lining or insulation, if required, will be utilized.

b. The location of the duct runs and the air outlets shall be closely coordinated with all other trades by the sheet metal contractor to avoid interference. The shop drawings shall show the contact surfaces adjacent to the ducts or air outlets and the space assigned for concealment. The drawings shall indicate principal items of equipment, adjacent piping and conduit, etc., the location of which shall be secured from the contractors of other trades.

c. Sheet Metal Contractor to include resubmissions of the shop drawings to the Engineer. The resubmissions are to include all corrections to previous submissions.

2. Manufacturer's literature and performance data of all equipment and devices.

3. Samples: Furnish color samples, etc., at request of the Architect.

1.6 SUBSTITUTIONS

A. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but shall not be limited to space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items furnished and installed by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, they shall be responsible for any and all additional costs associated with the changes required by other trades.

1.7 WARRANTY GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, General Requirements.

PART 2 – PRODUCTS

2.1 DUCTWORK (SINGLE WALL, SQUARE AND RECTANGULAR)

A. All ductwork shall be fabricated in accordance with SMACNA "HVAC Duct Construction Standards - Metal and Flexible" latest Edition except as described below. The minimum thickness of metal ductwork is 26 gauge. Fabrication requirements shall be based on ductwork subjected to positive or negative pressures of 4" W.G. Ductwork systems shall be sealed to SMACNA "Seal Class "A" Standards. Alternatively, "Ductmate" System 45 can be used in accordance with manufacturer's specifications. Drive slip joints are not permitted.

Exception: For ductwork smaller than 12" x 8", Contractor may provide slip and drive joints with all joints sealed with Hardcast tape and mastic system.

B. Rectangular ducts for 4" W.G. or less, positive or negative pressure shall be per SMACNA Table 1-7. Longitudinal seams shall be Pittsburgh Lock Type L-l per SMACNA Figure 1-5. Transverse joints shall be standing seam type T -15 per Figure 1-4.

1. In the event that material size is not compatible with duct size and segmenting must be utilized to fabricate duct, use SMACNA Figure 1-5, seam L-4 (Standing Seam).

C. Joints:

1. Per SMACNA Transverse Joint Reinforcement Table 1-12, only joints T -22, T -25a, T -25b and Proprietary slip on flanges will be acceptable.

2. Joints T -25a and T -25b that have stress fractures from bending will not be accepted.

3. All joints will have butyl gasket 3/16" thick by 5/8" wide installed per manufacturers installation instructions.

D. Ductwork systems for this standard shall be galvanized sheet steel, commercial quality of lock - forming grade, conforming to ASTM coating standards A-525 or A-527 with coating of designation G-60. For corrosive or moist conditions, use coating designation G-90.

1. Where the outer surface of the duct is exposed in finished spaces and is not scheduled for insulation, duct material shall be galvannealed, suitable for field painting by the General Contractor.

E. The size and configuration of each duct shall be indicated on design drawings. Where thicker sheets or different types of materials are required, they shall be specified on the design drawings or in the project specifications.

F. Aluminum Rectangular Ductwork:

1. Aluminum ductwork shall be two B.& S. gauges heavier than specified for the equivalent width steel ductwork. Bracing, supports and joints shall be as specified for steel ductwork.

2. Aluminum ducts shall be used where the ducts are concealed when exhausting saturated air from dishwashing, showers, outside air intakes and similar designated spaces.

3. Dishwashing exhaust ducts shall be made watertight by means of silicone or 3M duct sealant properly installed and compressed at each joint and seam.

G. Kitchen exhaust duct shall have all joints, seams, penetrations and duct-to-hood collar connections with continuous, external, liquid-tight welds.

1. Carbon Steel: Fabricate from 16 gauge, ASTM-A569 hot rolled or ASTM-A366.

2. Stainless Steel: Fabricate from 18 gauge, Type 304, 2D finish.

3. Option: Factory fabricated grease duct system, U .L. listed, which meets all the requirements of NFPA 96.

2.2 DUCTWORK (SINGLE WALL, SPIRAL ROUND)

A. Design Pressure: 2”

B. Leakage: All ductwork shall meet SMACNA Class "A" leak standards.

C. Fabrication:

1. Gauges, reinforcing angles, seams, joints, fabrication methods, installation methods and practices, duct reinforcement, fabricated dampers and devices installed in duct system, fittings, etc., shall conform to the latest editions of SMACNA standards for construction in accordance with requirements indicated in these specifications.

2. Minimum metal gauges shall be 26 gauge (.019). Follow SMACNA Table 3-2A for Positive pressure and Table 3-2B for Negative pressure.

3. Where the outer surface of the duct is exposed in finished spaces and is not scheduled for insulation, duct material shall be galvannealed, suitable for field painting by the General Contractor.

D. Joints:

1. Duct up to 36" diameter - Male/Female beaded slip joint similar to SMACNA Figure 3-2, joint RT-1 or RT-5, as long as it meets the criteria for the system design pressure. Fittings shall be undersized to fit into spiral duct. All joints shall be secured with a minimum of 4 screws on each duct section (equally spaced). Seal joint with an approved sealant compound, continuously applied prior to assembly of joint and after fastening, making certain that the majority of the sealant resides on the interior of the joint.

2. In lieu of beaded slip, there are proprietary connections that may be used, as long as they meet the pressure criteria set forth in this specification.

2.3 DOUBLE WALL ROUND DUCT

A. Double wall round duct will be constructed of perforated inner liner, a 2 inches layer of fiberglass insulation, and an outer pressure shell. Duct will be spiral lock seam construction provided in standard 10 foot lengths. It will be fabricated from galvanized steel meeting ASTM-A527 standards, and in accordance with the following guidelines:

Inner Diameter (Inches)	**Outer Shell Min. Gauge (2-10 inches WG)**	**Inner Gauge**	**Fitting Gauge**
3-8	26	26	24
9-12	26	26	24
13-24	24	26	24
25-34	22	26	24
36-42	20	26	22

B. For 2 inch insulation, the outer shell will be 4 inches larger than the inner liner nominal dimension. When a perforated liner is specified, perforations will be 3/32 inch in diameter with an overall open area of 23

percent. Insulated duct will have a maximum thermal conductivity (k) factor of 0.27 Btu/Hr ./SF/inch at 75 deg. F mean ambient temperature.

C. Follow SMACNA Table 3-2A for Positive Pressure and Table 3-2B for Negative Pressure.

D. Joints:

1. Duct up to 16" diameter, Male/Female beaded slip joint similar to SMACNA Figure 3-2, Joint RT-1 or RT-5, as long as it meets the criteria for the system design pressure. Fittings shall be undersized to fit into spiral duct. All joints shall be secured with a minimum of 4 screws on each duct section (equally spaced). Seal joint with an approved sealant compound, continuously applied prior to assembly of joint and after fastening, making certain that the majority of the sealant resides on the interior of the joint. The inner liner slip connection shall be a minimum of 2" longer than the outer wall slip connection. Sealant is not required on the inner wall slip.

2. Duct 17" - 60" diameter, - Accuflange@ joint as manufactured by Accuduct, Inc. Installation is to be per manufacturer's recommendations. Companion angle Vanstone with full face gaskets having bolt holes punched through prior to insertion of bolts may be used in lieu of Accuflange. Gasketing to be 1/8" thick. Joint is per SMACNA Figure 3-2, joint RT -2 and RT -2A.

E. Finish: Where the outer surface of the duct is exposed in finished spaces and is not scheduled for insulation, duct material shall be galvannealed, suitable for field painting by the General Contractor.

Note: Type RT-2 or RT-3 joints are acceptable for concealed work or exposed in Mechanical Rooms. For exposed work in finished spaces, use RT-3 only.

2.4 FLEXIBLE AIR DUCT

A. Insulated flexible air duct shall be non-metallic. Air duct shall comply with the latest NFPA Bulletin No. 90A and be labeled as Class 1 Air Duct, U.L. Standard No. 181.

B. Air ducts shall be suitable for working pressure of not less than plus 10.0 and minus 0.5 inches of W.G.

C. Non-metallic air duct shall be two element spiral construction composed of a corrosion resisting metal supporting spiral and a vinyl coated fiberglass base fabric and shall be mechanically interlocked together.

D. Insulation shall be 1-1/2” thick fiberglass flexible blanket with vapor barrier outer jacket of polyethylene or reinforced mylar. Maximum thermal conductance of 0.23 Btu/Hr./SF/Inch at 75 deg. F temperature.

E. Approved manufacturers shall include the Wiremold Company, Flexmaster USA, Owens-Corning, Thermaflex Flex Vent.

2.5 FLEXIBLE CONNECTIONS

A. Required between ductwork and suction and discharge connection of all fans and air handlers.

B. Material: Woven fiberglass with mounting hardware tested in accordance with UL Standard 181, listed and labeled as Class 0 or 1.

C. Manufacturer: Ventfabrics, Inc., Durodyne, Dynair, Ductmate Pro Flex.

2.6 DAMPERS

A. Provide where indicated and required to control flow of air and balance system.

B. Round dampers shall be single blade, molded synthetic bearings at each end, 20-gauge galvanized steel, adjusting quadrant and locking device. Round dampers shall be Ruskin Model MDRS25.

C. Rectangular and square dampers shall be opposed blade within 16-gauge galvanized steel channel frame with corner brace, 16-gauge galvanized steel blades; molded synthetic bearings and hex steel shafts, exposed or concealed linkage, adjustable quadrant and locking device. Dampers 10" and below shall be single-blade. Dampers shall be Ruskin Model MD35.

D. Approved Manufacturers: Ruskin, Arrow, Nailor-Hart, Pottorff, Lloyd Industries, Inc., Cesco Products, Louvers & Dampers, United Enertech.

2.7 FIRE DAMPERS

A. Fabricate in accordance with NFPA 90A and UL 555.

1. Ceiling Dampers: Galvanized steel, 22-gauge frame and 16-gauge flap, two layers 0.125 inch ceramic fiber on top side with locking clip.

2. Horizontal Dampers: Galvanized steel, 22-gauge frame, stainless steel closure spring, and lightweight, heat retardant, non-asbestos fabric blanket.

3. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for closure under air flow conditions. Configure with blades out of air stream except for 1.0 inch pressure class ducts up to 12 inches in height.

4. Multiple Blade Dampers: 16 gauge galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 x ½ inch plated steel concealed linkage, stainless steel closure spring, blade stops and lock.

5. Fusible Links: UL 33, separate at 160 deg. F with adjustable link straps for combination fire/balancing dampers.

B. Fire dampers of the applicable rating shall be provided at all locations where ductwork penetrates fire-rated walls, ceilings, or floors. Refer to Architectural Drawings.

C. Manufacturers: Air Balance, Inc., Ruskin, Louvers & Dampers, Prefco, Phillips-Aire, Metalaire, Pottorff, Lloyd Industries, Inc., Cesco Products, Greenheck, United Enertech.

2.8 AIR DIFFUSERS, REGISTERS AND GRILLES

A. Air diffusing terminals shall be provided in duct runs on drawings. The diffusers shall properly and uniformly distribute the design air quantity with no objectionable drafts, while maintaining not more than 50 F. P. M. velocity in the occupied portion of the space.

B. Ceiling Diffusers:

1. Square Louvered Diffuser Face:

a. Square housing, welded steel construction core of square concentric louvers, removable at face of diffuser, round duct connection, with borders suitable for lay-in ceiling tile application.

b. Diffuser Patterns: Fixed louver face for 1, 2, 3, or 4 direction air flow, direction indicated on drawings.

c. Finish: Matte white finish.

d. Manufacturers: Price Model SMD

2. Linear Diffusers:

a. Linear diffusers shall be horizontal continuous slot type with multiple slots per the schedule and drawings. Construction shall be extruded aluminum with 1/2", 3/4" or 1 " slots. The diffusers shall have integral devices to equalize air flow over the entire length of the diffuser.

b. Multiple sections of diffusers shall be installed in a continuous arrangement, the butt ends shall be provided without flanges to provide a continuous effect. Multiple sections shall be aligned and fastened with alignment pins and slots or a similar method.

c. Linear diffusers shall be provided with adjustable vanes to provide horizontal, vertical or midway patterns of air diffusion. Finish as selected by Architect.

3. Round Cone Diffusers:

a. Adjustable round cone diffuser, welded steel construction with round neck and removable inner assembly of cones.

b. Air pattern shall be field adjustable from horizontal to vertical.

c. Finish: Matte white finish

d. Price Model RCD

C. Registers & Grilles:

1. Registers and grilles shall be steel construction, fixed single deflection type, with clips and/or flange holes and screws (as required by Architectural finishes) to secure registers to ceiling construction. Face bars shall be inclined 30 degrees. Registers and grilles shall be factory primed and painted with a baked-on white enamel finish.

2. Wall Supply Registers:

a. Provide manufacturer's standard wall registers where shown; of size, shape, capacity, type of materials and components indicated.

b. Register Materials: Steel construction: Manufacturer's standard stamped sheet steel frame and adjustable blades.

c. Register Faces: Horizontal Straight Blades, individually adjustable, at manufacturer’s standard spacing.

d. Register Patterns: Double Deflection: 2 sets of blades in face, rear set at 90 degrees to face set.

e. Register Finishes: Aluminum Enamel: Air-dried aluminum enamel prime finish.

3. Supply Grilles (SG):

a. Aluminum supply grilles shall be available parallel to the long dimension of the grille. All supply grilles shall be constructed with a 11/4-inch wide heavy aluminum border having a minimum thickness of 0.040-0.050 inch. Outer borders shall be assembled and interlocked at the four corners and mechanically staked to form a rigid frame. Screw holes shall be countersunk for a neat appearance.

b. Blades shall be constructed of heavy duty aluminum and shall be contoured to a specifically designed airfoil cross-section to meet published performance data. Where indicated in drawing schedule or plans opposed-blade volume damper shall be constructed of heavy gauge steel or aluminum.

c. The finish shall be #26 white. The finish shall be a baked on anodic acrylic paint, with a pencil hardness of HB to H.

d. Price Model 22

4. Ceiling Return Grille (CR):

a. Ceiling grilles shall have a perforated face with 3/16-inch diameter holes on 1/4-inch staggered centers and no less than 51 percent free area. Perforated face shall be aluminum according to the model selected. The back pan shall be one piece stamped heavy gauge steel of the sizes and mounting types shown on the plans and outlet schedule.

b. The finish shall be #26 white. The finish shall be a baked on anodic acrylic paint, with a pencil hardness of HB to H. Inside of back pan shall be painted flat black.

c. Price Model PDDR

5. Return, Exhaust and Transfer Grilles (RG, EG & TG):

a. Grilles shall be available parallel to the long dimension of the grille. Construction shall be of steel with a 11/4-inch wide border on all sides. Screw holes shall be countersunk for a neat appearance. Corners shall be welded with full penetration resistance welds.

b. Deflection blades shall be firmly held in place by mullions from behind the grille and fixed to the grille by welding in place. Blade deflection angle shall be available at 35°.

c. The finish shall be #26 white. The finish shall be a baked on anodic acrylic paint, with a pencil hardness of HB to H.

d. Price Model 535 FL(RG,EG & TG)

6. Heavy-Duty Return Grille

a. Grille shall be 45-degree deflection fixed louver type with blades spaced ¾” on center.

b. The outlet shall have 14-gauge steel blades and heavy duty steel support bars and frames.

c. Blades shall run parallel to the long dimension of the grille.

d. The finish shall be #B12 white. The finish shall be a baked on anodic acrylic paint.

7. Ceiling Louvered Return Filter Grille (CR):

a. Return filter grilles shall be of size and mounting type as shown on the drawings and schedules.

b. Borders shall be constructed of steel with countersink holes or frame suitable for ceiling finish in each room.

c. The four corners shall be interlocked and mechanically staked to form a rigid frame.

d. Deflection blades shall be ½ inch spacing, 45° deflection.

e. Return grilles shall be provided with a filter frame that will accommodate a standard 1-inch thick disposable filter to fit the specified duct size. Filter shall be grille module size minus 4 inches. Filter capacity shall be as scheduled on the drawings.

f. Return grille finish shall be white powder coat.

g. Price Model 535FF

D. Manufacturers: Provide diffusers, registers and grilles of one of the following:

Anemostat	Price
Carnes Co.	Titus
Krueger	Tuttle & Bailey
Metalaire	Nailor Industries

2.9 PREFABRICATED ROOF CURBS AND EQUIPMENT SUPPORTS

A. Factory fabricated by the manufacturer of the respective roof-mounted equipment when available and capable of meeting the following requirements:

1. Thermally and acoustically insulated, rubber isolating pads.

2. Built to suit slope of roof and type of roofing; i.e. standing metal seam with integral cant strip and flashing extension.

3. 8” to 11” height unless otherwise indicated.

4. Support rails shall be aluminum, or sheet steel, with continuous wood nailer and removable counterflashing.

B. Curbs shall be a product of a custom manufacture in the following cases:

1. Curbs as specified are not available from the respective equipment manufacturer.

2. Piping or ducts penetrating roof.

3. Prefabricated equipment supports are required.

4. Step flashing assembly, EPDM for normal use and silicone for pipe temperatures above 200°F stainless steel clamp, suitable for single or multiple pipes.

C. Pipe supports shall be a product of a custom manufacture equal to Pipe Prop as made by JMB Industries, or Anvil International Haydon H-Block.

D. Manufacturers: Pate, Shipman, Custom Curb, Portals Plus, Lloyd Industries, Inc.

2.10 SOUND ATTENUATION

A. Provide silencers of the types and sizes shown on plans.

B. Materials and Construction:

1. Outer casings of rectangular silencers shall be made of 22 gauge galvanized steel in accordance with

ASHRAE Guide recommended construction for high pressure rectangular duct work. Seams shall be lock formed and mastic filled.

2. Outer casings of tubular silencers shall be made of galvanized steel.

3. Interior partitions for rectangular silencers shall be made of not less than 26 gauge galvanized perforated steel.

4. Interior construction of tubular silencers shall be compatible with the outside casings.

5. Filler material shall be of inorganic mineral or glass fiber of a density sufficient to obtain the specified acoustic performance and be packed under not less than 5 % compression to eliminate voids due to vibration and settling. Material shall be inert, vermin and moisture-proof.

6. Combustion rating for the silencer acoustic fill shall be not less than the following when tested in accordance with ASTM-E-84, NFPA Standard 255 or UL No. 723:

Flamespread Classification	25
Smoke Development Rating	15
Fuel Contribution	20

7. Airtight construction shall be provided by use of a duct sealing compound on the job site. Material and labor furnished by contractor. Silencers shall not fail structurally when subjected to a differential air pressure of 8 in. w .g. inside to outside of casing.

C. Acoustic Performance: Silencer ratings shall be determined in a duct- to-reverberant room test facility which provides for airflow in both directions through the test silencer in accordance with ASTM Specification E-477. The test set-up and procedure shall be such that all effects due to end reflection, directivity, flanking transmission, standing waves and test chamber sound absorption are eliminated. Acoustic ratings shall include Dynamic Insertion Loss (DIL) and Self- Noise (SN) Power Levels both for Forward Flow (air and noise in same direction) and Reverse Flow (air and noise in opposite directions) with airflow of at least 2000 fpm entering face velocity.

D. Aerodynamic Performance: Silencer shall be of the low static pressure loss type. Airflow measurements shall be made in accordance with ASTM specification E-477 and applicable portions of ASME, AMCA and ADC airflow test codes. Tests shall be reported on the identical units for which acoustic data is presented.

E. Certification: With submittals, the manufacturer shall supply certified test data on Dynamic Insertion Loss, Self-Noise Power Levels, and Aerodynamic Performance for Reverse and Forward Flow test conditions. Test data shall be for a standard product. All rating tests shall be conducted in the same facility, shall utilize the same silencer, and shall be open to inspection upon request from the Architect/Engineer.

F. Manufacturers: Industrial Acoustics Co., Rink, Commercial Acoustics, Dynasonics, BRD, Pottorff, Vibro-Acoustics, Price.

2.11 DUCT ACCESS DOORS (Interior Locations)

A. SMACNA standard duct access doors shall be fabricated with 22-gauge galvanized steel door and frame with double wall construction.

1. Doors shall be fabricated of aluminum when installed in aluminum ductwork and stainless steel to match special duct systems.

B. Continuous piano type hinge, same material as door.

C. Latches shall be sash type locks equal to Ventlock 100 latches.

1. Doors 16" and under shall have one latch.
2. Doors over 16" shall have two latches.

D. Door seals shall be foam gasket material continuously bonded to perimeter of door frame.

E. Door insulation shall be 1" thick fiberglass, minimum 1.5 pcf density.

F. Doors shall be able to withstand 3" W.C. static pressure up to 12" x 12" in size; 2" W.C. above that size.

G. Makes: Cesco Products, Karp Co., Nailor-Hart Industries, Pottorff, Lloyd Industries, Inc., Ductmate Industries, Inc.

2.12 FABRIC AIR DISPERSION DUCTWORK

A. Product shall be constructed of a coated woven fire-retardant fabric complying with the following physical characteristics:

1. Type: Verona

2. Configuration: Standard: round

3. Fabric Construction: Plain polyester weave.

4. Coating: Porous.

5. Weight: 5.2 oz. per square yard.

6. Permeability: 2 cfm per square foot @ 0.5” WC

7. Color: Standard color as selected by the Architect

8. Warranty: 5 years on products for the fabric system

9. Temperature Range: 0 degrees F to 180 degrees F

10. Fire Retardancy: Classified by Underwriters Laboratories in accordance with the 25/50 flame spread/smoke developed requirements of NFPA 90-A.

B. Systems Fabrication Requirements:

1. Air dispersion accomplished by round vent, and consist of open orifices rather than a mesh style vent to reduce maintenance requirements (common to mesh style).
2. Size of and location of vents shall be specified and approved by manufacturer.

3. Inlet connection to metal duct via fabric draw band with anchor patches supplied by manufacturer. Anchor patches shall be secured to metal duct via. zip screw fastener - supplied by contractor.

4. Inlet connection includes zipper for easy removal / maintenance.

5. Lengths to include required zippers as specified by manufacturer.

6. System to include Adjustable Flow Devices to balance turbulence, airflow and distribution as needed. Flow restriction device shall include ability to adjust the airflow resistance from 0.06 - 0.60 in w.g. static pressure.

7. End cap includes zipper for easy maintenance.

8. Fabric system shall include connectors to accommodate suspension system listed below.

9. Any deviation from a straight run shall be made using a gored elbow or an efficiency tee. Normal 90-degree elbows are 5 gores and the radius of the elbow is 1.5 times the diameter of the DuctSox.

C. Design Parameters:

1. Fabric air diffusers shall be designed from 0.25" water gage minimum to 3.1" maximum, with 0.5" as the standard.

2. Fabric air diffusers shall be limited to design temperatures between 0 degrees F and 180 degrees F.

3. Design CFM, static pressure and diffuser length shall be designed and approved by the manufacturer.

4. Do not use fabric diffusers in concealed locations.

5. Use fabric diffusers only for positive pressure air distribution components of the mechanical ventilation system.

D. Suspension Hardware:

1. Internal Hoop System: Provide a factory fabricated retention system consisting of an internal 360° hoop system spaced on maximum 5’ centers. Each hoop shall be fabricated of lightweight aluminum ring and tubing with negligible effect on airflow static resistance. The rings located at the inlet and end of run shall include tensioning anchor clips to secure the fabric to the hoop system. Sizes shall include 8” to 36” diameter in 2” increments. The system shall be installed with a one row suspension system located 1.5” above top dead center of the fabric duct system. System attachment shall be either cables or u-track using gliders spaced 12” on center.

E. Manufacturer: Duct Sox by Fabric Air Dispersion Products, Fabric Air Inc., or KE Fibertec.

PART 3 – EXECUTION

3.1 DUCTWORK

A. Dimensions on drawings are inside dimensions. Sheet metal dimensions shall be increased to suit thickness of acoustic duct lining, if applicable. Ductwork that is lined with acoustic lining is not insulated.

B. Ducts shall be concealed unless otherwise indicated.

C. Changes in direction shall be made with radius bends or turning vanes.

D. Supports shall be galvanized steel for steel ductwork and aluminum for aluminum ductwork.

E. Locate ceiling air diffusers, registers, and grilles on "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling modules.

F. Do not install ductwork directly above any electrical equipment.

G. Ductwork shall be supported per SMACNA Standards except as follows:

1. Rivet or screw to side of duct when using flat strap hangers. Rivet or screw to bottom of duct when using trapeze hangers.

2. Extend hangers down the side of the duct at least 9"; pass hangers under ducts less than 9" deep.

3. Space hangers not more than 8' on centers for ducts up to 18" wide and 4' on centers for ducts over 18" wide.

4. Wire hangers are not acceptable.

5. Support ductwork from building structure with expansion bolts, rods, steel angles or channels installed to meet existing or new building conditions.

6. Drilling into the roof deck is not permitted.

7. Driving nails into anchors is not permitted.

H. Air Flow Control:

1. Major take-offs: Install volume control dampers.

2. Branches: Install volume control dampers in all branches and at tap in branch take-off connections.

3. Elbows: Use unvaned elbows with throat radius equal to width of duct and full heel radius; provide turning vanes where full throat and heel radius are not possible.

4. Transitions: Make transitions in ducts as required by structural or architectural interferences.

   a. Proportion airways to compensate for any obstructions within duct.
   b. Avoid dead ends and abrupt angles.
   c. Do not exceed 15 degrees slope on sides of transitions.

3.2 FLEXIBLE AIR DUCT

A. When flexible duct is used for final connection between duct mains on branches and diffusers on registers. The maximum length of flexible ductwork shall be 5'-0" in length.

B. Flexible ductwork shall be properly hung at the tap collar in order to prevent eventual wear and damage to the flexible duct.

C. The ceiling tile system should not be considered a support on which to lay flexible duct. Refer to SMACNA Standards for proper installation.

3.3 DUCT SYSTEM LEAK SEALING

A. Joints in duct systems at duct heaters, fire dampers, sound traps, and supply air terminals shall be sealed to prevent air leakage.

B. All duct joints and seams in medium pressure and high-pressure duct systems shall be sealed to SMACNA Seal Class" A" Standards to prevent air leakage.

C. In the event there is in excess of 5% air leakage indicated in low pressure duct systems, it shall be the Contractors responsibility to seal the duct system. The amount of sealing necessary shall be that required to obtain the design air quantity at each terminal.

D. Duct sealing shall be by means of high velocity duct sealants such as Hardcast and/or Neoprene gaskets. Type of sealant and method of application shall conform to recommendations in SMACNA high velocity duct construction standards.

3.4 DUCTWORK TESTING

A. The following ductwork shall be pressure leak tested:

1. Supply ductwork
2. Return ductwork
3. Exhaust ductwork
4. Outside air intake ductwork

B. Pressure leak test the following:

1. All ductwork within chases
2. 10% of all ducts
3. 100% of all major equipment (ERUs, RTUs, AHUs, EFs, etc.)
4. 10% of all equipment (FCUs, HPs, etc.)

C. All tests shall be conducted in accordance with AABC National Standards.

D. Ducts to be tested at 100% maximum of static pressure before any duct is insulated externally and concealed in accordance with SMACNA Standards.

E. Calculate the allowable leakage using leakage factor of 5% of Design Air Flow.

F. Select a limited section of duct for which the estimated leakage will not exceed capacity of the test apparatus.

G. Connect the blower and flow meter to the duct section and provide temporary seals at all openings of the ductwork.

H. Start the blower motor with the inlet damper closed. Increase pressure until the required level is reached.

I. Read the flow meter and compare the leakage in cfm. Reading should be 5% or less of design flow for the duct segment being tested.

J. If reading is more than 5% of design flow, depressurize duct, repair all leaks and retest until 5% or less of design flow is obtained.

K. Complete test reports and obtain Owner's witness signature.

L. Remove all temporary blanks and seals.

M. Warning: Do not overpressure duct.

3.5 EQUIPMENT

A. Test apparatus shall consist of an airflow measuring device, flow producing unit, pressure indicating devices and accessories necessary to connect the metering system to the test specimen.

B. The Contractor conducting tests shall arrange for or provide all temporary services, all test apparatus, all temporary seals and all qualified personnel necessary to conduct the specified testing.

C. Test apparatus shall be accurate within plus or minus 7.5% at the indicated flow rate and test pressure and shall have calibration data or a certificate signifying manufacture of the meter in conformance with the ASME Requirements for Fluid Meters. Verification of above, to be supplied to Owner upon request.

D. Pressure differential sensing instruments shall be readable to 0.05" scale division for flow rates below 10 cfm or below 0.5" w.g. differential. For flows greater than 10 cfm scale divisions of 0.1" are appropriate. U-tube manometers should not be used for reading less than 1" of water.

E. Liquid for manometers shall have a specific gravity of 1 (as water) unless the scale is calibrated to read in inches of water contingent on use of a liquid of another specific gravity, in which case the associated gauge fluid must be used.

F. Instruments must be adjusted to zero reading before pressure is applied.

3.6 TEST REPORT

A. Log the project and system identification data.

B. Enter the fan CFM, the test pressure, and the leakage class specified by the designer.

C. Enter an identification for each duct segment to be tested.

D. Calculate the allowable leakage factor. Enter this number on the report for each test segment.

E. Conduct and record the field tests. If the sum of the CFM measured is less than or equal to the sum of the allowable leakage, the test is passed. Record the date(s), presence of witnesses and flow meter characteristics.

F. Maintain a mechanical duct plan of all tested duct segments. Plan to include duct segment identification and dates tested.

G. Test reports shall be submitted as required by the project documents.

3.7 LABELING

A. At all fire damper locations, access doors in ductwork shall be identified with a permanent placard of red-white-red laminated commercial grade plastic construction, minimum one-half inch high capital letters, reading, “FIRE DAMPER” as appropriate for the installation. Attach securely to face of access door with brass screws at each corner, sealed airtight.

END OF SECTION 23 06 00

SECTION 23 06 05
FANS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the contract, including the conditions of the contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions

C. Refer to Section 230210 for HVAC Basic Materials & Methods.

1.2 DESCRIPTION OF WORK

A. This Section includes labor, material, equipment and supervision to provide a complete air distribution system as specified herein and as shown on drawings.

1. Recessed Ceiling Fan
2. Roof-Mounted Exhaust Fans
3. Vertical Discharge exhaust Fan (Kitchen, Dishwashing)
4. Centrifugal Belt Drive Cabinet Fan

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

B. Requirements established within the portions of the Project Manual titled Division 1, General Requirements, are collectively applicable to the work of this section.

C. IMC (International Mechanical Code)

D. SMACNA (Sheet Metal and Air Conditioning Contractors National Association, Inc.)

E. American Society of Heating, Refrigerating and Air Conditioning Engineers' recommendations in ASHRAE Guide shall apply to this work.

F. UL (Underwriter's Laboratories, Inc.)

G. NFPA 90A and 96 shall apply to this work.

H. State Fire Prevention Regulations.

1.4 QUALITY ASSURANCE

A. Refer to Section 230210 for a general description of requirements applying to this Section.

B. Whenever a variable frequency PWM drive is installed to control an AC motor, a maintenance-free, circumferential, conductive micro fiber shaft grounding ring shall be installed on the AC motor drive end to discharge shaft currents to ground. Recommended part: AEGIS SGR™ Bearing Protection Ring, as made by Electro Static Technology. Install in accordance with the manufacturer’s written instructions.

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 230200.

B. Submit the following:

1. Shop drawings of all sheet metal. Indicate all steel, piping, conduit, and Architectural/Structural features to demonstrate complete coordination. Scale shall not be less than 1/4" = 1'-0".

2. Manufacturer's literature and performance data of all equipment and devices.

1.6 SUBSTITUTIONS

A. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents and as described within the specifications. This shall include, but shall not be limited to space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items furnished and installed by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, they shall be responsible for any and all additional costs associated with the changes required by other trades.

1.7 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, General Requirements.

PART 2 – PRODUCTS

2.1 RECESSED CEILING FAN

A. Recessed ceiling fan shall consist of a rectangular steel cabinet enclosing a true centrifugal fan directly driven by an electric motor.

B. Cabinet shall be complete with a finished plastic ceiling grille and discharge collar equipped with a backdraft damper, metal or plastic, gravity or spring return.

C. Motor and fan shall be conveniently removable with plug-in power chord.

D. The casing shall be sound attenuated, with minimum ½” thick acoustic lining.

E. Provide electronic speed controller, roof terminal, metal grille, isolator package, time delay switch with adjustable relay as scheduled on the drawings.

F. Unit shall be AMCA certified.

G. Manufacturers: Loren-Cook, Penn Ventilator, Acme, Carnes, Greenheck.

2.2 ROOF-MOUNTED EXHAUST FANS

A. Aluminum casing shall be heavy gauge, mill finish of spun construction, weatherproof, removable, with aluminum birdscreen.

B. Aluminum centrifugal fan, adjustable V-belt drive selected for 150% of motor ampere rating.

C. Fans shall be quiet operating, selected for sound level below that of the space ventilated.

D. Accessories: Disconnect switch, insulated roof curb.

E. Manufacturers: Penn Ventilator Co., Greenheck, Loren Cook, Acme, Carnes.

2.3 VERTICAL DISCHARGE EXHAUST FAN (KITCHEN, DISHWASHING)

A. The exhaust fan shall be a vertical discharge, roof-mounted, power ventilator with heat, vapor and fume resistant features.

B. The casing shall consist of base curb cap, ventilated motor compartment, and upper and lower exterior wind bands. The casing shall be of mill finish aluminum of spun construction.

C. Fan wheel shall be centrifugal backward curved type constructed of aluminum. Back plate of fan wheel shall be finned to provide forced cooling of the motor compartment.

D. An insulated heat shield shall separate the ventilated motor compartment from the air stream, and a shaft seal shall prevent seepage of heat and fumes from around the shaft into the motor compartment.

E. The fan shaft shall be motor driven through a V-belt drive which shall be adjustable by varying the pitch diameter of the motor pulley. The drive shall be provided with a safety factor equal to 150% of the motor ampere nameplate rating. Provision shall be made for adjusting the V- belt tension.

F. A disconnect safety switch shall be mounted under the removable motor dome. The fan motor shall have copper windings.

G. The fan shall be provided with a bird guard constructed of stainless steel expanded metal.

H. Provision shall be made in the unit design for ready access for cleaning and for serving all components and accessories. Provide hinged curb cap with stay brace to fit onto curb.

I. An integral grease trough shall be provided on the fan base for applications on Type I kitchen ventilators, as well as a vented curb extension.

J. Special motors for high heat and explosion-proof shall be provided where indicated in the schedule.

K. The exhaust fan unit shall be AMCA certified and shall be as manufactured by Penn Ventilator Company, Loren Cook, Acme, Greenheck.

2.4 CENTRIFUGAL BELT DRIVE CABINET FAN

A. Fan shall be centrifugal belt driven in-line type. Fan housing shall be of the square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars.

B. Fan shall be provided with removable service doors located perpendicular to the motor mounting panel. The service doors must be of sufficient size to permit easy access to all interior components.

C. Fan wheel shall be of the aluminum backward inclined, centrifugal type. Wheels shall be dynamically and statically balanced and shall overlap the spun inlet venturi for maximum performance.

D. Motor and drives shall be isolated from the air stream. Motors shall be of the heavy duty type with permanently lubricated, sealed ball bearings. Wheel shaft shall be ground and polished shafting mounted in heavy duty permanently sealed pillow block bearings. Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shaft. Motor pulleys shall be adjustable for final system balancing.

E. Flexible wiring leads shall be provided from the fan motor to an external mounted junction box and disconnect switch permitting access for service without disconnecting the field wiring. All fans shall bear the AMCA Certified Ratings Seal for both air and sound performance.

F. Manufacturers: Penn Ventilator, Greenheck, Carnes, Loren-Cook.

PART 3 – EXECUTION

3.1 FANS, EQUIPMENT AND ACCESSORIES

A. Install in accordance with manufacturer's details and instructions.

B. Mount fan speed control at the fan to facilitate mechanical balancing. Power wiring shall be part of the work of Division 26.

C. Perform field mechanical balancing in accordance with Section 230950: TESTING AND BALANCING OF MECHANICAL SYSTEMS.

D. Install units in accordance with manufacturer’s installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer’s recommended clearances.

E. Support: Install and secure roof curb structure, in accordance with National Roofing Contractor’s Association (NRCA) installation recommendations and shop drawings. Install and secure units on curbs and coordinate roof penetrations and flashing.

F. The Mechanical Contractor shall own as a part of his work, the following:

Provide one (1) additional drive set, if necessary, to obtain final design balancing requirements. The Mechanical Contractor shall coordinate with Balancing Firm and equipment manufacturer for drive selection, including belts and pulleys.

END OF SECTION 23 06 05

SECTION 23 07 25
TERMINAL HEATING UNITS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the contract, including the conditions of the contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions

C. Refer to Section 230210 for HVAC Basic Materials & Methods.

1.2 DESCRIPTION OF WORK

A. This Section includes work necessary and/or required and materials and equipment for construction of a complete system. Such work includes, but is not limited to the following:

1. Unit Heaters
2. Cabinet Heaters
3. Hot Water Coils
4. Electric Cabinet Heaters

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

1.4 QUALITY ASSURANCE

A. Refer to Section 230210 for a general description of requirements applying to this Section.

1.5 SUBMITTALS

A. Submit shop drawings in accordance with Section 230200.

B. Submit shop drawings and descriptive date for all equipment specified in this section.

1.6 SUBSTITUTIONS

A. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but not limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items furnished and installed by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, this Contractor shall be responsible for any and all additional costs associated with the changes required by other trades.

1.7 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, General Requirements.

PART 2 – PRODUCTS

2.1 UNIT HEATERS

A. Propeller type, direct drive, resilient-mounted motor, arranged for horizontal discharge, double-deflection louvers.

B. Tested at 400 psig hydrostatic and 200 psig air under water.

C. Enclosure shall be steel, cleaned, phosphated, primed and finished in baked enamel.

D. Manufacturers: Airtherm Manufacturing Co., Modine, Rittling, Sterling, Trane, Vulcan.

2.2 CABINET HEATERS

A. Provide cabinet heaters including chassis, heating elements, fans, motor and insulation.

B. Chassis: Galvanized steel wraparound structural frame with edges flanged.

C. Insulation: Faced, heavy density glass fiber.

D. Cabinet: Vertical semi-recessed/recessed/surface-mounted model as scheduled on the drawings, 16 gauge four sided overlap front panel with stiffeners. Clean cabinet parts, bonderize, phosphatize, and flow-coat with baked-on primer.

E. Coils: Aluminum fins, copper tubes, mechanically expanded for a permanent bond. Provide manual air vent.

F. Grilles: Intake and outlet grilles shall be integral, stamped 15 degrees deflection.

G. Fans: Provide direct drive centrifugal, forward curved double width fan.

H. Motors: Provide two-speed permanent split capacitor type motors (or variable speed) with integral overload protection and motor cords for plug-in to junction box in unit.

I. Provide HI/LO/OFF fan control (concealed).

J. Manufacturers: Airtherm Manufacturing Co., Modine, Rittling, Sterling, Trane, Vulcan, Sigma.

2.3 HOT WATER COILS

A. Provide coils of size and in location indicated, and of capacities and having performance data as scheduled. Certify coil capacities, pressure drops and selection procedures in accordance with AHRI 410.

B. Construct fins of continuous aluminum configurated plate-fin type with full fin collars for accurate spacing and maximum fin-tube contact.

C. Construct tubes of 5/8" or 1/2" seamless copper tubing, .025" nominal wall thickness, arranged in parallel pattern with respect to airflow.

D. Construct headers of gray cast iron. Hydrostatically test to 400 psi before assembly.

E. Construct casings of 14-gauge continuous coated galvanized steel with formed end supports and top and bottom channels.

F. Proof test coils at 300 psi, leak test at 200 psi under water.

G. Manufacturers: Carrier, York/Johnson Controls, The Coil Co., Trane, USA Coil.

2.4 ELECTRIC CABINET HEATERS

A. Provide cabinet heaters including chassis, heating elements, fan and motor designed for either recessed mounting within 2'x2' ceiling grid, or within wall construction.

B. Chassis: Galvanized steel wraparound structural frame with edges flanged.

C. Power disconnect switch, 30 AMPs, 600 volts, 3 phase.

D. Cabinet: Horizontal recessed model, heavy gauge, four-sided overlap front panel with stamped steel louver air openings. Clean cabinet parts, phosphatize and coat with baked-on enamel finish. Color: white.

E. Coils: Steel fins, copper brazed, for a permanent bond to low watt density, steel sheathed tubular heating elements.

F. Grilles: Intake and outlet grilles shall be integral, stamped 15 deg. Deflection in ceiling trim ring.

G. Fans: Provide direct drive, five bladed aluminum.

H. Motors: Provide single speed impedance protected, totally enclosed motor with integral overload protection and motor cords to junction box in unit.

I. Provide built-in fan delay control and automatic thermal cutout.

J. Manufacturers: Q-Mark, Berko, TPI/Markel, Indeeco, Electromode.

PART 3 – EXECUTION

3.1 INSPECTION

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

3.2 INSTALLATION OF UNIT HEATERS

A. Install heaters in accordance with manufacturer's installation instructions.

B. Uncrate units and inspect for damage. Verify that nameplate data corresponds with unit designation.

C. Hang unit from building substrate.

D. Protect units with protective covers during balance of construction.

3.3 INSTALLATION OF CABINET HEATERS

A. Install cabinet heaters in accordance with manufacturer's installation instructions.

B. Locate cabinet heaters as shown on the drawings. Coordinate with other trades.

C. Protect units with protective covers during balance of construction.

3.4 DUCT HEATING COILS

A. Install in accordance with manufacturer's recommendations.

B. Coil casing dimensions shall not be less than approach duct dimensions.

C. Comb fins if damaged. Install safing to eliminate air bypass or leakage at coil sections.

3.5 INSTALLATION OF ELECTRIC HEATERS

A. Install heaters in accordance with manufacturer's installation instructions.

B. Uncrate units and inspect for damage. Verify that nameplate data corresponds with unit designation.

C. Hang unit from building substrate.

D. Protect units with protective covers during balance of construction.

E. Perform field mechanical balancing in accordance with Section 230950: TESTING AND BALANCING OF MECHANICAL SYSTEMS.

END OF SECTION 23 07 25

SECTION 23 07 60
AIR HANDLING EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the contract, including the conditions of the contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions

C. Refer to Section 230210 for HVAC Basic Materials & Methods.

1.2 DESCRIPTION OF WORK

A. This Section includes work necessary and/or required and materials and equipment for construction of a complete system. Such work includes, but is not limited to the following:

1. Fan – Coil Air Handling Unit
2. Energy Recovery Unit (Modular, Sectional Type)
3. Single Packaged, Gas-Fired Rooftop Air Conditioning Unit
4. Packaged Gas-Fired Rooftop Unit (Kitchen Ventilation)
5. Air Handling Unit (Modular, Sectional Type)

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

B. AMCA Standards 210 and 300 for fans.

C. ARI Standard 410, ASHRAE Standard 33 for Heating and Cooling Coils.

D. ASHRAE Standard 52.2 and U.L. Standard 900 for media type air filters.

E. AMCA Standard 511 and 500D for Air Control Dampers.

F. ARI Standard 1060 and ASHRAE Standard 84 for Air-to-Air Energy Recovery Equipment.

G. ARI Standard 260 and 430 for Air Handling Units.

1.4 QUALITY ASSURANCE

A. Refer to Section 230210 for a general description of requirements applying to this Section.

B. Whenever a variable frequency PWM drive is installed to control an AC motor, a maintenance-free, circumferential, conductive micro fiber shaft grounding ring shall be installed on the AC motor drive end to discharge shaft currents to ground. Recommended part: AEGIS SGR™ Bearing Protection Ring, as made by Electro Static Technology. Install in accordance with the manufacturer's written instructions.

1.5 SUBMITTALS

A. Submit shop drawings in accordance with Section 230200.

B. Submit shop drawings and descriptive date for all equipment specified in this section.

1.6 SUBSTITUTIONS

A. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but not limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items provided by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, this Contractor shall be responsible for any and all additional costs associated with the changes required by other trades.

1.7 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, General Requirements. In addition, the following special guarantee applies:

1. Each compressor unit shall be provided with manufacturer's five (5) year parts and labor warranty.

PART 2 – PRODUCTS

2.1 FAN – COIL AIR HANDLING UNIT

A. General:

1. Install each unit as shown on the plans in accordance with: The Manufacturer's recommendations, and all applicable national and local codes.

2. UL approved.

3. Covered by a 2-year limited parts warranty on the complete unit.

4. In current production with published literature available to check performance, limitations, specifications, power requirements, dimensions, operation and appearance.

5. Fan coil units shall be mounted with vibration isolators.

6. There shall be a minimum of 4’0” straight duct between fan coil unit and first take-off or elbow.

B. Unit Enclosure:

1. Exterior panels of minimum18-gauge galvanized steel that have been finished with baked enamel to provide a long-lasting, quality appearance. Casing shall be insulated with ½” thick fiberglass, max k-valve of 0.24 fire resistant and odorless material.

2. Removable panels to provide easy access to the internal components for maintenance and service.

3. A filter rack with space to accommodate 1" throwaway, pleated filters, 30% standard MERV 7 efficiency, flat or angled arrangement with end covers. (NOTE: Units served with filter return grilles do not require final filter in unit. Provide panel to seal filter opening.)

4. All concealed units shall have 1-1/4” discharge duct collar, 1” on return.

5. Fan coil units shall be mounted with vibration isolators.

6. There shall be a minimum of 4’-0” straight duct between fan coil unit and first take-off or elbow.

C. Fans shall be double-width, forward-curved.

D. ECM Motors:

1. All motors shall be brushless DC (BLDC) electronically commutated motors (ECM) factory programmed and run tested in assembled units. Motors to soft ramp between speeds. Motors to be operated at three speeds. All motors shall have integral overload protection with a maximum ambient operating temperature of 104˚F and use permanently sealed ball bearings. Motors shall operate at plus or minus 10% of rated voltage on all speed settings.

E. Water Coils:

1. Main coils shall be two, three, four or six row, dual-temp application.

2. Coils shall use aluminum fins mechanically bonded to seamless copper tubes, factory tested with 450 psig air under water.

3. Maximum operating conditions shall be 300 psig at 200F.

4. Sweat type connections shall be standard.

5. Include sloped drain pan, stainless steel, fully drainable, main and auxiliary connections of ¾" PVC or threaded pipe.

6. All coils shall be provided with a manual air vent.

F. Accessories shall include 24VAC control transformer, and control enclosure. Factory mount and wire the DDC controller furnished as part of the work of ATC, coordinate with Section 230900.

G. Manufacturers: Carrier, International Environmental Corp., Daikin McQuay, Temtrol, Trane, York/JCI.

1. Any listed equivalent manufacturer and the Mechanical Contractor shall be completely responsible to comply with all requirements on the contract documents. This shall include, but not be limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades.

2.2 ENERGY RECOVERY UNIT (MODULAR, SECTIONAL TYPE)

A. The units shall be sectional component type. Components shall include supply and exhaust fan section, dual temp heating/cooling section, access section(s) heat recovery wheel, drain pan, double wall construction, filter section with air filters.

1. All segments shall be double wall construction and shall be constructed of G90 mill galvanized sheet steel, formed and reinforced to provide a rigid assembly.

2. The exterior casing shall be constructed of minimum 18-gauge galvanized steel.

3. The interior lining shall be a perforated lining of a minimum of 20 gauge. Units with double wall construction must have a full 2" (non-compressed) insulation throughout the entire unit.

4. All panels shall be insulated with 2" – 1.5# fiberglass insulation. The insulation shall meet the flame and smoke generation requirements of NFPA-90A.

5. All panels shall be completely gasketed prior to shipment with a minimum of ¼" thick and ¾" wide closed cell neoprene.

6. All access panels shall be completely removable for unit access and removal of components. All access panels must be removable without the use of electricity or compressed air. Panels will be removable with a hex wrench, or built-in latching handle.

7. Double wall access doors shall be provided in the fan and filter segments on the motor side of the unit. Access doors must also be provided in all segments where the removal of sheet metal screws is required for unit access.

   Doors shall be of the same thickness and construction as the wall panels. A bulb-type gasket shall be provided around the entire door perimeter. Industrial style hinges shall permit a complete 180 degree door swing. A door stop will be provided on all positive pressure doors.

8. The exterior of the unit shall be completely cleaned prior to application of finished coats. A prime coat of epoxy chromate shall be applied to a minimum thickness 1.5 mils.

B. The fan section shall consist of a rectangular steel cabinet, incorporating single or multiple centrifugal fans mounted on a cold rolled steel shaft which shall rotate in grease lubricated ball bearings. The fans shall be multi-blade forward, backward inclined or air foil as required by operating conditions shown in schedules. Fan ratings shall be based on AMCA Standards 210 and 300. Fans shall bear the AMCA seal.

1. Fan and fan motor shall be internally mounted and isolated on a full width isolator support channel using 1” springs. The fan discharge shall be connected to the fan cabinet using a flexible connection to ensure vibration-free operation. The isolator support rail shall be structurally supported from the unit base.

2. Fan motors shall be NEMA design ball bearing type with electrical characteristics and horsepower as specified on the schedule. Motors shall be 1750 RPM, open dripproof type. All motors shall be high efficiency.

3. The motor shall be mounted on the same isolation base as the fan. The motor shall be on an adjustable base.

4. Fan bearings shall be self-aligning, pillow block or flanged type regreaseable ball bearings and shall be designed for an average life (AFBMA L50) of at least 200,000 hours. All bearings shall be factory lubricated and equipped with standard hydraulic grease fittings and lube lines extended to the motor side of the fan.

5. Fan drives shall be selected for a 1.5 service factor and anti-static belts shall be furnished. All drives shall be adjustable pitch.

6. Fan shafts shall be selected to operate well below the first critical speed and each shaft shall be factory coated after assembly with an anticorrosion coating.

C. The fan shaft shall be motor driven through a Vee-belt drive. The drive assembly shall be designed for not less than 150% of the motor ampere rating. Adjustment of belt tension shall be by means of an adjustable motor base. The drive assembly shall conform to A.R.I. Standard 435-78. The drive sheave shall be variable pitch type where it falls between limits of A.R.I. Standard 435-78. Outside the established limits, an initial and a final set of fixed drives shall be required. Fan motors shall have copper windings.

D. Heat transfer coils shall be non-ferrous tube-in-fin type. The tubes shall be seamless copper with a wall thickness not less than 0.016 inch. The fins shall be rectangular plate type of aluminum with a thickness of not less than 0.009 inch. The tube openings in the fins shall be die-formed to provide a spacing collar between adjacent fins. The tubes shall be mechanically expanded with the fins to form a tight permanent mechanical joint. The tubes shall be silver-alloy brazed into heavy wall thickness copper or brass tubular headers.

1. All coils shall be installed on tracks for easy removal from the air handling unit. Units that require disassembly of the unit for coil removal are not acceptable.

2. Drainable water coils shall be designed to operate at 250 psig design working pressure and up to 300°F and shall be tested with 325 psig compressed air under water. Circuiting shall provide free and complete draining and venting when installed in the unit. All vent and drain connections shall be extended to the outside of the unit casing.

3. Coils shall be circuited for counter flow of air and water. All coils must have same end connections regardless of the number of rows deep.

4. Coil casing to be constructed of 16-gauge galvanized steel. Intermediate casing supports shall be supplied for finned lengths that exceed 60".

5. The primary surface shall be ½" O.D. copper tube, staggered in direction of air flow. Tubes shall be mandrel expanded to form fin bond and provide burnished, work-hardened interior surface.

6. Extended surface shall consist of die-formed, continuous, aluminum fins. The fins shall have fully drawn collars to accurately space fins, and to form a protective sheath for the primary surface.

7. Headers shall be of heavy seamless copper tubing, silver-brazed to tubes. Connections shall be of red brass, with male pipe threads, silver-brazed to the headers. A ¼" FPT, plugged, vent or drain tap will be provided on each connection.

8. Coil grommets shall be provided on all coils to completely seal the area between the coil connection and the unit casing.

E. Dual Temp heating and chilled water coils shall have tube diameters of approximately 1/2 inch, and shall be arranged in the required serpentine circuits. The assembled coils shall be pressure tested at 400 psig hydrostatic pressure and 200 psig air under water.

F. The unit coil section shall be provided with an extra heavy gauge drain pan sloping to drain outlets. The drain pan shall be insulated and finished or coated with waterproof and rust resistant material.

G. Total Energy (Enthalpy) Recovery Wheel:

1. The rotor media shall be made of aluminum which is coated to prohibit corrosion. All media surfaces shall be light weight polymer coated with a permanently bonded Silica gel desiccant prior to being formed into the honeycomb media structure to ensure that all surfaces are coated and that adequate latent capacity is provided. Desiccant coatings that must be reapplied over time are not acceptable.

2. Sensible and latent recovery efficiencies shall be clearly documented through a certification program conducted in accordance with ASHRAE 84-1991 and the results shall be presented in accordance with ARI 1060-2000 Standards. The certification shall have been conducted by the unit manufacturer.

3. Wheel testing to document that the desiccant material utilized does not transfer pollutants typically encountered in the indoor air environment shall be provided. The cross-contamination and performance certification reports shall be provided for as part of the submittals for this project.

4. The media shall be cleanable with low temperature steam, hot water or light detergent, without degrading the latent recovery. Dry particles up to 650 microns shall pass freely through the media.

5. Purge Sector: The unit shall be provided with a factory set, field adjustable purge sector designed to limit cross contamination to less than .1 percent of that of the exhaust air stream. Indicated air flows are exclusive of purge requirements.

6. Rotor System:

a. Seals: The rotor shall be supplied with diameter and perimeter seals which shall not make contact with any rotating surface of the exchanger rotor face.

b. Rotor Support System: The rotor media shall be provided in segmented fashion to allow for field erection or replacement of one section at a time without requiring side access. The media shall be rigidly held by a structural spoke system made of stainless steel.

c. Rotor Housing: The rotor housing shall be a structural framework which limits the deflection of the rotor due to air pressure loss to less than 1/32". The housing shall be made of galvanized steel to prevent corrosion. The rotor shall be supported by two pillow block bearings which can be maintained or replaced without the removal of the rotor from its casing or the media from its spoke system. Bearings shall be selected for an L-10 life in excess of 30 years.

d. Drive System: The rotor shall be driven by a self-adjusting flexible, circumferential belt system. A/C motors shall be utilized.

e. Assembled system shall incorporate the complete wheel assembly, seals, drive motor and belts in an insulated cassette frame within a slide-out track.

H. Return/relief sections complete with casing, fan and motor, and air control dampers shall be provided as an integral part of the unit where called for on the schedule.

I. Air filters shall be 2 inches thick arranged in modular sized to be readily removable through a hinged access door. Air filters shall be throwaway type.

1. Flat pre-filter segments shall accommodate 2” media, MERV 8.

2. The filter frames shall be constructed of galvanized steel and be built as an integral part of the unit. All filter segments shall be side service with an access door on the drive side of the unit.

J. The exterior and interior of the casing shall receive a rust and corrosion resistant finish.

K. Air handling unit shall be provided with a base rail to support unit. Refer to schedule for size.

L. The air conditioning units shall be manufactured by: Daikin McQuay, Carrier Corporation, Trane Company, York/Johnson Controls.

1. Any listed equivalent manufacturer and the Mechanical Contractor shall be completely responsible to comply with all requirements on the contract documents. This shall include, but not be limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades.

2.3 SINGLE PACKAGED, GAS-FIRED ROOFTOP AIR CONDITIONING UNIT

A. Refrigeration System:

1. One independent refrigeration circuit with hermetic compressor, crankcase heater, strainer, high and low-pressure control, compressor motor protection, and access valves.

2. A direct expansion, draw-thru evaporator coil shall be circuited so that its entire fin surface will be active during part load operation.

3. Draw-thru condenser coils with a separate sub-cooling circuit for each refrigeration system shall provide at least 15 F of sub- cooling at design conditions.

4. Outdoor air thermostats shall cycle the condenser fan motors to maintain stable operation at ambient temperature down to 35 deg. F. Condenser fan motors shall have inherent protection.

B. 100% Outdoor Air (Economizer Package):

1. Outdoor and return air dampers shall be interlocked in position by a fully modulating damper actuator. Actuator shall be spring return so that the outdoor air intake dampers will close when power to the unit is interrupted.

2. Maximum leakage rate for the outdoor air intake dampers shall not exceed 2% when fully closed and operating against a pressure differential of 0.5” WC.

3. The outdoor intake opening shall be covered with a birdscreen and a rain-hood that matches the exterior of the unit.

C. Exhaust Air Relief Dampers:

1. Economizer shall be equipped with barometric dampers that will open to exhaust return air as more outdoor air is supplied to the conditioned space during economizer operation. This relief shall prevent the conditioned space from over-pressurizing during economizer operation.

2. Exhaust air opening shall be covered with a birdscreen and a rain hood that matches the exterior of the unit.

D. Filters shall be 2" thick replaceable type MERV 8 and internal metal frame work.

E. A 1,750-rpm single supply air blower motor shall have a 1.15 service factor, solid base, Class B insulation and ball bearings with permanent lubrication. All belts and pulleys shall be treated with permanent lubrication. All belts and pulleys shall be rated at least 25% above the nominal drive horsepower. The fan shaft ball bearings shall have minimum average bearing life (AFBMA L-10) in excess of 100,000 hours at the maximum class RPM.

F. Roof Curb:

1. Roof curb shall be supplied by the unit manufacturer to provide a watertight seal between the roof and the unit.

2. Roof curb shall be approved by the National Roofing Contractor's Association.

3. Roof curb shall be full perimeter with all utility and duct connections within the perimeter of the curb eliminating the need for other roof penetrations.

G. Unit Construction:

1. All sheet metal parts shall be constructed of a zinc coated, commercial grade galvanized steel. All external surfaces shall be finished with a UL approved coating system.

2. Removable side panel shall provide easy access for maintenance, service and adjustment.

3. Unit shall be single wall construction with foil faced insulation such that insulation is not exposed to the air stream.

4. Unit shall have lifting lugs on each of the four upper corners.

5. Condenser coils and fan discharge shall be protected by heavy duty wire guards.

H. Basic Safety/Operating Controls - Unit manufacturer shall supply the following safety/operating control features:

1. A thermostat to deenergize the compressors when the suction line temperature drops below 22 deg. F.

2. A five-minute timer to prevent the compressor from short cycling.

3. A lock out circuit to prevent the compressors from cycling on one of their safety controls.

4. A cutout to protect the compressors during abnormally low voltage conditions.

I. Unit shall be completely factory wired, piped, charged and tested by the manufacturer before shipment. BAS Controller: DDC controller shall be provided as part of the work of ATC, field-mounted and wired. Coordinate with Section 230900.

J. Gas Heating Section:

1. Manufacturer shall furnish a natural gas furnace constructed of 20-gauge aluminized steel tubes.

2. Furnace shall include the following controls and safety devices:

a. Intermittent spark ignition with two stage gas valve with pressure regulator.
b. Centrifugal blower to maintain positive flue pressure with air pressure safety switch.
c. Electronic ignition with flame sensor and lockout safety valve.
d. High temperature limit thermostat with automatic reset.

K. Manufacturer: Trane, York/Johnson Controls, Carrier, Daikin McQuay.

L. Manufacturer shall furnish start-up.

1. Any listed equivalent manufacturer and the Mechanical Contractor shall be completely responsible to comply with all requirements on the contract documents. This shall include, but not be limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades.

2.4 PACKAGED GAS-FIRED ROOFTOP UNIT (KITCHEN VENTILATION)

A. Unit Construction:

1. All sheet metal parts shall be constructed of 18-gauge commercial grade galvanized steel. All external surfaces shall be finished with manufacturer's standard color enamel coating system.

2. Removable side panel shall provide easy access for maintenance, service and adjustment of components within the supply fan section and filter/damper section.

3. Unit shall be single wall construction with foil faced insulation minimum 1" thick fiberglass pinned to housing and designed for NPFA 90A requirements.

4. Unit shall have lifting lugs on each of the corners, factory assembled, except where larger units require two-piece shipment.

5. Modular sections shall include insulated downturn supply plenum, gas-fired heater section, supply fan, filter/damper section and air intake section.

6. All modules shall be of weatherproof design, joined with Ductmate connectors.

B. Outdoor Air/Filter/Damper Section:

1. Outdoor air damper shall be provided with a factory mounted and wired damper actuator. Actuator shall be spring return so that the outdoor air intake damper will close when power to the unit is interrupted. Damper actuator shall be mounted inside housing. Damper to be controlled by ATC.

2. Maximum leakage rate for the outdoor air intake dampers shall not exceed 2% when fully closed and operating against a pressure differential of 0.5” W.C.

3. The outdoor intake opening shall be covered with a removable inlet birdscreen and a rain hood that matches the exterior of the unit.

4. Filters shall be 2" thick replaceable type MERV 8 and internal metal frame work.

C. A 1,750-rpm single supply air blower motor shall have a 1.15 service factor, solid base, Class B insulation and ball bearings with permanent lubrication. All belts and pulleys shall be treated with permanent lubrication. All belts and pulleys shall be rated at least 65% above the nominal drive horsepower. The fan shaft ball bearings shall have an average life rating of 100,000 hours of operation. Fan shaft shall be machined from SAE 1020 cold rolled steel. Fans shall be FC Type, DWDI design. Fan and drive assembly shall be mounted on rubber isolators with adjustable motor base.

D. Roof Curb:

1. Roof curb shall be supplied by the unit manufacturer to provide a watertight seal between the roof and the unit.

2. Roof curb shall be approved by the National Roofing Contractor's Association.

3. Roof curb shall be full perimeter with all duct connections within the perimeter of the curb eliminating the need for other roof penetrations.

E. Gas Heating Section:

1. Manufacturer shall furnish a natural gas furnace AGA labeled and constructed of 20-gauge Type 409 stainless steel tubes. Provide Type 409 stainless steel flue collector and side vent with cap.

2. Furnace shall be as manufactured by Sterling and include the following controls and safety devices:

   a. Intermittent spark ignition with two stage gas valve with pilot gas valve pressure regulator.
   b. Centrifugal blower to maintain positive flue pressure with air pressure safety switch.
   c. Electronic ignition with flame sensor and lockout safety valve.
   d. High temperature limit thermostat with automatic reset.
   e. 24-volt control voltage.

F. Unit shall be completely factory wired, piped and tested by the manufacturer before shipment.

G. Unit-mounted motor control center shall be factory installed, wired and include the following components:

1. Single point power connections within NEMA 3R enclosures for fused disconnect switch and motor controls.

2. Magnetic contactors with overload protection in all legs.

3. Reset for supply fan, with interlocking contactor, additional contactor for motor-operated outside air damper.

4. Fused transformer to provide secondary 24 VAC control voltage for heater section control and control panel on face of kitchen hood. Electronic modulating discharge temperature control with internal setpoint selector.

5. All components U.L. listed or classified and wired per N.E.C.

H. Exhaust fan section shall be field mounted and wired. Fan shall be as scheduled on drawings and as specified in Section 230605.

I. Accessories:

1. Remote discharge air temperature setpoint controller for field mounting. Control interface with unit-packaged control center shall be part of the work of Division 23- Mechanical.

2. Provide 24VAC control voltage relays for interface between unit packaged control center and heat detectors furnished with the kitchen type I ventilator package for automatic operation of the makeup air unit and its associated ventilator exhaust fan.

J. Manufacturer: Kees, Inc., Greenheck, Captive Aire, Weather-Rite.

1. Any listed equivalent manufacturer and the Mechanical Contractor shall be completely responsible to comply with all requirements on the contract documents. This shall include, but not be limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades.

2.5 AIR HANDLING UNITS (MODULAR, SECTIONAL TYPE)

A. The air handling units for central station air conditioning shall be sectional component type. Components shall include fan section, dual-temp coil section, access section(s) DX cooling coil section, drain pan, double wall construction, filter/mixing box with OA/RA dampers.

1. All segments shall be double wall construction and shall be constructed of G90 mill galvanized sheet steel, formed and reinforced to provide a rigid assembly.

2. The exterior casing shall be constructed of minimum 18-gauge galvanized steel.

3. The interior lining shall be a perforated lining of a minimum of 20 gauge. Units with double wall construction must have a full 2” (non-compressed) insulation throughout the entire unit.

4. All panels shall be insulated with 2” – 1.5# fiberglass insulation. The insulation shall meet the flame and smoke generation requirements of NFPA-90A.

5. All panels shall be completely gasketed prior to shipment with a minimum of ¼” thick and ¾” wide closed cell neoprene.

6. All access panels shall be completely removable for unit access and removal of components. All access panels must be removable without the use of electricity or compressed air. Panels will be removable with a hex wrench, or built-in latching handle.

7. Double wall access doors shall be provided in the fan and filter segments on the motor side of the unit. Access doors must also be provided in all segments where the removal of sheet metal screws is required for unit access.

   Doors shall be of the same thickness and construction as the wall panels. A bulb-type gasket shall be provided around the entire door perimeter. Industrial style hinges shall permit a complete 180 degree door swing. A door stop will be provided on all positive pressure doors.

8. The exterior of the unit shall be completely cleaned prior to application of finished coats. A prime coat of epoxy chromate shall be applied to a minimum thickness 1.5 mils.

B. The fan section shall consist of a rectangular steel cabinet, incorporating single or multiple centrifugal fans mounted on a cold rolled steel shaft which shall rotate in grease lubricated ball bearings. The fans shall be single-width, single-inlet, multiblade type direct drive plenum fan OR as required by operating conditions shown in schedules. Fan ratings shall be based on AMCA Standards 210 and 300. Fans shall bear the AMCA seal.

1. Fan and fan motor shall be internally mounted and isolated on a full width isolator support channel using 1" springs. The fan discharge shall be connected to the fan cabinet using a flexible connection to ensure vibration-free operation. The isolator support rail shall be structurally supported from the unit base.

2. Fan motors shall be NEMA design ball bearing type with electrical characteristics and horsepower as specified on the schedule. Motors shall be 1750 RPM, open dripproof type. All motors shall be high efficiency.

3. The motor shall be mounted on the same isolation base as the fan. The motor shall be on an adjustable base.

4. Fan bearings shall be self-aligning, pillow block or flanged type regreaseable ball bearings and shall be designed for an average life (AFBMA L50) of at least 200,000 hours. All bearings shall be factory lubricated and equipped with standard hydraulic grease fittings and lube lines extended to the motor side of the fan.

5. Fan shafts shall be selected to operate well below the first critical speed and each shaft shall be factory coated after assembly with an anticorrosion coating.

C. Heat transfer coils shall be non-ferrous tube-in-fin type. The tubes shall be seamless copper with a wall thickness not less than 0.024 inch. The fins shall be rectangular plate type of aluminum with a thickness of not less than 0.009 inch. The tube openings in the fins shall be die-formed to provide a spacing collar between adjacent fins. The tubes shall be mechanically expanded with the fins to form a tight permanent mechanical joint. The tubes shall be silver-alloy brazed into heavy wall thickness copper or brass tubular headers.

1. All coils shall be installed on tracks for easy removal from the air handling unit. Units that require disassembly of the unit for coil removal are not acceptable.

2. Drainable water coils shall be designed to operate at 250 psig design working pressure and up to 300°F and shall be tested with 325 psig compressed air under water. Circuiting shall provide free and complete draining and venting when installed in the unit. All vent and drain connections shall be extended to the outside of the unit casing.

3. Coils shall be circuited for counter flow of air and water. All coils must have same end connections regardless of the number of rows deep.

4. Coil casing to be constructed of 16-gauge galvanized steel. Intermediate casing supports shall be supplied for finned lengths that exceed 60".

5. The primary surface shall be ½" O.D. copper tube, staggered in direction of air flow. Tubes shall be mandrel expanded to form fin bond and provide burnished, work-hardened interior surface.

6. Extended surface shall consist of die-formed, continuous, aluminum fins. The fins shall have fully drawn collars to accurately space fins, and to form a protective sheath for the primary surface.

7. Headers shall be of heavy seamless copper tubing, silver-brazed to tubes. Connections shall be of red brass, with male pipe threads, silver-brazed to the headers. A ¼" FPT, plugged, vent or drain tap will be provided on each connection.

8. Coil grommets shall be provided on all coils to completely seal the area between the coil connection and the unit casing.

E. Dual-temp coils shall have tube diameters of approximately 1/2 inch, and shall be arranged in the required serpentine circuits. The assembled coils shall be pressure tested at 400 psig hydrostatic pressure and 200 psig air under water.

F. The cooling coil section shall be provided with an extra heavy gauge drain pan sloping to drain outlets. The drain pan shall be insulated and finished or coated with waterproof and rust resistant material.

G. Air filters shall be 2 inches thick (MERV 8) arranged in modular sized to be readily removable through a hinged access door. Air filters shall be throwaway type.

H. The exterior and interior of the casing shall receive a rust and corrosion resistant finish.

I. Air handling unit shall be provided with a 6" base rail to support unit.

J. The air conditioning units shall be manufactured by: Daikin McQuay, Carrier Corporation, Trane Company, York/Johnson Controls.

1. Any listed equivalent manufacturer and the Mechanical Contractor shall be completely responsible to comply with all requirements on the contract documents. This shall include, but not be limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

B. Install in accordance with manufacturer's recommendations. Unit and all component sections shall be properly supported and vibration isolated.

3.2 INSTALLATION

A. Verify that coils, filters, motors, drives and other components are matched with the proper unit.

B. Assemble unit components following manufacturer's instructions for handling, testing and operation. Repair damaged galvanized areas, and paint in accordance with manufacturer's written recommendations.

C. Vacuum clean interior of units prior to operation.

D. Repair air leaks from or into casing that can be heard or felt during normal operation.

E. Install rooftop units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

F. Support: Install and secure roof curb to roof structure, in accordance with National Roofing Contractor's Association (NRCA) installation recommendations and shop drawings. Install and secure rooftop units on curbs and coordinate roof penetrations and flashing.

G. Perform field mechanical balancing in accordance with Section 230950: TESTING AND BALANCING OF MECHANICAL SYSTEMS.

H. The Mechanical Contractor shall own as part of his work, the following:

Provide one (1) additional drive set, if necessary, to obtain final design balancing requirements. The Mechanical Contractor shall coordinate with Balancing Firm and equipment manufacturer for drive selection, including belts and pulleys.

I. Provide certified factory start-up and written report on all units.

3.3 AUTOMATIC TEMPERATURE CONTROLS

A. Coordination of control work with the BAS shall include, but not be limited to, items as described in Section 230900: ATC.

END OF SECTION 23 07 60

SECTION 23 08 61
AIR PURIFICATION SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the contract, including the conditions of the contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions.

C. Refer to Section 230210 for HVAC Basic Materials & Methods.

1.2 DESCRIPTION OF WORK

A. This Section describes the design, performance and installation of an air purification system intended for use as part of another manufacturer's air handling unit as shown on the plans, details and equipment schedules.

B. This Section includes work necessary and/or required and materials and equipment for construction of a complete system.

1.3 REFERENCED STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

B. The following codes and standards are referenced through out. The edition to be used is that currently enforced by the authority having jurisdiction (AHJ) or in absence of such direction that referenced by the current enforceable IBC code or as indicated by the contract documents, except where specifically referenced by this section of the specifications.

1. ASHRAE Standards 62 & 52
2. National Electric Code NFPA 70
3. UL 867-2007 including ozone chamber test required as of December 21, 2007
4. UL 2998 Environment – No Ozone Certification
5. The cold plasma equipment and power supply shall be UL listed.
6. The technology shall have been tested to DO-160 by an independent lab and successfully passed all requirements for shock, vibration, EMF and line noise. Manufacturers not tested to DO-160 shall not be acceptable. DO-160 is normally used to test devices in aviation applications, but this standard is applicable to confirm EMF and line noise in HVAC applications.

1.4 QUALITY ASSURANCE

A. Refer to Section 230210 for a general description of requirements applying to this Section.

B. The Air Purification System shall be a product of an established manufacturer within the USA. Direct Current (DC) Ion modules manufactured outside the USA and assembled in the USA on mounting plates or formed channels shall not be acceptable.

C. A qualified representative from the manufacturer shall be available to inspect the installation of the air purification system to ensure installation in accordance with manufacturer's recommendation.

D. Technologies that do not address gas disassociation such as UV Lights, Powered Particulate Filters and/or polarized media filters shall not be considered. Uni-polar ion generators shall not be acceptable. "Plasma" particulate filters shall not be acceptable. Any system containing titanium dioxide (Ti02), which has been listed by the CDC as a known carcinogen, shall not be acceptable.

E. Projects designed using ASHRAE Standard 62, IAQ Procedure shall require the manufacturer to provide Indoor Air Quality calculations using the formulas within ASHRAE Standard 62.1-2007 to validate acceptable indoor air quality at the quantity of outside air scheduled with the technology submitted. The manufacturer shall provide independent test data on a previous installation performed within the last two years and in a similar application, that proves compliance to ASHRAE 62 and the accuracy of the calculations. The data shall be based on the manufacturer's use of the same make and model number as the equipment submitted on this project.

F. The Air Purification Technology shall have been tested by UL to prove conformance to UL 867-2007 including the ozone chamber testing and peak ozone test for electronic devices. Manufacturers that achieved UL 867 prior to December 21, 2007 and have not been tested in accordance with the newest UL 867 standard with the ozone amendment shall not be acceptable. All manufacturers requesting prior approval shall submit their independent UL 867 test data with ozone results to the engineer for preliminary review and during the submittal process. All manufacturers shall submit a copy with their quotation. Contractors shall not accept any proposal without the proper ozone testing documentation.

G. The maximum allowable ozone concentration per the UL 867-2007 chamber test shall be 0.001 PPM. The maximum peak ozone concentration per the UL 867-2007 peak test as measured 2 inches away from the electronic air cleaner's output shall be no more than 0.001 PPM. Manufacturers with ozone output exceeding these ozone values shall not be acceptable.

H. All manufacturers shall have their product tested to UL 2998 Environmental Standard for confirmation of no ozone with certificate available. The final report shall indicate the ozone levels and high voltage output the device's electrode(s) were operating during the test. Reports that do not include high voltage output during the UL 2998 testing shall not be acceptable.

1.5 SUBMITTALS

A. Submit shop drawings in accordance with Section 230200.

B. Product Data: Submit manufacturer's technical product data for ion generators including:

1. Schedule of plasma generators indicating unit designation, number of each type required for each unit/application.

2. Data sheet for each type of plasma generator, and accessory furnished; indicating construction, sizes, and mounting details.

3. Performance data for each type of plasma device furnished.

4. Indoor Air Quality calculations using the formulas within ASHRAE Standard 62.1-2007 to validate acceptable indoor air quality at the quantity of outside air Scheduled (when projects are designed with outside air reduction).

5. Product drawings detailing all physical, electrical and control requirements.

6. Copy of UL 867 independent ozone test.

7. Copy of UL 2998 conformance certificate.

8. Statement on the manufacturer's letterhead stating that the technology contains no titanium dioxide (Ti02).

9. Job-specific, factory wiring diagrams and instructions for field installation of all components.

1.6 SUBSTITUTIONS

A. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but not limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items provided by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, this Contractor shall be responsible for any and all additional costs associated with the changes required by other trades.

1.7 WARRANTY

A. Equipment shall be warranted by the manufacturer against defects in material and workmanship for a period of two years. Labor to replace equipment under warranty shall be provided by the owner or installing contractor.

PART 2 – PRODUCTS

2.1 AIR PURIFCATION SYSTEM

A. GENERAL: The air purification system(s) shall be of the size, type, arrangement and capacity indicated and required by the unit furnished and shall be of the manufacturer specified.

B. Each air handling unit, so designated on the drawings, details, equipment schedules and/or specifications shall contain a Plasma Generator with Bi-polar Ionization output as described herein.

C. The Bi-polar Ionization system shall be capable of:

1. Effectively killing microorganisms downstream of the bi-polar ionization equipment (mold, bacteria, virus, etc.).

2. Controlling gas phase contaminants generated from human occupants, building structure, furnishings and outside air contaminants.

3. Capable of reducing static space charges.

4. Effectively reducing space particle counts.

5. All manufacturers shall provide documentation by an independent NELEC accredited laboratory that proves the product has minimum kill rates for the following pathogens given the allotted time and in a space condition:

   a. MRSA - >96% in 30 minutes or less
   b. E.coli - > 99% in 15 minutes or less
   c. TB - > 69% in 60 minutes or less
   d. C. diff - >86% in 30 minutes or less
   e. Noro Virus -> 93.5% in 30 minutes or less
   f. Legionella -> 99.7% in 30 minutes or less

   Manufacturers not providing the equivalent space kill rates shall not be acceptable. All manufactures requesting prior approval shall provide to the engineer independent test data from a NELAC accredited independent lab confirming kill rates and time meeting the minimum requirements stated. Products

tested only on Petri dishes to prove kill rates shall not be acceptable. Products being sold under different trade names than those tested shall not be acceptable.

6. Capable of modular field assembly in 6-inch sections.

D. The bi-polar ionization system shall operate in a manner such that equal amounts of positive and negative ions are produced. Uni-polar ion devices shall not be acceptable. Ionizers with positive and negative output (DC type) shall not be acceptable. All ionizers provided shall be AC type ionizers with one electrode pulsing between positive and negative.

1. Air exchange rates may vary through the full operating range of a constant volume or VAV system. The quantity of air exchange shall not be increased due to requirements of the air purification system.

2. Velocity Profile: The air purification device shall not have maximum velocity profile.

E. Humidity: Plasma Generators shall not require preheat protection when the relative humidity of the entering air exceeds 85%. Relative humidity from 0 - 100%, condensing, shall not cause damage, deterioration or dangerous conditions within the air purification system. Air purification system shall be capable of wash down duty.

F. Equipment Requirements:

1. Electrode Specifications (Bi-polar Ionization):

a. Each alternating current (AC) Ionization Bar with Bi-polar Ionization output shall include a minimum of eighteen carbon fiber cluster ion needles per foot of coil face width shall be provided. The entire cooling coil width shall have equal distribution of ionization across the face. Systems without ion needles at least 0.50” apart shall not be acceptable. The plasma electrode shall require no more than 1.0” in the direction of airflow for mounting. All hardware required for mounting shall be provided by the air purification manufacturer except self-tapping screws for the power supply. Bi-polar ionization tubes manufactured of glass and steel mesh shall not be acceptable due to replacement requirements, maintenance, and performance output reduction over time, ozone production and corrosion.

b. Electrodes shall be provided in 6-inch increments, epoxy filled for an IP55 rating and utilizing brass connection hardware that is recessed into the connection joint once fully engaged and assembled.

c. Electrodes shall be energized when the main unit disconnect is turned on.

d. The ionization output shall be a minimum of 60 million ions/cc per inch of cooling coil width as measured 1 inch from the cold plasma needles.

e. Ionization bars shall be provided with magnet mounting kits to prevent penetration into cooling coils.

f. Ionization bars shall be constructed of UL 94VO and UL746C composite material.

G. Air Handler Mounted Units: Where so indicated on the plans and/or schedules. Mount the Plasma Generator and wire it to the remote mount power supply using the cables provided by the air purification manufacturer. A 24VAC, 115VAC or 208-230VAC circuit shall be provided to the plasma generator power supply panel. No more than 15 watts shall be required per power supply. Each power supply shall be capable of powering up to 6 ionization bars or a total of 100 linear feet of bar. Each plasma generator shall be designed with powder coated metal casing, liquid tight flexible conduit and a high voltage quick connector.

H. Plasma Requirements: Plasma Generators with Bi-polar ionization output shall be capable of controlling gas phase contaminants and shall be provided.

1. The Bi-polar ionization system shall consist of Bi-Polar Plasma Generator and power supply. The Bi-polar system shall be installed where indicated on the plans or specified to be installed. The device shall be capable of being powered by 24VAC, 115VAC or 208-230VAC without the use of an external transformer. Ionization systems requiring isolation transformers shall not be acceptable.

2. Ionization Output: The ionization output shall be controlled such that an equal number of positive and negative ions are produced (AC Ionizers only are acceptable). Imbalanced levels shall not be acceptable.

3. Ionization output from each bar shall be a minimum of 60 million ions/cc per inch of bar when tested at 1" from the ionization bar. Bars with needles spaced further apart than 0.5" shall not be acceptable.

4. Each plasma electrode shall be made from an all composite, UL 94V0 and UL 746C rated material for prevention of corrosion and electrical insulation.

5. Ozone Generation: The operation of the electrodes or Bi-polar ionization units shall conform to UL 2998 as tested by UL proving no ozone output.

I. Electrical Requirements:

1. Wiring, conduit and junction boxes shall be installed within housing plenums in accordance with NEC NFPA 70. Plasma Generator shall accept an electrical service of 24VAC or 115 VAC, 1 phase, 60 Hz. Coordinate all electrical requirements with air purification manufacturer's submittals.

J. Control Requirements:

1. All Plasma Generators shall have internal short circuit protection, overload protection, and automatic fault reset. Systems requiring fuses shall not be acceptable.

2. The Plasma Generator power supply shall have internal circuitry to sense the ionization output and provide dry contact alarm status to the BMS as well as a local "Plasma On" indication light.

3. The ionization system shall be provided with a stand-alone, independent ion sensor designed for plenum mounting to the ionization bar to monitor the ion output and report to the BAS system that the ion device is working properly. Ion systems provided without an independent ion sensor, shall not be permitted. The control voltage to power the ion sensor shall be 24VAC to 260VAC and draw no more than 150mA of current. The sensor shall provide at minimum, dry contact status to the BAS and optionally a BacNet or Lonworks interface as specified on the control drawings. Manufacturers not providing a stand-alone ion sensor shall not be acceptable. System shall be tied into the fan circuit to only be energized when fan is operating.

4. Mount and wire the Plasma device within the air handling unit specified or as shown or the drawings. The contractor shall follow all manufacturer IOM instructions during installation.

5. System shall be tied into fan circuit and only operate when fan is running.

6. A fiberglass NEMA 4X panel with Plasma On/Off Indicator Light (interfaced with stand-alone ionization detector), Ionization Output On/Off Indicator Light and an On/Off Illuminated Switch shall be provided to house the power supply, as noted on the schedule.

K. Manufacturers: Global Plasma Solutions, American Ion, Active Air Solutions, Plasma Aire Int.

1. Any listed equivalent manufacturer and the Mechanical Contractor shall be completely responsible to comply with all requirements on the contract documents. This shall include, but not be limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades.

PART 3 – EXECUTION

3.1 GENERAL

A. The Contractor shall be responsible for maintaining all air systems until the owner accepts the building.

3.2 ASSEMBLY: PLASMA GENERATOR

A. All equipment shall be assembled and installed in a workmanlike manner to the satisfaction of the manufacturer’s authorized representative.

B. Any material damaged by handling, water or moisture shall be replaced, at no cost to the owner.

C. All equipment shall be protected from dust and damage on a daily basis throughout construction.

3.3 TESTING

A. Provide the manufacturers recommended electrical tests.

3.4 START-UP & TRAINING

A. A manufacturer's local authorized representative shall provide installation, start-up supervision, and training of owner's personnel in the proper operation and maintenance of all equipment.

END OF SECTION 23 08 61

SECTION 23 09 00
AUTOMATIC TEMPERATURE CONTROL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Section 230200 and drawings are hereby made a part of this section as fully as if repeated herein.

B. The Mechanical Contractor shall coordinate with the work of Division 26 and the Fire Alarm System vendor for locations and mounting of all duct smoke detectors and carbon monoxide detectors. These devices are shown on the Mechanical Drawings for reference only to show the intent of the work. All locations shall be determined based on approved shop drawings from the Fire Alarm System vendor and the Contractor for the work of Division 26, Electrical.

1.2 DESCRIPTION OF WORK

A. Provide labor, material and supervision necessary to install a complete direct digital control system of temperature controls with a host PC and full color graphics to control all HVAC Systems, associated components and accessories as described herein.

1.3 SUBMITTALS

A. Submit shop drawings and manufacturer's data sheets of all equipment.

B. Submit manufacturer's certificates of conformance with applicable codes.

C. Furnish point-to-point diagram of automatic temperature control system approval, including heating, ventilating and air conditioning equipment wiring diagrams where temperature control connections are required.

D. Provide ten (10) copies of submittal data within thirty (30) days of contract award.

E. Submittal shall consist of:

1. System Architecture showing all digital actuated devices.

2. Equipment lists of all proposed devices and equipment including data sheets of all products.

3. Valve, damper and well and tap schedules showing size, configuration, capacity and location of all equipment.

4. Data entry forms for initial parameters. Contractor shall provide English listing of all analog points with columnar blanks for high and low warning limits and high and low alarm limits, and a listing of all fan systems with columnar blanks for beginning and end of occupancy periods; and samples of proposed text for points and messages (for at least two systems of at least 15 points total) including sample 480-character alarm message. All text shall be approved prior to data entry.

5. Wiring and piping interconnection diagrams including panel and device power and sources.

6. Sketches of all graphics.

1.4 QUALITY ASSURANCE

A. Insure that all work and equipment is installed in accordance with manufacturer's warranty requirements.

B. Provide adequate supervision of labor force to assure that all aspects of specifications are being fulfilled.

C. The system shall be engineered, programmed and installed by personnel trained and regularly employed by the control's manufacturer.

D. Supplier shall have technical support to promptly respond within 24 hours or less to service calls to the site with technical staff, spare parts inventory and test and diagnostic equipment.

E. Codes and Approvals:

1. The complete system installation shall be in strict accordance with national and local electrical codes. All devices designed for or used in line voltage applications shall be UL listed.

   a. All microprocessor-based devices shall be UL916 listed.

   b. All electrical environmental control and monitoring devices shall be UL429 and/or UL873 listed.

2. All electronic equipment shall conform to the requirements of FCC regulation Class B, Part 15, Section 15 governing radio frequency electromagnetic interference and be so labeled.

3. The complete system shall conform to ANSI/ASHRAE Standard 135-2012, BACNET.

F. All system components shall be designed and built to be fault tolerant.

1. Provide satisfactory operation without damage at 100% above and 85% below rated voltage and at +3 Hertz variation in line frequency.

2. Provide static, transient, and short circuit protection on all inputs and outputs. Communication lines shall be protected against incorrect wiring, static transients and induced magnetic interference. Bus connected devices shall be A.C. coupled or equivalent so that any single device failure will not disrupt or halt bus communication.

1.5 ELECTRICAL WIRING

A. All electrical wiring, components and accessories in connection with the Automatic Temperature Control System shall be furnished and installed by the control manufacturer.

1. Electrical Contractor shall provide all wiring to duct smoke detectors.

2. Electrical Contractor shall provide all wiring to carbon monoxide detectors.

3. Unless stated otherwise in the design documents, the ATC Contractor is responsible for providing control power to all valves, actuators, devices and components within the DDC System regardless of the selected voltage of those devices. This also includes all 120 volt power circuits required for devices, panels and control equipment.

4. The ATC Contractor shall be responsible for providing the control interface between terminal unit condensate pumps and their respective units at the required voltage of these devices in order to shut down the terminal unit in the event of high water level in the condensate pump receiver.

B. Control wiring shall include all wiring necessary to interface with new controls, such as electric relays and transducers, and shall also include electric and electronic devices such as freezestats, electronic sensors, relays, flow switches and controlled devices such as valve and damper operators, both electric/electronic actuated devices. Pilot devices such as ON/OFF switches and thermostats installed in series with line voltage circuits shall be considered to be control wiring.

1.6 AUTOMATIC TEMPERATURE CONTROL

A. Provide a DDC System of automatic temperature control which shall be as manufactured by Alerton Technologies, Inc., as installed by Albireo Energy. The system shall be complete in all respects including labor, materials, equipment and services necessary.

B. All electrical wiring in connection with the installation of the automatic temperature control system shall be furnished and installed under the direct supervision of the control manufacturer.

PART 2 – PRODUCTS

2.1 BMCS COMPUTER HARDWARE

A. The host computer and accessories shall be provided by the Owner.

2.2 TEMPERATURE SENSORS

A. Solid state room sensors shall be of the wire wound resistance type element. Sensors shall be equipped with visual readout and adjustment. Sensors shall be of the completely solid state type with no moving contacts. Printed circuit board under thermostat cover shall contain a low mass resistance type setpoint dial and amplifier. Provide test points for measuring output voltage. Sensors shall be direct or reverse acting as required for the sequence of operation.

B. Sensors shall provide the application for night setback override.

C. Sensors shall be mounted at ADA height (48” above floor).

2.3 SMOKE DETECTORS

A. Duct type ionization smoke detectors shall be furnished by the Electrical Contractor (supplied by JCI) and installed by the Mechanical Contractor in the supply and return air stream. The Electrical Contractor shall provide wiring from each detector to the Fire Alarm System panel.

B. The Electrical Contractor shall provide an alarm output signal from the FAS panel to the BAS for unit shutdown.

2.4 CARBON MONOXIDE DETECTORS

A. Duct type carbon monoxide detectors shall be furnished by the Electrical Contractor and installed by the Mechanical Contractor in the supply air stream. The Electrical Contractor shall provide wiring from each detector to the Fire Alarm System panel.

B. The Electrical Contractor shall provide an alarm output signal from the FAS panel to the BAS for unit shutdown.

2.5 ACTUATORS

A. Electronic actuators shall be sized to operate their appropriate dampers and valves with sufficient reserve power to provide smooth modulating action or two-position action as specified.

B. Provide integral, auxiliary switches for direct coupled actuators to indicate when a desired position is reached or to interface additional controls for a specific sequence.

C. Align actuator with drive shaft, provide permanent mark to identify closed position of end device.

2.6 SENSOR TRANSMITTERS

A. Duct and immersion sensors shall have minimum spans as required to meet the temperature requirements. Duct sensors shall have sensing elements of sufficient length and accuracy to measure average duct temperature in each location.

B. Sensors shall be of corrosion resistant construction, tamperproof, suitable for mounting on a vibrating surface. Exposed capillaries shall be temperature compensated, and armored or installed in protective tubing.

C. All sensing elements for water pipe mounting shall be of the rod and tube type with linear output and shall be furnished complete with separable protecting wells filled with heat conductive compound. Sensors shall be factory calibrated and tamperproof. If easily adjustable sensors are provided, they shall be located inside metal enclosures with cylinder lock and key to prevent unauthorized setting.

D. Safety Devices: Provide the following:

1. Low limit, electric type, with 20' long serpentine element, with manual reset, set for 37°F for "freeze" protection and 55°F for fan discharge application, unless otherwise noted.

2. Air and water duty flow switches: Current **switch** type for fan and pump status.

3. Carbon dioxide sensor/transducer suitable for wall or duct mounting.

   a. Analog output of 4 to 20 milliamps corresponding to 0 to 2000 ppm CO2.
   b. ABS plastic housing, suitable for an operating environment of 0 to 125 F/ 0 to 100% RH, non-condensing.
   c. Repeatability less than +/- 20 ppm.
   d. Response time less than 60 seconds.
   e. Power supply, 24 VAC.
   f. Make: Vaisala Inc. model GMW 21 (wall)
      GMD 20 (duct)
   g. Manufacturers: Air Test Technologies, Inc., Macurco, Rotronic Instrument Corp., Vaisala, Inc.

4. Make-up Water Monitoring System (Typical for chilled water & hot water heating system): (Manufacturer's Rep. 888-397-5353)

   a. Monitor data as received by flow meter on cold water make-up system. When flow exceeds 10 gal./1 min (adj.), ATC system to close normally open solenoid valve, alarm system (provide call out), shutdown boilers, pumps, chillers, etc., associated with respective system.

   b. Flow sensor, consisting of a removable flow sensor mounted in cast bronze housing, available in ½" to 1-1/2" pipe size. Sensor shall be rated for a flow range of 0.5 to 15 feet per second, 220°F max., 400 psig at 100°F max. pressure; Nylon impeller, Pennlon bearing, tungsten carbide shaft, PPS housing and EPDM seals. Manufacturer: Kele Model 250B, Data Industrial Series 250BR.

   c. Programmable analog flow transmitter shall be a loop-powered device that converts a flow sensor signal into a linear 4 – 20 mA signal. Electronic signal dampening, computer programmable, compact size in a metal enclosure. Power input, 9-35 VDC/0-1 kHz, 75 ohms at 24 VDC, accuracy of 0.1% of full scale. Manufacturer: Kele Model 310-02, Universal Flow Transmitter Model UFT-1.

5. Liquid Leak Detection System: Kele, Raychem, Trace Tek.

   a. Mechanical float devices attached to or inserted within the auxiliary pan are not acceptable.

b. Sensor shall be activated when there is at least ¼ inch of water, but no more than ½ inch of water in the auxiliary pan.

c. Equal to Kele Model AQS00661 water detector.

E. HUMIDITY TRANSMITTERS

1. Units shall be suitable for duct, wall (room) or outdoor mounting. Unit shall be two-wire transmitter utilizing bulk polymer resistance change or thin film capacitance change humidity sensor. Unit shall produce linear continuous output of 4-20 mA for percent relative humidity (%RH). A combination temperature and humidity sensor may be used for zone level monitoring. Sensors shall have the following minimum performance and application criteria:

a. Input Range: 0 – 100% RH

b. Accuracy (%RH): +/- 2% (when used for enthalpy calculation, dewpoint calculation or humidifier control) or +/- 3% (monitoring only) between 20-90%RH at 77°F, including hysteresis, linearity, and repeatability.

c. Sensor Operating Range: As required by application.

d. Long Term Stability: Less than 1% drift per year.

2. Acceptable Manufacturers: Units shall be Vaisala HM Series, General Eastern, Microline, or Hy-Cal HT Series.

2.7 CONTROL VALVES

A. Valves shall be rated for a minimum of 150 percent (150%) of system operating pressure at the valve location but not less than 125 psig.

B. 2" and Smaller: Valves shall be bronze body with screwed or flared connections.

C. 2-1/2" and Larger: Valves shall be bronze or iron body, flanged.

D. Flow characteristics:

1. Three-way valves shall have a linear relation of flow vs. valve position.
2. Two-way valve position vs. flow relation shall be equal percentage for water flow control.

E. Maximum pressure drop through valve:

1. Modulating water flow control: 1/2 the pressure drop through the apparatus with maximum of 10 feet of water. Two position water valves shall be line size.

2.8 CONTROL DAMPERS

A. The ATC Sub-contractor shall furnish all the controlled dampers of the type and sizes indicated on the drawings for installation by the sheet metal Sub-contractor.

B. All 2-position control dampers shall be parallel blade and sized for minimum pressure drop, at the specified duct size.

C. All modulating dampers shall be opposed blade and sized for an effective linear air flow control characteristics within the angle of rotation and maximum pressure drops specified. Information shall be provided to the sheet metal Subcontractor for determining the proper duct reductions or baffles used.

D. Damper frames shall not be less than 16-gauge galvanized steel, formed with corner braces for extra strength, with mounting holes for enclosed duct mounting.

E. All damper blades shall be of not less than 16-gauge galvanized steel formed for strength and high velocity performance. Blades on all dampers must not be over 8" in width. Blades shall be secured to 1/2" diameter zinc plated axles by zinc plated bolts and nuts. All blade bearings shall be nylon or oilite. Blade side edges shall be sealed off against spring stainless steel seals. Teflon coated thrust bearings shall be provided at each end of every blade to minimize torque requirements and insure smooth operation. All blade leakage hardware shall be constructed of corrosion resistant, zinc plated steel and brass.

F. Dampers shall be suitable for operation between -40 and 200 degrees. The control manufacturer shall submit leakage and flow characteristics plus a size schedule for all controlled dampers.

G. All blade edges shall have inflatable seal edging that shall be rated for leakage less than 10 cubic feet per minute per square foot of damper area at a differential pressure of 4" of water when the damper is being held by a torque not to exceed 50 inert lbs. Leakage shall not exceed 1/2 of 1% of total flow.

H. Provide permanent mark or scribe end of drive shaft to align damper with actuator in closed position.

2.9 CONTROL CABINETS

A. Control cabinets shall be constructed of 18-gauge steel with locking hinged door. Unless otherwise specified, all controllers, electric relays, switches and other equipment furnished as part of the control system which are not required to be mounted on mechanical equipment, shall be cabinet mounted. The temperature indicators and switches shall be flush mounted on the door tagged with plastic labels. All electrical devices shall be wired to a numbered terminal strip and all devices shall be completely adjusted and checked for proper operation prior to shipment to job site. All wiring shall be numbered according to the control diagram.

2.10 SEQUENCE OF OPERATION

A. Host Computer and Operator's Work Station (OWS)

1. The host computer and accessories shall be located in Cust. Office 123 as shown on the drawings. The computer and all peripheral equipment shall be furnished by the Owner.

2. Coordinate required capacity and features with the Owner's IT representative.

3. All control programs and application features shall reside in the OWS.

4. Control manufacturer shall provide subsequent levels of control capability to whatever extent necessary to achieve performance required for individual units in their respective local control panels. All ATC panels shall be wired to the nearest source of power at 277/1. Coordinate with the work of Division 26 – Electric.

5. Work with the Owner to establish occupied/unoccupied schedules and setpoints. Enter the schedules and setpoints into the system. Provide the required number of input/output points to achieve the specified sequences of operation and monitoring points.

6. Work with the Owner to determine which points shall be trended and the sampling frequency. Set up the trend logs in the BAS.

B. Dual Temperature Loop Summer/Winter Changeover Control:

1. The BAS shall provide control of summer/winter changeover. Provide two way control valves in the boiler room and throughout the piping system to isolate the hot water and chilled water systems as well as heating-only terminal units in the building. Blocking valves shall be actuated open/closed with failure to last controlled position.

2. Summer Mode:

   a. When the system is manually put in the "summer" mode, the isolation control valves shall be positioned to allow chilled water into the dual temperature loop and to isolate the hot water boilers and heating terminal units from the dual temperature loop. Before the chilled water isolation valves open, the dual temperature loop temperature must be below the programmed setpoint of 100°F, adjustable, in order to prevent damage to the chiller as well as condensation in the heating units.

   b. At each end-of-main location, provide a two-way blocking valve at the crossover piping balancing valve. When the plant is in the cooling mode, these valves shall be open.

   c. Provide an end switch on each valve actuator. The chilled water system shall not be activated until the isolation valves are in the proper position. Display the end switch positions at the OWS. If the valve's end switch does not coincide with the commanded position of the valve, provide an alarm at the OWS and lock out the chiller start sequence.

3. Winter Mode:

   a. When the system is manually put in the "winter" mode, the isolation control valves shall be positioned to isolate the chiller from the dual temperature loop while opening the hot water system isolation valves and terminal heating unit isolation valves to the dual temperature loop.

   b. When the plant is in the heating mode, the end-of-main blocking valves described in paragraph B.2.b shall be closed.

   c. Provide an end switch on each valve actuator. The hot water system shall not be activated until the isolation valves are in the proper position. Display the end switch positions at the OWS. If a given valve's end switch does not coincide with the commanded position of the valve, provide an alarm at the OWS and lock out the boilers start sequence.

4. Loop changeover shall be subject to manual selection based on schedule, loop temperature and outside air temperature, all adjustable.

5. The following items shall be displayed at the OWS:

   a. Graphical display of the dual temperature system and related piping.
   b. Current system setting – summer/winter.
   c. End switch status for each isolation valve.
   d. Commanded status for each isolation valve.
   e. Isolation valve failure status.
   f. Outside air temperature, global.
   g. Outside air temperature setpoints for automatic changeover.
   h. Dual temperature loop discharge and return temperatures.
   i. Chilled water system supply and return temperatures.
   j. Hot water system supply and return temperatures.

C.1 Heating System Control:

1. This system consists of two boilers, B-1 and B-2, each with boiler circulating pumps BP-1 and BP-2, primary loop isolation valves, and building dual temperature heating/cooling pumps P-1 and P-2. Each boiler is equipped with a burner suitable of using natural gas.

   a. Each boiler's combustion system shall be controlled by its integral burner controls. The boilers shall be activated/de-activated via the BAS based on outdoor air temperature, or via manual command at the OWS. Once activated, the boilers' integral controls and sequencing panel shall maintain setpoint

of the system at the boiler's control panel.

2. Whenever the outdoor air temperature is at or below 55°F, adjustable, boilers B-1 shall be enabled and B-2 shall be on standby. On a call for boiler B-1 to operate, the system isolation valves shall be commanded open, Article 'F', on a proof of open via valve end switch the boiler shall be enabled. B-2 shall remain in standby. If boiler B-1 cannot maintain hot water supply setpoint boiler B-2 shall be enabled to operate. The BAS shall stage the boilers to maintain optimum efficiency and hot water supply temperature at setpoint.

3. The boiler control panel shall provide boiler modulation, boiler pump operation, and diagnostics. The BAS shall monitor boiler inlet/outlet, outside air temperature, modulation rate setpoint and mixing valve demand percent on the boiler's secondary heat exchanger.

4. When the boiler's integral controls are activated, Pump BP-1 or BP-2 shall be activated, and the system isolation valves shall open (proven). A current switch on one phase of power feeding the boiler pumps shall monitor flow status at the OWS. If pump operation is not indicated, and the boiler did not fire or isolation valves open, deactivate the boiler and activate the second (back-up) boiler; generate a boiler alarm at the OWS.

   a. The BAS shall receive a general boiler failure alarm from a set of dry contacts, which are provided by the boiler manufacturer. This alarm shall be annunciated at the OWS.
   b. The BAS shall rotate the lead boiler/pump set to equalize the accumulated run time.

5. During the unoccupied mode of the building systems, the boilers shall maintain the following status:

Outdoor Temperature	Boiler Status
Less than 50°F	Hot Standby
Above 60°F	Off

6. Provide hot water discharge and return temperature sensors for each boiler.

7. BAS Contractor shall provide all field control wiring for control panels, header temperature sensors, and boiler controller.

8. Provide system software in the OWS to monitor and trend weather and building response time to initiate morning warm-up cycles in sufficient time to establish occupied space temperatures before actual occupancy occurs.

9. The following items shall be displayed at the OWS:

   a. Graphical display of the boilers, pumps, and related piping.
   b. Boiler activated/de-activated status, each boiler.
   c. Boiler failure, each boiler.
   d. Outside air temperature.
   e. Outside air temperature setpoint for boiler activation (adjustable).
   f. Boiler discharge temperature, each boiler.
   g. Boiler return temperature, each boiler.
   h. Pump water flow status/alarm, each pump via current switch.
   i. Status of each isolation valve: open/closed.
   j. Primary loop pump flow status/alarm: via VFD alarm/status contact and frequency feedback signal.

C.2 Make-Up Water Monitoring System Control

1. Provide system control for the make-up water serving the dual temp heating and cooling system in the plant.

2. Provide a water flow meter on the make-up water supply. When the measured flow exceeds 10 gallons/minute, adjustable, close the normally open solenoid valve, generate an alarm at the OWS, and shut down the boilers, pumps, chiller, and auxiliaries affected.

3. Flow sensor, consisting of a removable flow sensor mounted in a cast-bronze housing, available in ½" to 1-1/2" pipe size. Sensor shall be rated for a flow range of 0.5 to 15 feet per second, 220°F max., 400 psig at 100°F maximum pressure; Nylon impeller, Pennlon bearing, tungsten carbide shaft, PPS housing and EPDM seals. Manufacturer: Kele Model 250B.

4. Programmable analog flow transmitter shall be a loop-powered device that converts a flow sensor signal into a linear 4 – 20mA signal, with electronic signal dampening, computer programmable, and compact size in a metal enclosure. Power input, 9-35 VDC/0-1 kHz, 75 ohms at 24 VDC, accuracy of 0.1% of full scale. Manufacturer: Kele Model 310-02.

5. The following items shall be displayed at the OWS:
   a. Water flow in gallons per minute.
   b. Command signal to the valve.
   c. High flow/equipment shut down alarm.

D. Primary Dual Temperature Heating/Cooling Water Pumps Control:

1. Pumps P-1 and P-2 shall be controlled directly by the BAS per a lead/lag sequence with the designated lead pump alternated on a minimum weekly basis, or as reset at the OWS. The designated lead pump shall be activated as part of the heating or cooling water system. The pumps shall also be subject to a manual command at the OWS.

   a. Each pump shall be provided with a VFD as part of the work of Division 26 - Electric. The VFD on the pump shall modulate, in response to the differential pressure sensor to maintain a constant differential pressure of 7-10 psig. The BAS shall provide a differential sensor for this purpose near the last coil in the dual temperature water circuit. The differential pressure setpoint shall be adjustable at the OWS.

   b. A differential pressure switch shall be located across the common discharge and return of the loop pumps for flow status monitoring and alarming.

2. Monitor flow status via VFD alarm/status contact and frequency feedback signal at the OWS.

3. Once activated, the designated lead pump shall run continuously. If the lead pump fails, after a 20 second time-delay, the lag pump shall be energized after an alarm is sent to the OWS. After the cause of the failure is corrected, a manual command from the OWS is required to restore normal operation.

4. The designated lead pump shall be enabled whenever the building heating or cooling system is activated, as programmed through the BAS.

   a. When the system is manually put in the "winter" mode, the lead pump shall operate through its variable speed drive to provide full flow equal to 60 Hertz on the drive output. The pump speed shall change in response to system pressure changes as described in Paragraph 1.a as terminal unit two-way control valves close off to the system.

   b. When the system is manually put in the "summer" mode, the lead pump shall operate through its variable speed drive to provide full flow equal to the scheduled chiller evaporator gpm. Coordinate this calibration point during the TAB agenda of the work. To avoid the chiller evaporator low temperature alarm, maintain the speed/hertz setpoint at this gpm on a constant basis.

5. The following items shall be displayed at the OWS:

a. Graphical display of pumps and related piping.
b. Outside air temperature.
c. Designated lead and lag pumps (i.e.: Pump P-1 Lead - Pump P-2 Lag).
d. Pump command start/stop.
e. Commanded status of each pump via VFD alarm/status contact and frequency feedback signal.
f. Flow status/alarm via differential pressure switch.
g. Dual temperature loop discharge and return temperature.

E. Chilled Water System Control:

1. This system consists of one air-cooled water chiller, CH-1, dual temperature loop pumps P-1 and P-2, and interconnecting piping and accessories. Pumps P-1 and P-2 shall be controlled directly by the BAS per a lead/lag sequence as described in article D.

2. The chiller control sequence shall be activated based on an occupied/unoccupied time schedule and outdoor air temperature. When the system is scheduled to operate and outdoor air temperature is at or above the programmed setpoint of 60°F, adjustable, system control sequence shall be activated. The system can also be manually activated via a software switch at the OWS. Additionally, the chilled water system activation shall be subject to the summer/winter changeover sequence described under 'Dual Temperature Isolation Valves'.

3. When the chiller control sequence is activated, the chilled water pump shall be energized. When water flow is proven through each pump, via a current switch, the chiller's factory controller shall be activated to maintain its integral setpoint of 44°F, adjustable.

   a. Chiller controller shall activate factory installed heat tape on the evaporator whenever chiller is off and outside air temperature is at or below 35°F, adjustable. Verify setting and operation per chiller manufacturer's written instructions.

4. The BAS shall limit the chiller on-time to a minimum of 10 minutes. The minimum off-time for the chiller shall be 20 minutes. Timing set-points are adjustable, and final setting must be approved by the chiller manufacturer.

5. The OWS shall accommodate up to 3 alarm/status inputs from the chiller for monitoring and alarm generation.

6. The BAS shall monitor chilled water discharge and return temperatures for display at the OWS.

7. BAS Contractor shall provide all field control wiring for operation of the chiller.

8. The following items shall be displayed at the OWS:

   a. Graphic depicting equipment, piping layout and temperature control devices with dynamic display of each status, temperature, etc.
   b. Chilled water discharge and return temperature at the chiller.
   c. Common chilled water supply and return water temperatures.
   d. Up to 3 alarm/status inputs for chiller.
   e. Chilled water pump start/stop command and status via current switch.
   f. Chilled water pump flow/alarm per pump via current switch.
   g. Chiller on/off command and status.
   h. Heat tape status.

F. Dual Temperature Isolation Valves

1. Furnish dual temperature isolation valves as shown on the drawings. During heating season, the hot water isolation valves shall be open to the dual temperature piping and the chilled water isolation valves shall be

closed. During cooling season, the chilled water isolation valves shall be open and the hot water isolation valves shall be closed. Heating and cooling valves shall be commanded from separate and individual outputs. When switching between heating and cooling, implement an adjustable time delay initially set to 12 hours to allow the dual temperature loop to reach ambient temperature before mixing with primary systems.

2. The following items shall be displayed at the OWS:

   a. Individual zones showing isolation control valves and commanded position.
   b. Operator selection to set heating/cooling position of each isolation control valve of each zone.

G. Domestic Water Heater System Control

1. The domestic water heater located in the MER shall be activated by its integral temperature controls. The heater is equipped with sealed combustion air control which does not require any further control interface.

2. Provide a hot water discharge sensor for monitoring, high/low limit alarms for the heater and for the hot water circulating loop. The OWS shall receive a general status/failure alarm from the domestic water heater for monitoring and alarm generation at the OWS. Set the high/low limit alarms to suit system operation and water loop.

3. Provide on/off control of the domestic hot water circulating pump based on a schedule furnished by the Owner. Provide a current switch on one phase of power to the pump for monitoring and alarm generation. If the pump is commanded on and flow is not detected, after a 20-second delay, provide an alarm at the OWS.

4. The following items shall be displayed at the OWS:

   a. Domestic water heater activated/deactivated.
   b. Domestic hot water discharge temperature.
   c. High/Low discharge temperature alarm, heater and loop.
   d. General failure signal.
   e. Commanded status of domestic hot water circulator pump.
   f. Pump flow status/failure alarm.

H1. Mech Rm 122 Heating and Ventilation System Control

1. This system consists of unit heaters UH-A2 and UH-A3, and duct mounted exhaust fan EF-A5, and outside air intake OAI-A1. Provide motor operated dampers and actuators for control of exhaust and outside air in the room. Provide space temperature sensor as shown on the drawings.

2. On a rise in space temperature above 80°F, adjustable, the exhaust air and outside air dampers shall open. Subject to a limit switch on the exhaust air damper, the exhaust fan shall start. On a fall in space temperature below setpoint, the fan shall be de-energized and all dampers shall close.

3. On a fall in space temperature below 60°F, adjustable, room sensor shall energize the fan on the unit heater to run. On a rise in space temperature, the reverse shall occur.

4. The following items shall be displayed at the OWS:

   a. Space temperature.
   b. Low temperature alarm, 40°F, adjustable.
   c. High temperature alarm, 100°F, adjustable.
   d. Heating setpoint.
   e. Ventilation setpoint.
   f. Commanded status of exhaust fan and dampers.

g. Commanded status of unit heater fan.

H.2 Storage 121 Heating and Ventilation System Control

1. This system consists of unit heater UH-A1 and duct mounted exhaust fan EF-A6, and outside air intake OAI-A2. Provide motor operated dampers and actuators for control of exhaust and outside air in the room. Provide space temperature sensor as shown on the drawings.

2. On a rise in space temperature above 80°F, adjustable, the exhaust air and outside air dampers shall open. Subject to a limit switch on the exhaust air damper, the exhaust fan shall start. On a fall in space temperature below setpoint, the fan shall be de-energized and all dampers shall close.

3. On a fall in space temperature below 60°F, adjustable, room sensor shall energize the fan on the unit heater to run. On a rise in space temperature, the reverse shall occur.

4. The following items shall be displayed at the OWS:

   a. Space temperature.
   b. Low temperature alarm, 40°F, adjustable.
   c. High temperature alarm, 100°F, adjustable.
   d. Heating setpoint.
   e. Ventilation setpoint.
   f. Commanded status of exhaust fan and dampers.
   g. Commanded status of unit heater fan.

I. Fan Coil Unit Control

1. Each unit shall be controlled by an individual DDC Controller. The DDC Controller shall be wired to a space temperature sensor with setpoint adjustment and override switch (Microtouch). Provide all sensors required for operation, monitoring, and control of each unit; interface with the 24-volt control transformer furnished with the unit. Provide a 2-way control valve for the dual temperature coil for installation by the Mechanical Contractor.

2. During the programmed occupied mode, the fan shall run continuously.

   a. Provide motor operated dampers and actuators for units which are directly connected to a source of outside air for ventilation. Each damper shall open fully during the occupied mode and remain closed during the unoccupied mode.

   b. Heating mode: On a fall in space temperature below the programmed heating setpoint of 70°F, adjustable, the coil control valve shall modulate open to the coil. On a rise in space temperature, the valve shall modulate closed. The valve shall be under further control of a high limit discharge air temperature sensor with setpoint at 100°F, adjustable, to prevent damage to the unit's components. Provide an alarm at the OWS if the discharge air temperature rises above the high limit setpoint.

   c. Cooling mode: On a rise in space temperature above the programmed cooling setpoint of 75°F, adjustable, the coil control valve shall modulate open. On a fall in space temperature, the valve shall modulate closed to the coil.

3. During the programmed unoccupied mode, the fan shall cycle and the control valve shall modulate in sequence to maintain the programmed unoccupied space temperature setpoints of 60°F (heating) and 85°F (cooling), all adjustable. When the override switch on the room sensor is activated, the unit shall be controlled as outlined in item 2 above for a minimum 2-hour period, adjustable at the OWS. Once the override cycle times out, the unit shall reset to the unoccupied mode of operation.

4. If the discharge temperature fails to rise to a programmed minimum temperature during a call for heating, a low temperature alarm shall be activated at the OWS. If the discharge temperature fails to fall to a programmed minimum temperature on a call for cooling, a high temperature alarm shall be activated at the OWS.

5. Provide a current switch on one phase of power feeding the supply fan for status indication at the OWS.

6. Provide a condensate sensor in the auxiliary drain pan below each unit. When condensate is detected in the pan, close the coil control valve, deactivate the unit supply fan, and provide an alarm at the OWS.

7. The following items shall be displayed at the OWS:

   a. Global outside air temperature.
   b. Space temperature.
   c. Space temperature setpoint.
   d. Discharge temperature.
   e. High and low limit discharge air setpoints.
   f. Commanded status of fan.
   g. Operational status of fan via current switch.
   h. Commanded status of each control valve.
   i. Low discharge temperature alarm.
   j. High discharge temperature alarm.
   k. Condensate alarm.
   l. Diagram showing the layout of the unit with major components and dynamic temperatures shown where temperature sensors exist in the system.

J. Cabinet Unit Heater Control

1. Each cabinet unit heater shall be controlled by the BAS via a space temperature sensor.

   a. Provide a separate DDC controller and flat plate space sensor for each unit; no override switch is required.
   b. Provide a 2-way, hot water control valve for installation in the unit by the Mechanical Contractor.

2. During the programmed occupied mode, the unit fan shall cycle. On a fall in space temperature below the programmed setpoint of 65°F, adjustable, the hot water coil control valve shall open. On a rise in temperature above setpoint, the valve shall close.

3. During the programmed un-occupied mode, the fan shall cycle and the hot water coil control valve shall open to maintain the programmed temperature setpoint of 60°F, adjustable.

4. If the discharge temperature fails to rise to a programmed minimum temperature during a call for heating, a low temperature alarm shall be activated at the OWS.

5. Provide a current switch on one phase of power feeding the supply fan for status indication at the OWS.

6. The following items shall be displayed at the OWS:

   a. Space temperature.
   b. Space temperature setpoint.
   c. Discharge temperature.
   d. Commanded status of fan.
   e. Operational status of fan via current switch.
   f. Commanded status of control valve.
   g. Low discharge temperature alarm.

h. Diagram showing the layout of the unit with major components and dynamic temperatures shown where temperature sensors exist in the system.

K. Unit Heater Control

1. Each unit heater shall be controlled by the BAS via a space temperature sensor.

   a. Provide a separate DDC controller and flat plate space sensor for each unit; no override switch is required.

2. The unit fan shall cycle to maintain the programmed setpoint of 65°F, adjustable.

3. Provide a current switch on one phase of power feeding the unit fan for status indication at the OWS.

4. The following items shall be displayed at the OWS:

   a. Space temperature.
   b. Space temperature setpoint.
   c. Commanded status of fan.
   d. Operational status of fan via current switch.

L. Zone Heating Duct Coil Control

1. Duct coils shall be controlled by an individual DDC Controller and space temperature sensor. Provide space sensor and two-way control valve for each coil.

2. Sensor shall modulate the heating coil control valve to maintain space temperature at 75°F, adjustable.

3. The following items shall be displayed at the OWS:

   a. Space temperature.
   b. Space temperature setpoint.
   c. Discharge air temperature.
   d. Commanded status of control valve.

M. Ductless Split System Unit Control:

1. The following sequence is typical for all of the systems scheduled on the drawings.

2. Each unit shall be controlled by its factory controls. Adjust factory controls to allow the indoor unit fan to cycle off once space temperature is achieved. Mount and wire the thermostat, which is furnished by the equipment manufacturer, and interlock the controls from the indoor unit to the outdoor unit. Set to maintain 75°F, adjustable.

   a. On units equipped with direct connected outside air, provide a motor operated damper and actuator for the intake air hood or other opening as shown on the drawings.

   b. Whenever the system is activated and the indoor unit supply fan is running, outside air damper shall open fully. Damper shall close when the system is deactivated and the indoor unit supply fan stops.

3. Provide a space mounted temperature sensor for monitoring and alarm generation at the OWS. On a rise in space temperature above the programmed high limit setpoint of 80°F, adjustable, an alarm shall be activated. On a fall in space temperature below the programmed low limit setpoint of 50°F, adjustable, an alarm shall be activated.

4. The following items shall be displayed at the OWS:

   a. Space temperature.
   b. High and low limit alarms and setpoints.
   c. Commanded status of outside air damper.

N.1 Kitchen Hood Exhaust Fan & Make-Up Air Unit Control:

1. This system consists of EF-A1, MAU-A1, and ventilator item 16 as shown on the drawings.

2. The hood exhaust fan and make-up air unit shall be energized manually by an on/off switch provided as part of the hood. Interface with this switch in accordance with hood manufacturer's written instructions.

   a. Mount the remote temperature sensor furnished with the hood as shown on the drawings.

3. The kitchen equipment manufacturer shall provide the BAS Contractor with wiring diagrams for the hood and all factory sensors.

4. The following items shall be provided by the make-up air unit manufacturer:

   a. Motor starter and overload protection.
   b. Outside air damper and actuator.
   c. Remote control panel.
   d. Terminal blocks for all wiring connections between equipment and control devices.

5. Whenever fan switch is engaged in the 'ON' position, the exhaust fan and make-up air supply fan shall be energized.

   a. Provide a current switch on one phase of the power feeding the exhaust fan. When current is sensed, indicating that the exhaust fan has been energized, the make-up air unit outside air damper shall open 100% and the supply fan shall be energized.

   b. On a fall in discharge air temperature below setpoint of 65°F, adjustable, the gas heat shall stage and modulate through its unit-mounted controls to maintain setpoint. Discharge air temperature shall be manually adjustable through the remote-control panel furnished with the makeup air unit.

6. Provide a current switch on one phase of power feeding the supply fan for monitoring and alarm generation at the OWS.

7. The system shall prevent the circulation of smoke. Upon activation of the duct smoke detector in the supply air ducts in the vicinity of the hood, the unit shall stop and all dampers shall close. The Mechanical Contractor shall install duct smoke detector furnished as part of the work of Division 26 – Electric.

8. Interface with a common fire alarm input to the BAS system from the fire alarm system (FAS). The fire alarm contact shall be provided by the fire alarm system vendor at the FAS panel. The status of the alarm contact shall be communicated throughout the BAS. When the fire alarm contact indicates an alarm condition, the BAS shall de-energize the supply fan, exhaust fan, gas heat and damper motors. When de-energized, the damper motor shall spring return the outside air damper closed. NOTE: the FAS shall also shut down the unit whenever the room CO (carbon monoxide) detector goes into alarm.

   a. If the kitchen ventilator exhaust fan is running and the hood fire suppression system is activated manually, the exhaust fan shall continue to run until deactivated by the FAS or manually shut down at the hood.

   b. The MAU shall shut down whenever the hood suppression system or fire alarm system is activated. Provide interface with each system.

9. The following items shall be displayed for each system at the OWS:

    a. Discharge air temperature.
    b. Discharge air temperature setpoint.
    c. Discharge low limit alarm.
    d. Fire alarm system status alarm.
    e. Commanded status of fans.
    f. Supply fan operational status via current switch.
    g. Exhaust fan operational status via current switch.
    h. Smoke detector status/alarm.
    i. Diagram showing the layout of the equipment with major components and dynamic temperatures shown where temperature sensors exist in the system.

N.2 Dish Washer Exhaust Fan Control

1. The sequence that follows is typical for fans EF-A3. Provide a motor operated damper and actuator as shown on the drawings. The damper shall be installed by the Mechanical Contractor. Fan shall run subject to a limit switch on the exhaust air damper, once activated.

2. Provide a current switch on one phase of power feeding the dishwasher unit. Upon activation of the dishwasher, the exhaust fan shall start and run as long as the dishwasher is energized.

3. Provide a current switch on one phase of power feeding the fan for status indication at the OWS.

4. The following items shall be displayed at the OWS:

    a. Fan status via current switch: on/off/alarm.
    b. Commanded status of fan and damper.

N.3 Exhaust Fan EF-D2 and EF-D3 Control

1. Each exhaust fan shall be energized by a motion sensor provided by Division 26 - Electric.

2. Provide a motor operated damper and actuator for each fan as shown on the drawings. The damper shall be installed by the Mechanical Contractor.

3. Subject to a limit switch on the exhaust air damper, the fan shall run continuously when activated.

N.4 Exhaust Fan Control

1. The sequence that follows is typical for fans EF-A2, A4, and D1. Coordinate schedule with the zone rooftop unit serving the area where these fans are shown on the drawings.

2. Each exhaust fan shall be energized during the occupied period and de-energized during the unoccupied period via the BAS. The damper shall be open during the occupied mode and shall be closed during the unoccupied mode.

3. Provide a motor operated damper and actuator for each exhaust fan as shown on the drawings. The damper shall be installed by the Mechanical Contractor.

4. Subject to a limit switch on the exhaust air damper, the fan shall run continuously during the occupied mode.

5. Provide a current switch on one phase of power feeding the fan for status indication at the OWS.

6. Interface with a common fire alarm input to the BAS system from the fire alarm system (FAS). When the FAS indicates an alarm condition, the BAS shall de-energize the fan and close the exhaust air damper.

7. The following items shall be displayed at the OWS:

   a. Fan status via current switch: on/off/alarm.
   b. Commanded status of fan and damper.

O. Air Handling Unit Control - Two Pipe/DX Unit:

1. The sequence that follows is for units AHU-A1/ACC-A3. The unit is a constant volume system with minimum outside air and economizer mode of operation. Unit shall be controlled by an individual DDC Controller. The DDC controller shall be wired to a space temperature sensor with setpoint adjustment and override switch (Microtouch), discharge air temperature sensor, mixed air temperature sensor, return air temperature sensor, and low limit thermostat. Provide all sensors required for operation, monitoring and control of unit. Provide a 2-way control valve for the dual temperature coil for installation by the Mechanical Contractor.

   a. Interface unit with its scheduled air-cooled condensing unit.
   b. Provide actuators for dampers in the mixing box, relief air damper, and damper at wall louver.

2. During the programmed occupied mode, the supply fan shall run continuously with the outside air damper open at the louver. Delay opening the unit mixing box outside air damper to its minimum position until the zone space temperature has recovered from its setback or setup temperature setting. The return air damper shall move in unison with the outside air damper to maintain the balance of air in the system. Once this condition is achieved, the outside air damper shall remain closed until the space CO2 level rises to 700 ppm. OWS shall be able to override fan from constant operation to cycle fan.

   a. On a rise in CO2 level above 700 ppm, the outside air damper shall open gradually to its first minimum position as scheduled on the drawings. The return air damper shall move in unison to maintain the balance of the air in the unit. Relief air dampers shall remain closed.

   b. On a continued rise in CO2 level above 900 ppm, activate an alarm at the Controller.

   c. On a decrease in CO2 level below 700 ppm, the outside air damper shall revert back to the closed position, while return air damper opens fully to maintain the balance of air in the unit. Relief air dampers shall remain closed.

3. Cooling Mode:

   a. On a rise in space temperature above the programmed cooling set-point, 75°F, adjustable, the control valve shall modulate open to maintain set-point to the extent of the water coil capacity in cooling mode as first stage of cooling. The DX system shall be locked out.

   b. On a continued rise in space temperature, the dual temperature control valve shall close, and the controller shall activate the DX cooling system. On a fall in temperature the reverse shall occur.

4. The mixing box economizer sequence shall be activated as the first stage of cooling. The DDC controller shall receive input from the Global outside air temperature and humidity sensors to calculate outside air enthalpy. If the outside air enthalpy is at 21 BTU/lb, the mixing box dampers shall modulate to maintain the mixed air temperature minimum setpoint of 55˚F, adjustable.

   a. The outside air damper shall continue to open up to 100% outside air to satisfy cooling demand. The return damper shall move in unison to maintain the balance of air in the system. The outside air damper shall never close past the minimum position during the occupied period.

5. Heating Mode:

   a. On a fall in space temperature below the programmed heating set-point, 70°F, adjustable, the control valve shall modulate open to the coil. On a rise in space temperature, the valve shall modulate closed. The valve shall be under further control of a high limit discharge air temperature sensor with setpoint at 100°F, adjustable, to prevent damage to the unit's components. Provide an alarm at the OWS if the discharge air temperature rises above the high limit setpoint.

   b. If space temperature rises above 75°F, adjustable, the 2-way control valve shall close to the coil, and the DX cooling system shall be activated to maintain space setpoint. The reverse shall occur when the space temperature falls to heating setpoint.

6. During the programmed unoccupied modes, the fan shall cycle and the control valve & DX cooling system shall modulate in sequence to maintain the programmed unoccupied space temperature set-points, 85°F cooling/60°F heating, all adjustable. When the override switch on the room sensor is activated, the unit shall be controlled as outlined above for a minimum 2-hour period, adjustable at the OWS. Once the override cycle times out, the unit shall reset to the unoccupied mode of operation.

7. Provide a current sensor on one phase of power feeding the supply fan for status indication at the OWS.

8. Provide a condensate sensor in the auxiliary drain pan the unit. When condensate is detected in the pan, close the coil control valve, deactivate the unit supply fan, and provide an alarm at the OWS.

9. Duct smoke detectors shall be installed in the supply and return air ducts at the unit as part of the work of Division 23. The detectors shall be furnished and wired to the fire alarm system as part of the work of Division 26. The duct smoke detector shall alarm through the FAS, which shall provide a signal to the BAS to de-energize the supply fan, exhaust fan, cooling and hot water control valves and damper motors. When de-energized the damper motors shall spring return the outside and exhaust air dampers closed. When the smoke detectors trip, an alarm shall be generated at the OWS.

10. The following items shall be displayed at the Operator's Terminal:

    a. Outside air temperature, global.
    b. Space temperature.
    c. Space temperature setpoint.
    d. Discharge temperature.
    e. High and low limit discharge air setpoint.
    f. Commanded status of fan.
    g. Operational status of fan via current sensor.
    h. Commanded status of the control valve.
    i. Low discharge temperature alarm.
    j. High discharge temperature alarm.
    k. Condensate alarm.
    l. Freezestat status/alarm
    m. Status of condensing unit: on/off.
    n. Diagram showing the layout of the unit with major components and dynamic temperatures shown where temperature sensors exist in the system.

P. Energy Recovery Ventilation System Unit Control:

1. The sequence that follows is typical for unit ERU-1, 2, and 3. Each unit consists of a supply fan, exhaust fan, chilled water-cooling coil, hot water heating coil, energy recovery wheel and drive, and filters. Each unit shall be provided with internal exhaust air and outside air bypass dampers. Each unit is a constant volume system with 100% outside air and economizer mode of operation.

2. The unit shall be controlled by an individual DDC Controller. The DDC Controller shall be wired to the coil discharge air temperature sensors, unit discharge air temperature sensor, return air temperature sensor, global outside air temperature sensor, exhaust air temperature sensor, and freeze stat. Each unit shall be provided with internal return air, exhaust air and outside air bypass dampers with actuators.

    a. Provide motor-operated dampers and actuators for control of outside air and exhaust air. (Locate close to hoods)

    b. Provide actuators for bypass dampers (by unit manufacturer).

3. The DDC Controller and required sensing and control devices shall be provided for field installation and wiring.

4. The following items shall be provided by the equipment manufacturer:

    a. Energy wheel motor, speed controller, freeze-stat, defrost controller and rotation failure contact, bypass dampers.

5. The following items will be provided by the BAS Contractor and installed in the equipment:

    a. DDC Controller
    b. Unit discharge air temperature sensor
    c. Heating and cooling coil discharge air temperature sensors.
    d. Return air temperature sensor.
    e. Temperature sensor at exhaust air outlet.
    f. Current sensor for one phase of power feeding the supply and exhaust fans.
    g. Current sensor for one phase of power feeding the heat recovery wheel
    h. Three-way control valves and actuators for all coils in the unit.
    i. Actuators for all dampers.

6. The occupied/unoccupied schedule shall correspond to the occupancy schedule for the school. During the occupied mode, the supply fan, exhaust fan, and energy recovery wheel shall run continuously with the outside air damper and exhaust air damper open. The cooling and heating coils shall modulate to maintain the minimum return air temperature setpoint of 70°F, adjustable, in the return air duct based on a temperature sensor at the unit return.

    a. Delay startup of the unit until the zone temperature has recovered from its previous setback or setup temperature during the unoccupied mode.

7. The energy recovery wheel shall preheat or pre-cool outside air to the extent of its capacity based on return air and outside air conditions. The heating coil control valve and cooling coil control valve shall modulate in sequence to maintain the discharge air temperature setpoint. Whenever the enthalpy of the outside air is sufficient for economizer operation, the energy recovery wheel shall stop and the OA & EA bypass dampers shall open. Wheel shall bump rotation to prevent build-up of dirt on wheel.

    a. The heating coil three-way control valve shall modulate to maintain its leaving air temperature whenever the air temperature off of the energy recovery wheel falls below its setting, or the wheel fails for any reason.

    b. When the freeze stat trips, de-energize the supply fan, exhaust fan, energy recovery wheel, and damper motors. When de-energized the damper motors shall spring return the outside air and exhaust air dampers closed, the control valves on the heating coil shall open full to the coil. When the freeze stat trips, an alarm shall be generated at the OWS.

    c. Within each ERU unit's cooling coil section condensate pan, mount a liquid detection sensor at the high sloped end of the pan to indicate the condensate is not draining out properly. Whenever moisture

is detected, shut down the unit until the condition has been examined and corrected. Manual reset shall be required to restore unit operation.

8. During the unoccupied mode, the supply and exhaust fan shall stop, the energy recovery wheel shall stop, and outside air and exhaust dampers shall close.

9. The BAS shall install energy wheel current sensor for monitoring and alarm generation at the OWS.

10. The BAS shall interface with a "Global" fire alarm input from the fire alarm system (FAS). The fire alarm contact shall be provided to the BAS from the fire alarm panel by the fire alarm system vendor. The status of the alarm contact shall be communicated throughout the BAS. When the fire alarm contact indicates an alarm condition, the BAS shall de-energize the supply fan, exhaust fan and damper motors. When de-energized, the damper motors shall spring return the outside and exhaust air dampers closed. Provide an alarm at the OWS to indicate fire alarm status.

11. Duct smoke detectors shall be installed in the supply and return air ducts at the unit as part of the work of Division 23. The detectors shall be furnished and wired to the fire alarm system as part of the work of Division 26. The duct smoke detector shall alarm through the FAS, which shall provide a signal to the BAS to de-energize the supply fan, exhaust fan, cooling and hot water control valves and damper motors. When de-energized the damper motors shall spring return the outside and exhaust air dampers closed. When the smoke detectors trip, an alarm shall be generated at the OWS.

12. The following items shall be displayed at the OWS:

    a. Discharge air temperature and humidity.
    b. Discharge air temperature setpoint.
    c. Return air temperature.
    d. Exhaust air temperature.
    e. Outside air temperature.
    f. Fire alarm system status/alarm.
    g. Commanded status of fans.
    h. Supply and exhaust fan start/stop command and speed signal
    i. Supply fan operational status via a current sensor.
    j. Exhaust fan operational status via a current sensor.
    k. Energy recovery wheel commanded status, operational status via current sensor and alarm.
    l. Smoke detector status/alarm.
    m. Freeze stat status/alarm.
    n. Damper command position of all damper actuators
    o. Diagram showing the layout of the equipment with major components and dynamic temperatures shown where temperature sensors exist in the system.

Q.1 Packaged Rooftop Unit Control: General

1. The sequence that follows is typical for units RTU-A1, RTU-A2, RTU-D1, and RTU-D2 (ALT). Each unit consists of a supply fan, packaged air-cooled DX cooling system with hot gas bypass control, gas fired heating section, air filters, air control dampers and actuators, and unit controls.

    a. Each unit is a constant volume system with minimum outside air and economizer mode of operation.

    b. Each unit shall be controlled by an individual DDC Controller. The DDC Controller shall be wired to sensors which shall include, but are not limited to, a discharge air temperature sensor, mixed air temperature sensor, return air temperature sensor, global outside air temperature/humidity/enthalpy, CO2 sensors, and space temperature sensors. The DDC Controller and all required sensors shall be provided by the BAS Contractor, field mounted and wired.

2. The following items shall be provided by the equipment manufacturer:

a. Motor starters and overload protection.
b. Control transformers.
c. Dampers and damper motors.
d. Terminal blocks for all wiring connections between equipment and control devices.
e. Standard factory control modules for unit DX and natural gas functions.

The following items shall be provided by ATC:

a. Space temperature sensors.
b. Discharge air temperature sensor.
c. Return air temperature sensors.
d. Global outside air temperature and humidity sensors.
e. Current sensor for one phase of the power feeding the fan.
f. Mixed air average temperature sensor.
g. CO2 sensors and space temperature sensors.
h. DDC Controller.

3. During the programmed occupied mode, the supply fan shall run continuously with the outside air damper closed. When fan fails to start once activated, initiate an alarm to the system after a twenty second delay. Monitor fan status with a current switch on one leg of power feeding the fan motor. Delay opening the outside air damper to its minimum position until the zone space temperature has recovered from the setback or setup temperature setting.

   a. Outside air damper shall remain closed until return air CO2 level rises to 700 ppm. The outside air damper shall step open from the closed to full scheduled open position to maintain CO2 level at or below 700 ppm. The return air and relief air dampers in the system shall modulate in unison to maintain the balance of air in the system.

   b. On a continued rise in CO2 level above 900 ppm, activate an alarm at the OWS. On a decrease in CO2 level below 700 ppm, the outside air damper shall step closed.

4. On a drop-in space air temperature below the programmed setpoint of 70°F, adjustable, the unit gas heating section shall be activated through its unit controls and stage to maintain setpoint. Use space sensors to maintain average temperature setting.

5. On a rise in space air temperature above setpoint, the mixing box economizer sequence shall be activated. On a further rise or if the economizer sequence is deactivated, the unit air-cooled DX system hall be activated through its unit controls to maintain setpoint. On a fall in temperature the reverse shall occur. Maintain 75°F, adjustable.

6. The mixing box economizer sequence shall be activated as the first stage of cooling. The DDC Controller shall receive input from the global outside air temperature and humidity sensors to calculate outside air enthalpy. If the outside air enthalpy is at 25 BTU/lb, adjustable, the mixing box dampers shall modulate to maintain the mixed air temperature setpoint of 55°F, adjustable. The outside air damper shall continue to open up to 100% outside air to satisfy cooling demand. The return/relief dampers in the unit shall move in unison to maintain the balance of air in the unit. The outside air damper shall not close below the minimum position during the occupied period.

7. During the programmed un-occupied mode, the fan, heating, cooling and mixing box dampers shall be cycled/modulated to maintain the un-occupied setpoints of 60°F (heating) and 85°F (cooling), all adjustable. Unless required for economizer cycle, the outside air and relief air dampers shall remain closed with the return air damper fully open.

8. Interface with a common fire alarm input from the fire alarm system. The fire alarm contact shall be provided at the fire alarm panel by the Fire Alarm Contractor. The status of the alarm contact shall be

communicated throughout the BAS. When the fire alarm contact indicates an alarm condition, the BAS shall de-energize the unit. When de-energized, the damper motors shall spring return the outside and relief air dampers closed. Provide an alarm at the OWS to indicate fire alarm status. NOTE: the FAS shall also shut down the unit whenever the room CO (carbon monoxide) detector goes into alarm.

9. The Mechanical Contractor install duct smoke detectors in the supply and return air ducts at the unit as furnished by the FAS vendor as part of the work of Division 26 – Electric. When wired to the fire alarm system as required by the Division 26 contractor, the duct smoke detectors shall alarm the FAS, which shall signal the BAS to de-energize the unit in a manner similar to item 8.

10. The following items shall be displayed at the OWS:

    a. Space temperature.
    b. Space temperature setpoint.
    c. Mixed air temperature.
    d. Mixed air temperature setpoint.
    e. Global outside air temperature, humidity and enthalpy.
    f. Fire alarm system status/alarm.
    g. Duct smoke detectors status: normal/alarm.
    h. Commanded status of fan.
    i. Supply fan operational status via current switch.
    j. Diagram showing the layout of the equipment with major components and dynamic temperatures shown where temperature sensors exist in the system

Q.2 Rooftop Unit Control

1. The sequence that follows is for system RTU-B1/RF-B1as scheduled on the drawings. The rooftop unit consists of a supply fan, packaged air-cooled DX cooling system with hot gas bypass control, gas fired heating section, air filters, air control dampers and actuators, and unit controls with inline return air fan.

    a. Each unit is a constant volume system with minimum outside air and economizer mode of operation.
    b. Each unit shall be controlled by an individual DDC Controller. The DDC Controller shall be wired to sensors which shall include, but are not limited to, a discharge air temperature sensor, mixed air temperature sensor, return air temperature sensor, global outside air temperature/humidity/enthalpy, CO2 sensors, and space temperature sensors. The DDC Controller and all required sensors shall be provided by the BAS Contractor, field mounted and wired.
    c. Interlock each unit with its respective duct mounted return air fan.

2. The following items shall be provided by the equipment manufacturer:

    a. Motor starters and overload protection.
    b. Control transformers.
    c. Dampers and damper motors.
    d. Terminal blocks for all wiring connections between equipment and control devices.
    e. Standard factory control modules for unit DX and natural gas functions.
    f. Motor starter and overload protection for the return fan shall be provided as part of the work of Division 26 – Electric.

    The following items shall be provided by ATC:

    a. Space temperature sensors.
    b. Discharge air temperature sensor.
    c. Return air temperature sensor.
    d. Global outside air temperature and humidity sensors.
    e. Current sensor for one phase of the power feeding the fan.
    f. Mixed air average temperature sensor.

g. CO2 sensors and space temperature sensors.
h. DDC Controller.

3. During the programmed occupied mode, the supply and return air fans shall run continuously with the outside air damper closed. When either fan fails to start once activated, initiate an alarm to the system after a twenty second delay. Monitor fans status with a current switch on one leg of power feeding the fan motors. Delay opening the outside air damper to its minimum position until the zone space temperature has recovered from the setback or setup temperature setting.

   a. Outside air damper shall remain closed until return air CO2 level rises to 700 ppm. The outside air damper shall step open from the closed to full scheduled open position to maintain CO2 level at or below 700 ppm. The return air and relief air dampers in the system shall modulate in unison to maintain the balance of air in the system.

   b. On a continued rise in CO2 level above 900 ppm, activate an alarm at the OWS. On a decrease in CO2 level below 700 ppm, the outside air damper shall step closed.

4. On a drop-in space air temperature below the programmed setpoint of 70°F, adjustable, the unit gas heating section shall be activated through its unit controls and stage to maintain setpoint. Use space sensors to maintain average temperature setting.

5. On a rise in space air temperature above setpoint, the mixing box economizer sequence shall be activated. On a further rise or if the economizer sequence is deactivated, the unit air-cooled DX system hall be activated through its unit controls to maintain setpoint. On a fall in temperature the reverse shall occur. Maintain 75°F, adjustable.

6. The mixing box economizer sequence shall be activated as the first stage of cooling. The DDC Controller shall receive input from the global outside air temperature and humidity sensors to calculate outside air enthalpy. If the outside air enthalpy is at 25 BTU/lb, adjustable, the mixing box dampers shall modulate to maintain the mixed air temperature setpoint of 55°F, adjustable. The outside air damper shall continue to open up to 100% outside air to satisfy cooling demand. The return/relief dampers in the unit shall move in unison to maintain the balance of air in the unit. The outside air damper shall not close below the minimum position during the occupied period.

7. During the programmed un-occupied mode, the fans, heating, cooling and mixing box dampers shall be cycled/modulated to maintain the un-occupied setpoints of 60°F (heating) and 85°F (cooling), all adjustable. Unless required for economizer cycle, the outside air and relief air dampers shall remain closed with the return air damper fully open.

8. Interface with a common fire alarm input from the fire alarm system. The fire alarm contact shall be provided at the fire alarm panel by the Fire Alarm Contractor. The status of the alarm contact shall be communicated throughout the BAS. When the fire alarm contact indicates an alarm condition, the BAS shall de-energize the unit and inline return air fan. When de-energized, the damper motors shall spring return the outside and relief air dampers closed. Provide an alarm at the OWS to indicate fire alarm status. NOTE: the FAS shall also shut down the unit whenever the room CO (carbon monoxide) detector goes into alarm.

9. The Mechanical Contractor install duct smoke detectors in the supply and return air ducts at the unit as furnished by the FAS vendor as part of the work of Division 26 – Electric. When wired to the fire alarm system as required by the Division 26 contractor, the duct smoke detectors shall alarm the FAS, which shall signal the BAS to de-energize the unit in a manner similar to item 8.

10. The following items shall be displayed at the OWS:

    a. Average space temperature.
    b. Average space temperature setpoint.

c. Mixed air temperature.
d. Mixed air temperature setpoint.
e. Global outside air temperature, humidity and enthalpy.
f. Fire alarm system status/alarm.
g. Duct smoke detectors status: normal/alarm.
h. Commanded status of each fan.
i. Supply fan operational status via current switch.
j. Return fan operational status via current switch.
k. Diagram showing the layout of the equipment with major components and dynamic temperatures shown where temperature sensors exist in the system

R. Electric Cabinet Heater Control:

1. Each heater is equipped with a unit mounted thermostat, fan control, and residual heat sensor.

2. Set thermostat to maintain 65°F, adjustable. Thermostat shall energize the heating element and start unit fan. Once setpoint is met, the unit fan shall continue to run until the residual heat sensor allows the element to dissipate excess heat to the room. Fan shall then shut down.

3. Provide a blank-plate sensor in each space for space temperature monitoring and low limit alarm at the OWS. Set alarm at 40°F, adjustable.

S. Outdoor Lighting Control:

1. Division 26 - Electric shall provide multiple lighting contactors for control of outdoor lighting. The lighting will be divided into two or more zones. The lighting contactors shall be located adjacent to each other as shown on the electrical drawings.

2. Provide an outdoor, ambient light level sensor. During the programmed operation period, the outdoor lighting shall be activated when the outdoor ambient light level falls below the programmed setpoint. Each zone shall have independent light level setpoints and time schedules. Set time schedules and light level setpoints as directed by the owner. All time schedules and setpoints shall be adjustable at the OWS.

3. The following items shall be displayed at the OWS:

a. Ambient light level.
b. Time schedule per zone.
c. Commanded status of each zone.

T. Biohazard Shut Down System Control:

1. Provide a biohazard shutdown system including an emergency shut down switch, a “normal” pilot light and an emergency pilot light. The switch/pilot light assembly shall be located in the Principal’s Office or as directed by the Owner. Provide labeling of all components.

2. When the emergency switch is activated, a signal shall be sent to the BAS to shut down all air handling equipment and to close all dampers controlled by the BAS in the entire school. Provide an alarm at the OWS when the switch is activated.

3. The alarm shall be manually reset at the switch and at the OWS before normal system operation resumes.

4. The status of switch/system – normal or alarm shall be displayed at the OWS.

U. Blocking Valves

1. Furnish blocking valves as shown on the drawings. The purpose of the valves is to prevent chilled water

from migrating through the piping to terminal heating only equipment when the system is in the cooling mode, since the equipment is not equipped for condensation. The valves shall be of the two-position type and will fail in the last position (no spring return).

2. When the dual temperature loop is in the heating mode, the blocking valves shall be open. When the dual temperature loop is in the cooling mode, the blocking valves shall be closed.

3. An end switch on the valve actuator shall be monitored by the BAS to indicate that the valve is fully open. Provide an alarm at the OWS if the valve is commanded open but not proven open via the end switch.

4. The following items shall be displayed at the OWS:

   a. Individual blocking valves and commanded position.
   b. Operator selection to set heating/cooling position of each valve.
   c. Status of valve end switch/valve open position.
   d. Alarm if valve is commanded open and end switch does not indicate that the valve is open.

V. Cold Storage Monitoring Control

1. Provide temperature sensor in each of the walk-in cold storage units in the kitchen as shown on the food service drawings.

2. Set high limit alarms for each cold storage unit as recommended by the unit manufacturer.

3. Provide high limit alarms to the OWS and any remote call-out as directed by the Owner.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install system and materials in accordance with manufacturer's instructions and roughing-in drawings, and details and drawings. Install electrical work and use electrical products complying with requirements of these specifications. Mount controllers at convenient locations and heights.

B. All wiring shall be properly supported and run in a neat and workmanlike manner. All wiring exposed and in equipment rooms shall run parallel to or at right angles to the building structure. All wiring within enclosures shall be neatly bundled and anchored to prevent obstruction to devices and terminals. All wiring shall be in accordance with all local and national codes. Low voltage wiring for space temperature sensors, communication bus between terminal units, etc., above accessible ceilings in finished spaces on the floors may be plenum rated cable. Wiring in all other locations shall be installed in EMT conduit. All electronic wiring shall be #18 AWG minimum THHN and shielded if required, except standard network (Ethernet, LonWorks, etc.) cabling shall be as tested and recommended in lieu of #18 gauge twisted, #22 or #24 gauge is acceptable if used as a part of an engineered structured cabling system. The control manufacturer must submit technical and application documentation demonstrating that this cabling system has been tested and approved for use by the manufacturer of both the control system and the engineered structured cabling system.

C. Provide all sensing, control, and interlock wiring for the following:

System inputs and outputs
System communications
System power
System interlocks
Unit controls

D. The Control Manufacturer shall enter all computer data into the Host computer including all graphics, control programs, initial approved parameters and settings, and English descriptors. The Control Manufacturer shall

maintain diskette copies of all data file and application software for reload use in the event of a system crash or memory failure. One copy shall be delivered to the owner during training sessions, and one copy shall be archived in the Control Manufacturer's local software vault.

3.2 DATA CONTROL (D/C) AND GRAPHICS SUMMARY

A. All hardware, custom software, application software, graphics, etc., necessary to accomplish the control sequences and display the graphics specified shall be provided as part of this contract. Provide all controllers, inputs, outputs, valves, dampers, actuators and flow meters required to provide the control and graphic data described. Provide software setpoints required for display in logical groups and graphics.

B. Each digital output shall have a software-associated monitored input. Any time the monitored input does not track its associated command output within a programmable time interval, a "command failed" alarm shall be reported.

C. Where calculated points (such as CFM) are shown, they shall appear in their respective logical groups.

D. Unless otherwise specified or approved prior to bidding, the primary analog input and the analog output of each DDC loop shall be resident in a single remote panel containing the DDC algorithm, and shall function independent of any primary or UC communication links. Secondary (reset type) analog inputs may be received from the primary network, but approved default values and/or procedures shall be substituted in the DDC algorithm for this secondary input if network communications fail or if the secondary input becomes erroneous or invalid.

3.3 ACCEPTANCE

A. The Control Manufacturer shall completely check out, calibrate and test all connected hardware and software to ensure that the system performs in accordance with the approved specifications and sequences of operations approved.

B. Witnessed acceptance demonstration shall display and demonstrate each type of data entry to show site specific customizing capability; demonstrate parameter changes; execute digital and analog commands; and demonstrate DDC loop stability via trend of inputs and outputs.

3.4 MANUALS

A. The following manuals will be provided:

1. An Operators Manual shall be provided with graphic explanations of keyboard use for all operator functions specified under Operator Training.

B. Computerized printouts of all GPC data file including all point processing assignments, physical terminal relationships, scales and offsets, command and alarm limits, etc.

C. A manual shall be provided including revised as-built documents of all materials required under the paragraph "SUBMITTALS" on this specification.

D. Two Operators Manuals, and two As-Built Manuals shall be provided to the owner.

3.5 TRAINING

A. All training shall be by the BMCS contractor and shall utilize operator’s manuals and as-built documentation.

B. Operator training shall include three (3) four-hour sessions encompassing modifying text and graphics, sequence of operation review, selection of all displays and reports, use of all specified OWS functions, troubleshooting of sensors (determining bad sensors), and password assignment and modification. One training

session shall be conducted at system completion, one shall be conducted forty-five days after system completion, and one at ninety (90) days, or as requested by the Owner.

3.6 SERVICE GUARANTEE

A. The control system herein specified shall be free from defects in workmanship and material under normal use and service. After completion of the installation, the control manufacturer shall regulate and adjust all thermostats, control valves, motors and other equipment provided under this contract. If within twelve (12) months from date of acceptance either for beneficial use of final acceptance, whichever is earlier, any of the equipment herein described is proven to be defective in workmanship or materials, it will be replaced or repaired free of charge. The control manufacturer shall, after acceptance, provide any service incidental to the proper performance of the control system under guarantee outlined above for the period of one year. Normal maintenance of the system or adjustments of components is not to be considered part of the guarantee. The control manufacturer will upon completion of the installation, during the warranty period, make available to the Owner, an annual service agreement covering all labor and material required to efficiently maintain the control system.

3.7 FINAL ADJUSTMENT

A. After completion of installation, adjust thermostats, control valves, motors and similar equipment provided as work of this section.

B. Final adjustment shall be performed by specially trained personnel in direct employ of installer of primary temperature control system.

END OF SECTION 23 09 00

SECTION 23 09 50
TESTING & BALANCING OF MECHANICAL SYSTEMS

PART 1 – GENERAL

1.1 JOB CONDITIONS

A. Systems shall be completely installed and in continuous operation as required to accomplish the tests.

B. Heating, ventilating and air conditioning equipment shall be completely installed and in continuous operation as required to accomplish the balance work specified.

C. Adjust and balance shall be performed when outside conditions approximate design conditions indicated for heating and cooling functions.

D. Make at least two inspections of the mechanical systems during construction to verify that balancing procedures may be accomplished. Report findings to the Construction Manager.

E. Balancing firm shall balance Mechanical System two (2) times. The first time shall be considered a rough balance. Any discrepancy in air flow shall be addressed to the Construction Manager. The final balancing will be accomplished after review of rough balance reports.

F. The final balancing reports shall be submitted and approved prior to project's being considered complete; i.e., commencement of warranties.

1.2 ENGINEER QUALIFICATIONS

A. The firm shall be an independent organization having no affiliation with construction contractors, equipment sales or design engineering.

B. The firm shall specialize in balancing heating, ventilating and air conditioning systems.

C. The firm shall show proof of having balanced and tested at least five projects of similar size and scope.

D. All field work shall be under the direct supervision of a registered Professional Engineer who is a full-time employee of the balancing firm.

E. The firm shall be certified by and a member of the AABC (Associated Air Balance Council), or NEBB (National Environmental Balancing Bureau).

1.3 REPORT

A. Data Sheets:

1. Submit data sheets on each item of testing equipment required.

2. Include name of device, manufacturer’s name, model number, latest date of calibration and correction factors.

B. Report Forms:

1. Submit specimen copies of report forms.

2. Forms shall be 8-1/2 x 11-inch paper for loose-leaf binding, with blanks for listing of the required test ratings and for certification of report.

3. Reports shall be on standard forms published by AABC or NEBB.

PART 2 – PRODUCTS

2.1 AIR BALANCE INSTRUMENTS

A. Alnor Velometer with probes and alnor pitot tube.

B. Rotating Vane Anemometer: 4-inch size.

C. ASHRAE Standard Pitot Tubes, stainless steel 5/16 inch outside diameter, lengths 18 inches and 36 inches.

D. Magnehelic Differential Air Pressure Gauges, 0 to 0.5 inches, 0 to 1.0 inch and 0 to 5.0 inches water pressure ranges, each arranged as a portable unit for use with a standard Pitot tube.

E. Combination Inclined-Vertical Portable Manometer, range 0 to 5.0 inches water.

2.2 WATER BALANCING INSTRUMENTS

A. 30 Inch Mercury U-Tube Manometer, 200 psig, with 3 valve bypass assembly and return wells or mercury check valves.

B. Inspector's gauge testing set.

C. Water Differential Pressure Gauge, 4-1/2-inch dial, 0 to 100 psi range.

D. Pressure gauge measurement points, quick connect couplings, 1/4-inch psi.

2.3 SYSTEM PERFORMANCE MEASURING INSTRUMENTS

A. Insertion Thermometers, with graduation at 0.5 degrees F for air and 0.1 degrees F for water.

B. Sling Psychrometer.

PART 3 – EXECUTION

3.1 GENERAL REQUIREMENTS

A. Arrange and pay for all tests.

B. Notify Construction Manager at least three working days in advance of test and conduct in presence of Construction Manager.

C. Tests to be performed prior to insulation, covering or concealment.

D. Provide signed report of completion of test with signature of witnesses. Report shall indicate:

1. System Tested
2. Date
3. Specified test requirements and actual testing results

E. The balancing firm shall report to and review the work required with the Architect/Engineer before beginning field balance work. The balancing firm shall make at least two inspections of the air systems during construction and shall report his findings in writing to the Architect/Engineer.

F. The balancing firm shall cooperate with the Construction Manager and the Mechanical Contractor to effect smooth coordination of the balancing work with the job schedule.

G. The balancing firm shall be responsible for getting the various systems into proper operation. They shall enlist the aid of the equipment suppliers and Mechanical Contractor as may be required to effect proper operation consistent with the contract plans and specifications.

H. When the balancing firm cannot balance a belt-driven piece of equipment with the supplied belts and sheaves, inform the Mechanical Contractor that the Mechanical Contractor shall provide additional sheaves as spelled out in other Division 23 Sections.

3.2 CIRCULATING WATER SYSTEM TEST

A. All piping tests shall be applied not only to piping, but also to all devices and equipment connected thereto with the exception of control valves, boilers or any other equipment which may be damaged by the test pressure. All valves shall be full open.

B. Test at 100 psi hydrostatic pressure for 6 hours:

1. Record pressures each hour
2. Repair all leaks
3. Retest until 6 hours can be completed with no leaks or loss of pressure.

C. After completion of successful test, strainers shall be cleaned, then system shall be backflushed and strainers cleaned again.

3.3 DUCTWORK TESTING

A. Witness testing conducted by the Mechanical Contractor per Section 230600, PART 3: EXECUTION.

3.4 BALANCING PROCEDURE

A. Air System Balance:

1. With the fan supply system set to handle normal minimum outdoor air, the balancing firm shall perform the following tests and compile the following information:

Air Handling Equipment

a. Design Conditions:

(1) CFM Supply Air
(2) Static Pressure
(3) CFM Fresh Air
(4) Fan RPM

b. Installed Equipment:

(1) Manufacturer
(2) Size/Model Number

(3) Motor HP, Voltage, Phase, Full Load Amperes

c. Field Test:

(1) Fan Speed
(2) No Load Operating Amperes
(3) Fan Motor Operating Amperes
(4) Calculated BHP

d. Test for Total Air:

(1) Size of discharge, return air and outside air ducts.
(2) Number and locations of Velocity Readings taken.
(3) Duct Average Velocity
(4) Total CFM
(5) Outside Air CFM
(6) Return Air CFM

e. Individual Outlets (Diffusers, Registers and/or Grilles):

(1) Identify each outlet or inlet as to location and area and fan system
(2) Outlet, manufacture and type
(3) Outlet size
(4) Outlet free area, core area, or neck area
(5) Required FPM and test velocity found for each outlet.
(6) Required CFM and test results for each outlet

2. After completion of tests, adjustment and balancing under minimum fresh air conditions, set the system for 100% fresh air. Repeat the total CFM tests to check field versus design conditions. The results under 100% fresh air cycle shall agree with conditions found under "minimum fresh air operation" before the system is considered to be in balance. Adjustments of the proper dampers shall be made to achieve balance.

3. Testing and adjusting of individual outlets shall be performed under procedures recommended by the manufacturers of the outlets. All outlets shall be set for air pattern required and all main supply air and return air dampers to be adjusted and set for design CFM indicated. Any required changes in air patterns, settings, etc., necessary for achieving correct air balance, shall be provided by this Contractor. Total CFM of all outlets shall agree with total CFM of all branches and the grand total shall agree with the air volume for the fan(s).

B. Water Balance:

1. Water balance shall include dual temperature water, heating water, chilled water and condenser water systems. The balancing agency shall perform the following tests, compile data and submit reports.

2. Pumps:

a. Design Data

(1) GPM, head
(2) RPM, BHP

b. Installed Equipment

(1) Manufacturer, Size
(2) Type Drive
(3) Motor HP, Volts, Cycles and Phase
(4) Full Load Amperes

c. Field Test

(1) Discharge Pressures: Full flow & no flow
(2) Suction Pressures: Full flow & no flow
(3) Operating Head and GPM
(4) No Load Amperes (where possible)
(5) Full Flow Amperes, No Flow Amperes
(6) Calculated BHP

3. Heating and/or Cooling Elements Including Loop Water to all terminal Units:

a. Design Data:
(1) MBH Specified, GPM Specified
(2) Entering Water Temperature (EWT)
(3) Entering Air Temperature (EAT)
(4) Water Temperature Drop (DTW)
(5) Element Type Specified

b. Field Test:
(1) Identify each element as to location
(2) Required water temperature drop corrected for item (3) above
(3) Actual entering air and water conditions (temperature and GPM)
(4) Adjust element until required temperature drop is obtained

C. In addition to the above work, the Balancing Firm shall check the operation of all automatic temperature control equipment; verify all thermostat, aquastat, etc., set-points and operations; and enlist the aid of the Mechanical Contractor and the Control Subcontractor to make necessary adjustments where required.

END OF SECTION 23 09 50

SECTION 26 00 00
GENERAL PROVISIONS – ELECTRICAL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other conditions, if any) and Division 1 as appropriate, apply to the work of this Section.

B. The specification or drawing and the design features or resulting construction disclosed, are the property of Furlow Associates, Inc., and shall not be reproduced without written permission.

1.2 DESCRIPTION OF WORK

A. Provide all materials, equipment, labor, services and all appurtenances required to completely install and satisfactorily operate the various systems. The items listed below are for general guidance only and do not necessarily include the entire requirements for the project.

1. Coordination with other trades
2. Electrical service
3. Interior feeders
4. Lighting and power panels
5. Lighting branch wiring
6. Power wiring
7. Lighting fixtures and lamps
8. Wiring devices
9. Connections for electrically operated equipment
10. Fire alarm and detection system
11. Telephone/Data/Audio Visual
12. Lightning protection system
13. Related work as herein described or otherwise defined under the heading "Related Work".

B. Wherever the term "provide" is used, it shall be understood to mean both "furnish" and "install".

1.3 RELATED WORK

A. Equipment specified in sections of Divisions 1 thru 23 that require electric power supply.

B. Work related to this trade as defined on the following contract drawings:

Architectural/Structural
HVAC
Plumbing

1.4 SITE CONDITIONS

A. Attention of all bidders is called to the necessity for a careful inspection of the site, its present condition and encumbrances, the extent of the work, the protection to be afforded to adjacent properties or structure, availability of utilities, the extent and nature of the material required to be excavated and the amount of fill and removal. He shall also determine local or site limitations which will affect construction.

1.5 PERMITS, INSPECTIONS AND ORDINANCES

A. All work shall be executed and inspected in accordance with local and state ordinances, rules and regulations and the requirements of public utilities having jurisdiction. The contractor shall secure and pay for all permits, inspections and connections required.

B. The Electrical Contractor shall furnish a certificate of inspection to the Owner at the time of completion.

C. Requirements of the following organization shall be considered minimum:

1. National Electrical Code
2. National Electrical Safety Code
3. OSHA
4. Local City and County Codes

D. Reference to technical societies, trade organizations and governmental agencies are in accordance with the following:

1. ANSI - American National Standards Institute
2. ASTM - American Society for Testing Materials
3. IEEE - Institute of Electrical and Electronics Engineers, Inc.
4. NEC - National Electrical Code
5. NEMA - National Electrical Manufacturer's Association
6. NFPA - National Fire Protection Association
7. MSS - Manufacturer's Standardization Society
8. IES - Illuminating Engineers Society
9. ETL - Engineering Testing Laboratories
10. EIA - Electronic Industries Association
11. OSHA - Occupational Safety and Health Administration
12. Federal Specifications
13. UL - Underwriters Laboratories, Inc.

1.6 QUALITY ASSURANCE

A. Provide adequate supervision of labor force to assure that all aspects of the contract documents are fulfilled.

B. Contractor to provide manufacturer’s written certification that the following equipment has been installed and will operate correctly and in accordance with the manufacturer’s warranty requirements.

Fire Alarm and Detection System

C. Testing:

1. After completion of the work, the entire wiring system shall test entirely free from grounds, short circuits, opens, overloads and improper voltage.

2. The grounding system shall be tested for a resistance of 25 ohms or less.

3. Perform testing as follows: Arrange and pay for all tests, provide all equipment, materials and labor to perform test. Notify Engineer and Owner three (3) working days before tests are to be made. Conduct tests in the presence of the Engineer or authorized representative. Repeat tests after defects are corrected.

D. Special Engineering Services: In the instance of complex specialized electrical power and signaling systems, and other similar systems, the installation and final connections of these systems shall be made by and/or under

the supervision of a competent installation and service engineer who shall be a representative of the respective equipment manufacturer. Any and all expenses of these installation and service engineers shall be borne by this Contractor.

1.7 COORDINATION

A. As a requirement of this project, the Electrical Contractor shall furnish coordination for his equipment and layouts with other subcontractors furnishing equipment and services for Divisions 1 thru 23. Any and all contractors who install their equipment or furnish services prior to coordination, any contractor who changes their equipment or services after coordination has occurred, without notifying associated subcontractors, shall be held responsible for making all required changes with no additional cost to the Owner. Or delay in construction time. This coordination will include conduit layout to allow access to equipment for maintenance.

B. The Mechanical, Plumbing and Electrical Contractors are responsible to coordinate all manufacturer's recommended circuit breakers, starters, disconnects and fuse sizes for all equipment. Submission of a shop drawing will certify that this has been completed.

C. The drawings and specifications reflect the type, number and size of services required for the equipment the design is based upon. Should the supplying subcontractor elect to furnish an alternate piece of equipment requiring difference services and/or space conditions, he shall inform the subcontractor furnishing those services and be held responsible to pay for all required changes as part of this contract.

1.8 SUBMITTALS

A. Shop Drawings:

1. Shop drawings shall be submitted in accordance with Division 1 of these specifications except where herein modified.

NOTE: Submittals will only be reviewed once and resubmittals will be reviewed once. Any other submittals will be billed to the Contractor at the Engineer's standard rates.

2. Shop drawings comprising complete catalog cuts, performance test data for electrical equipment as required by other sections of Division 26 shall be submitted for review checking. The Contractor shall review these shop drawings for conformance to contract documents prior to submission and affix contractor's signature to each submittal certifying that this review has been done. By approving and submitting shop drawings, product data, wiring diagrams and similar materials, the Electrical Contractor represents that he and/or his subcontractor has determined and verified materials, field measurements and field construction data that relates to the work, and has checked and coordinated this information with all of the Divisions 1 thru 23 subcontractors.

3. All shop drawing submittals shall have the following identification data, as applicable, contained therein or permanently adhered thereto:

a. Project name

b. Project number

c. Sub-Contractor's, Vendor's and/or manufacturer's name and address.

d. Product identification.

e. Identification of deviation from the contract documents.

f. Applicable contract drawings and specification section number.

g. Shop drawing title, drawing number, revision number, and date of drawing and revision.

h. Resubmit revised or additional shop drawings as requested.

i. Wherever shop drawings or vendor's standard data sheets indicate work to be done "by others", it shall be the responsibility of the Contractor making the submission to identify by name, the Contractor who is to do this work. If the Contractor named is other than the Contractor making the submission, the shop drawing submission must be reviewed by the named Contractor and bear his mark of approval, prior to submission to the Architect/Engineer.

j. Where equipment proposed differs from that shown on the drawings or specified, he shall submit for approval drawings showing the manner in which the layout is affected by the substitution.

k. The Contractor shall keep one copy of approved shop drawings at the job site, filed in a suitable metal container. The shop drawings shall be cataloged and kept in good repair, and shall be available for use by the Owner, Architect and Engineer.

l. No equipment shall be ordered, fabricated, etc., before approval of shop drawings.

1.9 SUBSTITUTIONS

A. Whenever a material, article, piece of equipment or system is identified in the following specification or indicated on the drawings by reference to manufacturers' or vendors' names, trade names, catalog numbers or the like, it is so identified for the purpose of establishing the basis of the Bid.

B. Substitution approval must be obtained and included as an addendum item prior to the submission of the bid. An approved substitution shall not be considered as an approval for the contractor or an equipment vendor to deviate from the written portion of the specifications unless so stated in the addendum.

C. The drawings illustrate the space allocated for equipment and the Contractor shall install the equipment accordingly. If changes are required in the building or arrangement due to substitution of equipment, the Contractor making the substitution must pay for the necessary modifications.

D. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but shall not be limited to space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items furnished and installed by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, then they shall be responsible for any and all additional costs associated with the changes required by other trades.

1.10 LUBRICATION

A. Furnish, install and maintain all required lubrication of any equipment operated prior to acceptance by the Owner. Lubrication shall be as recommended by the equipment manufacturer.

B. Provide one year's supply of lubricants to Owner at date of acceptance.

C. Verify that required lubrication has taken place prior to any equipment start-up.

1.11 ADJUSTMENT & CLEANING

A. Adjust and clean equipment to be placed in proper operation condition.

1.12 EQUIPMENT START-UP

A. Verify proper installation by manufacturer or his representative.

B. Advise General Contractor 2 days prior to actual start-up.

C. Verify proper operation. Obtain signed statement by manufacturer or his representative that equipment is operating within warranty requirements. Submit statement to General Contractor.

1.13 OPERATION AND MAINTENANCE INSTRUCTIONS

A. Properly and fully instruct Owner's personnel in the operation and maintenance of all systems and equipment.

B. Insure that the Owner's personnel are familiar with all operations to carry on required activities.

C. Such instruction shall be for each item of equipment and each system as a whole.

D. Provide report that instruction has taken place. Include in the report the equipment and/or systems instructed, date, contractor, Owner's personnel, vendor, and that a complete operating and maintenance manual has been reviewed.

E. Manual shall include all instructions on operation, maintenance, repair parts list, lubrication requirements, brochures, catalogue cuts, wiring diagrams, piping diagrams, control sequences, service requirements, names and addresses of vendors, suppliers and emergency contacts. Three manuals shall be provided.

F. Submit manuals for review prior to operating instruction period. Manuals shall be 8-1/2 x 11" with hard cover, suitably bound.

G. Training

1. Electrical Contractor shall be responsible for coordination of Owner training. Factory employed technician(s) shall provide training, including demonstration and education on the system capabilities, operation and maintenance. Training sessions shall be minimum 4 hours (maximum 8 hours), and shall be provided for each shift of workers. Scheduled training shall be coordinated at least two 92) weeks in advance with the Owner and the Commissioning Agent.

2. Video Documentation: Furnish three (3) copies of a professionally taped video and three (3) copies of professionally prepared drawings demonstrating the following:

- Security System
- Fire Alarm System
- Integrated Access Control
- Clock and Speaker System
- VFD’s
- MDF/IDF
- Stage Sound System
- Stage Dimming Rack

1.14 TOOLS

A. All equipment furnished by the Contractor which requires special tools or devices other than those normally available to the maintenance or operating staff shall be furnished in duplicate to the Owner, sufficiently marked, packed or boxed for staff usage. The tools provided shall be listed by the Contractor identified as to their use or the equipment applicable in a written transmittal to the Owner.

1.15 CLEANING AND FINISHING

A. After equipment start-up and all operating tests have been made and the system pronounced satisfactory, each respective Contractor shall go over the entire project, clean all equipment, etc., installed by him and leave in a clean and working condition. Any surfaces found marred after this final cleaning shall be refinished or replaced by each Contractor at no cost to the Owner.

1.16 OPERATING AND MAINTENANCE MANUALS

A. Three complete sets of instructions containing the manufacturer's operating and maintenance instructions for each piece of equipment shall be furnished to the Architect. Each set shall be furnished before the contract is completed. The following identification shall be inscribed on the covers: the words "OPERATING AND MAINTENANCE INSTRUCTIONS", the name and location of the building, the name of the Contractor and the name of the Architect and Engineer. Flysheet shall be placed before instructions covering each subject. The instruction sheets shall be approximately 8-1/2 by 11 inches, with large sheets of drawings folded in. The instructions shall include, but shall not be limited to, the following:

Approved wiring and control diagrams, with data to explain the detailed operation and control of each component.

A control sequence describing start-up, operation and shutdown.

Operating and maintenance instructions for each piece of equipment, including lubrication instructions.

Manufacturer's bulletins, cuts and descriptive data.

Parts lists and recommended spare parts.

1.17 SERVICE INTERRUPTION

A. All service interruptions to the electric or related systems, whether during regular working hours or at any other time, must be coordinated with the Owner. All such interruptions shall be so scheduled and planned as to require a minimum of time and shall occur only during a mutually satisfactory period.

1.18 INTERPRETATION OF SYSTEMS

A. The interpretation of the Architect will be final in the event there is a lack of understanding of the full scope or requirements of the systems under this contract.

1.19 LAYOUTS

A. On small scale drawings, i.e., 1/8" - 1'-0", the approximate location of the electrical branch circuit items such as receptacle, telephone, grounding and equipment outlets are shown to indicate their existence. The exact location of these items and their related raceways are governed by structural conditions, coordination with the work of other trades and the Architect's final decision. By accepting a contract, the Contractor agrees to install the work in accordance with the above statement and within the contract price.

PART 2 – PRODUCTS

2.1 MATERIAL

A. All material shall be new and of good quality. Material shall conform to all accepted trade standards, codes, ordinances, regulations, or requirements governing same, and shall be approved before being installed.

B. The Architect reserves the right to require the Contractors to submit samples of any or all articles or materials to be used on the project.

C. Where any device or equipment is herein referred to in the singular number, such as "the panel", this reference shall be deemed to apply to as many such devices or equipment as are required to complete the installation as shown on the drawings or specified.

D. All materials and equipment used in the work shall comply with the standards of recognized authorities such as UL, NEMA, IEEE, ETL, IES and EIA in every instance where such standards have been established for the particular type of materials to be installed.

E. All similar pieces of equipment or materials of the same type or classification used for the same purpose shall be of the same manufacturer.

F. All manufactured equipment shall have factory applied finishes.

2.2 CONCRETE

A. Concrete shall be in accordance with Section 03300, or ACI-613. Designer choice if 03300 is not used.

B. The 28-day minimum compressive strength shall be 3000 psi.

2.3 WARRANTY

A. Wherever in the specification sections of this division, reference is made to a specific warranty period, this warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the contract documents.

PART 3 – EXECUTION

3.1 INSPECTION

A. Prior to performing the work, examine areas and conditions; check and verify all dimensions, under which the work is to be installed and notify the Architect in writing of conditions and dimensions detrimental to the proper and timely completion of the work. Do not proceed until authorization is given by the Architect.

3.2 LAYING OUT WORK

A. The Contractor is responsible for the accuracy of all lines, elevations, and measurements, grading and utilities and must exercise proper precaution to verify figures shown on drawings before laying out work and will be held responsible for any error resulting from his failure to exercise such precaution.

3.3 WORKMANSHIP

A. Install all work neat, trim, parallel and plumb with building lines in accordance with standard trade practice acceptable to the Architect.

3.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Protect all equipment and materials from damage during transportation, storage and installation.

3.5 PROTECTION

A. Protect all work, equipment and materials during construction up to the time of acceptance by the Owner.

Arrange and design the protection to prevent damage from infiltration or dust, debris, moisture, chemicals and water. Cap or plug electrical raceways.

B. Protect all surfaces against damage from welding, cutting, burning, or similar construction functions. This protection shall be accomplished by care in operations, covering and shielding. Special care is directed to exposed finished masonry, metal or wood surfaces and painted surfaces. Corrective measures required shall be accomplished by the trade which made the original installation when and as directed by the Architect at the expense of the Contractor.

C. Cover and protect all lighting fixtures as may be necessary until completion of the work. Replace damaged fixtures or damaged fixture parts as directed by the Architect at no cost to the Owner.

D. Do not install devices, polished metal fittings or parts until adjoining tile or masonry work is completed.

E. Maintain and replace protective covering when so directed by the Architect until the work is ready for acceptance.

3.6 CUTTING & PATCHING

A. Furnish information to the General Contractor as to sizes and locations of recesses required to install panel boxes and other equipment or devices. If the information is late or incorrect, this Contractor shall, at his own expense, have the trade which originally installed the work do the required cutting and patching.

B. Perform all cutting of concrete or other material for passage of raceways as required to install the work.

C. Close all such openings around raceways with material as specified under the heading "SEALING".

D. Install concealed work in place for the mason to wall-in as he carries up the walls; otherwise, this Contractor will be responsible as stated in the first paragraph.

3.7 SEALING

A. Where raceways pass through fire-rated walls and floors, seal opening with RTV foam.

B. Seal raceways entering the building to conform to the requirements of the NEC.

3.8 OFFSETS AND MODIFICATIONS

A. Furnish and install all offsets necessary to install the work and to provide clearance for the work of other trades.

B. Maintain adequate clearance as directed by the Architect/Engineer.

C. Incidental modifications necessary to the installation shall be made as necessary and at the direction and/or approval of the Architect.

3.9 SLEEVES

A. Furnish and install sleeves for all raceways passing through floors and walls. Sleeves shall be Schedule 40 galvanized steel pipe and shall extend 1" above finished floor surface. Where sleeves are set in interior walls, they shall finish flush with the wall.

B. Furnish and install watertight sleeves for all raceways extending through foundation walls into crawl spaces, mechanical rooms or basement areas from building exterior or from unexcavated areas to building interior. Sleeve shall consist of extra heavy pipe sleeve with anchor flange. Space between raceway and the sleeve shall be sealed with modular wall and casing seal similar to Thunderline Corporation "Link-Seal",, Metraseal or approved substitute. Install seal in strict accordance with the manufacturer's recommendations.

3.10 EXCAVATION

A. The excavation shall be of the open-trench method and to the depths and widths as may be necessary. The Contractor shall do all excavation required in connection with his work. Bottoms of trenches shall be excavated to a uniform grade. All materials excavated shall be deposited on the side of the trenches and beyond the reach of slides. Excavated material shall not be piled where it will interfere with traffic.

B. No conduits shall be bedded directly on rock. They shall be cushioned by a 6-inch layer of crushed stone or gravel of selected grade, of size to pass through a 3/4" mesh sieve. Not less than 30% shall be fine which will pass through a 3/8" mesh sieve.

C. Where excavation is required through tree root areas, roots shall be saw cut, treated with pruning paint and covered with burlap. Burlap shall be wet and shall be protected and maintained in a moist condition during entire period of exposure. Backfill shall be carefully placed and hand-tamped to a minimum of 6" above roots.

D. Bidder shall base his estimate upon the presumption that all excavation required in the performance of this Contract will be earth. If rock is encountered, Contractor will be reimbursed for the additional work required to remove same based upon the unit cost established in the proposal.

E. All detached boulders or loose stone not exceeding 1 cubic yard, all topsoil, sand, gravel, clay, rubbish, walls or other subgrade construction, and all other materials of every name and nature which can be removed without breaking up with pneumatic breakers shall be considered earth excavation.

F. All rocks, attached boulders, boulders exceeding 1 cubic yard, walls or other subgrade construction and materials which cannot be removed without breaking up with pneumatic equipment shall be considered rock excavation.

G. Before commencing any rock excavation for which extra compensation is to be paid, a rock contour drawing shall be prepared by the Contractor and checked by the Architect. The width shall be based on 2'-0". This rock contour drawing and width allowance will be used to compute the quantity of rock for which the Contractor will be reimbursed at the unit price established.

3.11 SHORING AND PUMPING

A. The Contractor shall provide all shoring, bracing or sheet piling necessary to maintain the banks of his excavation and shall take out same as the work progresses and filling in has been accomplished. Shoring shall be in accordance with OSHA Standards.

B. The arrangement of shoring must be such as to prevent any movement of the trench banks and consequent strains on the conduits. Shoring shall be provided to prevent damage to work installed by other trades.

C. The Contractor shall do all pumping required to keep his excavations free of water. The water shall be conveyed in piping or watertight troughs a sufficient distance that it will flow from the site and not affect other work being performed.

3.12 BACKFILLING

A. After work in trenches has been completed, they shall be filled with good, clean, fine earth in 8" layers and shall be pneumatically tamped before the next layer of material has been filled in. The backfill shall be free of excavated rock, cinders, stones, brickbats or other debris.

B. Wherever rock is removed, the Contractor shall secure and fill select clean earth to a minimum depth of 3'-0" above the top of the conduit. Unless otherwise indicated, no rock shall be deposited in the trench fill. This clean earth fill shall be procured other than from the site unless permission for earth borrow from the site is granted by the Architect. If site borrow is permitted, the topsoil removal, relocation and finished grading will be accomplished as directed by the Architect.

C. Under no circumstances shall excavated material be left where it will interfere with the Owner's or other Contractor's operations.

D. All earth and other materials taken from the trenches and not required for backfilling shall be deposited where directed, or removed from the premises as directed by the Architect.

E. Any rock removed from the excavation shall be removed from the project site by the Contractor.

F. Trenches which pass under wall footings or within 18" of column footings shall be backfilled with clean concrete. To secure adequate foundation support, the method and depositing of the concrete fill shall be as directed by the Architect. To prevent the concrete from adhering to the conduits, necessary conduit protection shall be applied.

3.13 FOUNDATIONS FOR EQUIPMENT/HOUSEKEEPING PADS

A. Provide all foundations for equipment installed under this specification Division and/or as indicated on plans.

B. Construct concrete foundations on structural floor slabs or on grade in the manner or as required by the approved shop drawing details of the manufacturer or the utility company.

C. Provide and install concrete.

D. Metal reinforcement shall be deformed steel bars or cold drawn steel wire, or fabricated forms of these materials as required.

E. Furnish anchors of size and number noted, with bottom plates and sleeves.

F. Forms shall conform to the shape, lines, grades, and dimensions of the concrete, required by the approved shop drawing details of the equipment manufacturers, or approved on the Contractor's Equipment room layouts. They shall be sufficiently tight to prevent leakage of mortar and shall be braced or tied together to maintain position and shape. Forms shall be moved in such manner as to insure the complete safety of the structure.

G. All exposed corners or edges shall be chamfered. All burrs, fins, irregularities of forming or spillage shall be removed and the surface float or trowel finished to a smooth, straight surface.

H. Housekeeping Pads: Provide 4” thick, and size as required by approved shop drawings, concrete pad for all equipment installed on floor. Pad shall be steel reinforced with all edges and surfaces finished as described above. When installing over existing concrete, surface of existing pad shall be prepped using a bushing tool to rough in entire surface. Whether pouring over new or existing concrete, provide U-shaped rebar anchors set in epoxy to secure pad to pad.

3.14 ITEMS RECESSED IN MASONRY CONSTRUCTION

A. Wherever boxes, electric panels, equipment, devices, access panels, and similar items of electrical construction are installed in exposed masonry construction, the Contractor shall utilize and submit for approval items of such size, height, and arrangement to conform to the corresponding masonry unit. The Contractor shall include as part of this contract, the necessary offsets, adjustments and relocations necessary to conform with the instructions of the Architect as to the final location of the equipment item in the exposed masonry.

B. As part of his contract and before the purchase of the items hereinbefore mentioned, the Contractor shall notify the Architect of such modifications in the building arrangement that will be necessary to accommodate the proposed equipment.

3.15 ROOF FLASHINGS

A. All conduit extending through roofs shall be provided with watertight flashing and counterflashing as hereinafter described.

B. Furnish and install standard counterflashing fittings on the conduit or properly designed clamped counterflashing with caulking as directed by the Architect/Engineer.

3.16 PAINTING

A. Refinish all factory applied finishes that have been damaged to match the original finish as directed by the Architect.

B. Prime coat all steel furnished under this Division with material and methods as described in another Section under the heading "PAINTING".

3.17 EQUIPMENT CONNECTIONS

A. Provide required wiring, raceways and final connections for all equipment provided by this Division and Divisions 1 thru 23.

.

B. Make final connections in accordance with wiring diagrams obtained from equipment manufacturer.

C. Rough-in in accordance with approved shop drawings from the manufacturer or supplier of the equipment. Rough-in prior to shop drawing approval will be subject to change without adjustment to contract cost.

3.18 BALANCING

A. The system of feeder and branch circuits for power and lighting shall be connected to panel busses in such a manner as to electrically balance the connected load as close as is practicable. Should the Owner disclose any unfavorable conditions reacting on the service, this Contractor shall make such changes as may be suggested to balance the load.

3.19 GUARANTEE

A. All work shall be guaranteed to be free from defects for a period of one year of operation from date of acceptance by the Owner unless otherwise specified in Division 1.

B. Guarantee shall be extended on an equal time basis for all non- operational periods due to failure within the guarantee period.

C. Contractor to include an 11 month "walk-thru" of the building system with representatives of the School District, Architect, Engineer and the Construction Manager. The purpose is to establish a list of corrective work that relates to operational issues, material/installation deficiencies.

END OF SECTION 26 00 00

SECTION 26 00 55
ELECTRICAL IDENTIFICATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. This section is a Division 26 Basic Materials and Methods Section, and is part of each Division 26 Section making reference to electrical identification specified herein.

1.2 DESCRIPTION OF WORK

A. Types of electrical identification specified in this section include the following:

Cable conductor identification.
Operational instructions and warnings.
Danger signs.
Equipment/system identification signs.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products of one of the following (for each type of marker):

W. H. Brady Co.
Ideal Industries, Inc.
Seton Name Plate Co.
3M Electrical Products

2.2 ELECTRICAL IDENTIFICATION MATERIALS

A. Provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is Installer's option, but provide single selection for each application.

2.3 COLOR-CODED PLASTIC TAPE

A. Provide manufacturer's standard vinyl tape not less than 7 mils thick by 3/4" wide.

B. Colors: Unless otherwise indicated or required by governing regulations, provide tape color as indicated in Paragraph 3.2.B.

C. Tape shall be of Type 3M Scotch 35 for color coding, Scotch Super 33+ for splices and Tem Flex 1700 for general use.

2.4 CABLE/CONDUCTOR IDENTIFICATION BANDS

A. Provide manufacturer's standard vinyl cloth, self-adhesive cable/conductor markers of wrap-around type; either pre-numbered, plastic-coated type, or write-on type with clear plastic, self-adhesive cover flap; numbered to show circuit identification.

2.5 BAKED ENAMEL DANGER SIGNS

A. Provide manufacturer's standard "DANGER" signs of baked enamel finish on 20-gage steel; of standard red,

black and white graphics; 14" x 10" size except where 10"x 7"is the largest size which can be applied where needed, and except where larger size is needed for adequate vision; with recognized standard explanation wording (as examples: HIGH VOLTAGE, KEEP AWAY, BURIED CABLE, DO NOT TOUCH SWITCH).

2.6 ENGRAVED PLASTIC-LAMINATE SIGNS

A. Provide engraved stock melamine plastic laminate, in sizes and thicknesses indicated, engraved with engraver's standard letter style of sizes and wording indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

B. Thickness: 1/16" for units up to 20 sq. in. or 8" length; 1/8" for larger units.

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

2.7 LETTERING AND GRAPHICS

A. Coordinate names, abbreviations and other designations used in electrical 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 electrical systems and equipment.

PART 3 – EXECUTION

3.1 APPLICATION AND INSTALLATION

A. Coordination: Where identification is to be applied to surfaces which require finish, install identification after completion of painting.

B. Regulations: Comply with governing regulations and requests of governing authorities for identification of electrical work.

3.2 CABLE/CONDUCTOR IDENTIFICATION

A. Apply cable/conductor identification on each cable and conductor in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present. Match identification with marking system used in panelboards, shop drawings, contract documents, and similar previously established identification for project electrical work.

B. Conductor Color Coding:

1. All conductors used in all systems shall have insulation that is inherently colored. All conductors of a system performing the same function shall be colored alike throughout the project.

2. Equipment Grounding Conductors:

a. Standard and/or general feeders or circuits shall be green.
b. Isolated feeders or circuits shall be green with yellow stripe.

3. On larger conductors, where colored insulation is not available, colored tape adhesive vinyl bands 3/4" width may be installed 6" maximum from the end of the conductors. Where passing through pull boxes without splice, each conductor shall be banded.

4. Power system conductor colors shall be as follows:

a. 120/208 Volt System

Phase A - Black
Phase B - Red
Phase C - Blue
Neutral - White or Gray

b. 277/480 Volt System

Phase A - Brown
Phase B - Orange
Phase C - Yellow
Neutral - White or Gray

3.3 DANGER SIGNS

A. In addition to installation of danger signs required by governing regulations and authorities, install appropriate danger signs at locations indicated and at locations subsequently identified by Installer of electrical work as constituting similar dangers for persons in or about project.

B. High Voltage: Install danger signs wherever it is possible, under any circumstances, for persons to come into contact with electrical power voltages higher than 110-120 volts.

3.4 EQUIPMENT/SYSTEM IDENTIFICATION

A. Install engraved, plastic laminate sign on each major unit of electrical equipment in building, including central or master unit of each electrical system including communication/signal systems, unless unit is specified with its own self-explanatory identification or signal system. Except as otherwise indicated, provide single line of text, 1/2" high lettering on 1-1/2" high sign (2" high where 2 lines are required), white lettering in black field. Provide text matching terminology and numbering of the contract documents and shop drawing. Provide signs for each unit of the following categories of electrical work:

1. Panelboards, electrical cabinets and enclosures.
2. Access panel/doors to electrical facilities.
3. Major electrical switchgear, main and feeder circuit breakers and/or disconnects.
4. Fire Alarm Master Station and Annunciator.
5. Paging and Intercommunication Systems
6. Security Control Panels and Annunciator.

B. Install signs at locations for best convenience of viewing without interference with operation and maintenance of equipment. Secure to substrate with fasteners, except use adhesive where fasteners should not or cannot penetrate the substrate.

3.5 JUNCTION AND PULL BOX IDENTIFICATION

A. Emergency Systems: Each junction and pull box cover shall be painted orange. Use black indelible liquid marker to label "EMERG." in 3/8" letters minimum.

B. Fire Alarm System: Each junction and pull box cover shall be painted red. Use black indelible liquid marker to label "F.A." in 3/8" letters minimum.

C. Feeders Shown on Single Line Diagram: Each junction and pull box shall be marked with black indelible liquid marker with the assigned feeder number "FDR #38" in 3/8" letters minimum.

END OF SECTION 26 00 55

SECTION 26 01 10
RACEWAYS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other conditions, if any) and Division 1 as appropriate, apply to the Work specified in this Section.

B. Refer to Section 260000 for General Provisions - Electrical.

1.2 DESCRIPTION OF WORK

A. Types of raceways in this section include the following:

Rigid metal conduit
Intermediate metal conduit
Electrical metallic tubing.
Polyvinyl chloride conduit (Exterior Underground Only)
Flexible metal conduit.
Liquid-tight flexible metal conduit.
Multi-Cell Raceway
Wireways.

1.3 REFERENCE STANDARDS

A. Refer to Section 260000 for a general description of requirements applying to this Section.

1.4 QUALITY ASSURANCE

A. Refer to Section 260000 for a general description of requirements applying to this Section.

1.5 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS.

1.6 COORDINATION

A. The drawings and details there upon are scheme and/or diagrammatic in nature, and indicate the need and intent of the design. These are to be used for general guidance only. It shall be the responsibility of the Electrical Contractor to coordinate, with other Division Subcontractors, the installation of all raceways, raceway supports, junction boxes and required fittings. This coordination will include conduit layout to allow access to equipment for maintenance.

B. This coordination shall be carried out prior to actual installation; this shall be done to eliminate the possibility of conflicts between trades on items such as access, clearances and maintenance issues that may arise after completion of construction.

C. Should the coordination not be carried out prior to installation, and a conflict exists, the installing contractor shall remove and reinstall the equipment as required to clear the conflict at no additional cost to the Owner and no delay in project completion.

PART 2 – PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Rigid Metal Conduit:

1. Raceway: Full weight, heavy wall rigid steel with zinc coating conforming to ANSI-C80.1.

2. Fittings: Cast malleable iron fittings with threaded hubs, insulated throat and zinc protective coating.

3. Subject to compliance with requirements, provide products of one of the following:

   Allied Tube and Conduit Corporation
   LTV Steel Tubular Products Co.
   Wheatland Tube

B. Intermediate Metal Conduit:

1. Raceway: Light weight, rigid steel, hot dipped galvanized manufactured in accordance with UL1242.

2. Fittings: Cast malleable iron fittings with threaded hubs, insulated throat and zinc protective coating.

3. Subject to compliance with requirements, provide products of one of the following:

   Allied Tube and Conduit Corporation
   LTV Steel Tubular Products Co.
   Wheatland Tube

C. Electrical Metallic Tubing:

1. Raceway: Light weight, thin wall, rigid steel, hot dipped galvanized manufactured in accordance with ANSI C80.3.

2. Fittings: Raintight, insulated throat, compression type with zinc protective coating.

3. Subject to compliance with requirements, provide products of one of the following:

   Allied Tube and Conduit Corp.
   LTV Steel Tubular Products Co.
   Wheatland Tube Co.

D. Polyvinyl Chloride Conduit:

1. Raceway: Heavy wall, rigid non-metallic, schedule 40 with bell type end, designed for above ground exposed applications, direct earth burial, and concrete encasement.

2. Fittings: Polyvinyl chloride, heavy duty, glue type, designed for Schedule 40 application.

3. Subject to compliance with requirements, provide products of one of the following:

   Allied Tube & Conduit
   Carlon
   Queen City Plastics, Inc.
   Scepter Electric Systems

E. Flexible Metal Conduit:

1. Raceway: Construct of single strip, flexible, continuous, interlocked, and double-wrapped steel, galvanized inside and outside.

2. Fittings: Steel, insulated throat, with zinc protective coating.

3. Subject to compliance with requirements, provide products of one of the following:

   AFC
   Alflex Corp.
   Electri-Flex Company

F. Liquid-Tight Flexible Metal Conduit:

1. Raceway: Construct of single strip, flexible, continuous, interlocked, and double-wrapped, galvanized inside and outside, coat with liquid-tight jacket of flexible polyvinyl chloride.

2. Fittings: Steel, water and oiltight, insulated throat, with zinc protective coating.

3. Subject to compliance with requirements, provide products of one of the following:

   AFC
   Alflex Corp.
   Electri-Flex Company

G. Multi-Cell Raceway

1. Raceways: Shall be a multi-cell raceway system for concrete encasement applications, 20 ft. lay length sections of 4" PVC outer shell type C with four (4) 1-1/4" nominal pre-lubed PVC innerducts pre-installed. The innerducts shall be color coded (white/grey/orange/green). Raceway shall be similar to Carlon Telecom System Part No. MXSS4S-020.

2. Fittings: Raceway shall be provided with a complete line of, but shall not necessarily be limited to, couplings, offsets, 90 deg., 36" radius bends, adapters, hold-down clips, end-caps and other accessories as needed for a complete system.

3. Interior Use Only:

   a. Raceways: Shall be multi-cell raceway system for use inside building applications. 10 ft. length sections of 4" electrical metallic tubing with four (4) 1-1/4" nominal pre-lubed PVC innerducts pre-installed. The innerducts shall be color-coded (white/grey/orange/green). Raceway shall be similar to Carlon Telecom System Part No. MESS4S-010.

   b. Fittings: Raceway shall be provided with a complete line of, but shall not necessarily be limited to, couplings, offsets, 90 deg., 36" radius bends, adapters, hold-down clips, end-caps and other accessories as needed for a complete system.

4. Subject to compliance with requirements, provide products of the following:

   Carlon Electrical Products.

H. Wireways:

1. Furnish electrical wireways of the type, size, and style for each service indicated. Wireway shall be a complete assembly including but not necessarily limited to, couplings, offsets, elbows, adapters, hold-down clips, end-caps and other components and accessories as needed for a complete system.

2. System shall fulfill wiring requirements as indicated in contract documents, and shall comply with applicable portions of Article 362 of the National Electrical Code.

3. Subject to compliance with requirements, provide products of one of the following:
   Circle AW Products Co.
   The EMF Company, Inc.
   Hoffman Engineering Company
   Square "D" Company

I. The above items shall include the statement "Approved Equal" and/or "Approved Substitute". This statement requires that the product or item be in compliance with the written intent of this specification and the submission meets the requirements of Section 260000.

PART 3 – EXECUTION

3.1 INSTALLATION OF ELECTRICAL RACEWAYS

A. Install electrical raceways in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA "Standard of Installation", and complying with recognized industry practices.

B. Coordinate with other work as necessary to interface installation of electrical raceways, wireways and required components.

C. Raceways used for distribution, feeders, or branch circuits shall be a minimum size of 3/4" or equal equivalent cross-sectional area. Raceways used for control and signal shall be a minimum size of 1/2" or equal equivalent cross-sectional area.

D. All raceways shall be concealed within the building construction, where indicated on the floor plans surface raceway shall be installed. Should it be impossible or impracticable to install a raceway concealed and surface raceway is not indicated, the Contractor shall consult with the Architect or Engineer for approval prior to installation.

E. All raceways installed in ceiling cavities and exposed within mechanical spaces shall be run parallel with building lines and installed level and square at the proper elevation/height.

F. Complete the installation of electrical raceways before starting the installation of cables/wires within the raceway.

G. Furnish and install one (1) nylon or fiberglass pull cord in each empty raceway. Each empty raceway shall be cleaned, capped, and tagged as to its termination location.

H. Install liquid-tight flexible metal conduit for connections to motors and for other electrical equipment when subject to movement and vibration, and also where subjected to one or more of the following conditions:

1. Exterior locations.
2. Moist or humid atmosphere when condensation can be expected to accumulate.
3. Corrosive atmosphere.
4. Subjected to water spray.

5. Subjected to dripping oil, grease or water.

I. Install Electrical Metallic Tubing for building interior electrical work except:

1. Underground
2. In gravel, cinder, concrete or other sub-base floor construction.
3. Horizontal runs in concrete floor slabs.
4. Where exposed to the elements.
5. In masonry construction below finished grade.
6. Vertically in poured concrete walls.

J. Refer to Section 260000 for excavation, shoring and pumping, concrete and backfilling requirements.

K. Where and whenever possible, install horizontal electrical raceways as tight to building construction as possible and above water, drain and steam piping. A separation of at least six (6) inches shall be maintained between electrical conduits and hot water and steam piping.

L. In accordance with NEC requirements, install Rigid or Intermediate Metal Conduit where Electrical Metallic Tubing is not permitted.

M. In all instances where recessed type panelboards are installed, furnish and install one (1) one inch raceway for each two (2) future circuits for which "space" or "spare" provisions have been made in the panelboard. These raceways shall extend between the panelboard cabinet and a convenient location above an access panel or a removable tile ceiling construction and capped.

3.2 CLEANING

A. Upon completion of installation of raceways, inspect interiors of raceways; remove burrs, dirt and construction debris.

END OF SECTION 26 01 10

SECTION 26 01 20
WIRES AND CABLES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. This section is a Division 26 Basic Materials and Methods section and is part of each Division 26 Section making reference to wires and cables specified herein.

1.2 DESCRIPTION OF WORK

A. Electrical wire and electrical cable work is indicated by drawings and specifications.

B. Types of wire, cable and connectors in this section include, but not limited to the following:

Copper conductors.
Tap type connectors.
Split-bolt connectors.

C. Refer to other sections of Division 26 for, but not limited to, raceways, connections used in conjunction with wire and cable work.

D. Applications for wire, cable and connectors required for project are as follows unless otherwise indicated:

1. Primary Service Circuitry.
2. Power Distribution Circuitry.
3. Appliance and Equipment Circuitry.
4. Motor Branch Circuitry.
5. Control Circuitry.
6. Signal/Communication Circuitry.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. <u>Wire and Cable</u>

Anaconda Wire and Cable Co.
Advance Wire and Cable, Inc.
American
Cerro Wire and Cable Co.
Electrical Conductors, Inc.
General Cable Corp.
Hitemp Wires, Inc.
Rome Cable Corp.
Southwire Company
Triangle PWC,, Inc.
The Okonite Co.
General Electric Co.
Rockbestos Surprenant Cable Corp.

<u>Connectors</u>
Burndy Corp.
Eagle Electric Mfg. Co., Inc.

Gould, Inc.
Ideal Industries, Inc
Joslyn Mfg. and Supply Co.
O-Z/Gedney Co.
Pyle National Co.
Thomas and Betts Co.

2.2 WIRE, CABLE AND CONNECTIONS

A. Except as otherwise indicated, provide wire, cable and connectors of manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer, and as required for the installation. Minimum wire and cable size is #12 AWG for power and branch circuits and #14 AWG for control and signal/communication circuits unless otherwise indicated.

B. Wire: Provide factory fabricated wire of sizes, ratings, materials and types indicated for each service. Where not indicated, provide proper selection as determined by Installer to comply with project's installation requirements and NEC standards. Select from the following types, materials, conductor configurations, insulation and coverings:

UL Type: THHN
UL Type: TW
UL Type: THW
UL Type: THWN
UL Type: TF
UL Type: XHHW
UL Type: AC (Armor Clad)
UL Type: MC (Metal Clad)

Material: Copper

Conductors: Solid (AWG 14 to AWG 10 only).
Conductors: Concentric-lay-stranded (standard flexibility)

Outer Covering: Nylon
Outer Covering: Thermoplastic

C. Connectors: Provide factory fabricated metal connectors of sizes, ratings, materials, types and classes as required for each service. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements and NEC standards. Select from the following types, classes, kinds and styles.

Type: Pressure
Type: Crimp
Type: Threaded

Class: Insulated
Class: Non-insulated

Kind: Copper (for CU to Cu connection).

Style: Butt connection
Style: Elbow connection
Style: Combined "T" and straight connection
Style: "T" connection.
Style: Split-bolt parallel connection

Style: Tap connection
Style: Pigtail connection

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install electrical cables, wires and connectors, in compliance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in accordance with recognized industry practices.

B. Coordinate cable and wire installation work with electrical raceway and equipment installation work, as necessary for proper interface. Pull conductors together where more than one is being installed in a raceway. Use pulling compound or lubricate, where necessary; compound must not deteriorate conductor or insulation. Use pulling means including fish tape, cable or rope which cannot damage raceway. Rope must be used as pulling means when pulling wires or cables into plastic conduit and duct. Keep conductor splices to a minimum and install in junction boxes only. No splices shall be permitted within conduit. Install splices and tapes which have mechanical strength and insulation rating equivalent or better than conductor. Use splice and tape connectors which are compatible with conductor material.

3.2 FIELD QUALITY CONTROL

A. Prior to energization, test cable and wire for continuity of circuitry and also for short circuits. Correct malfunctions when detected.

B. Subsequent to wire and cable hook-ups, energize circuitry and demonstrate functioning in accordance with requirements.

END OF SECTION 26 01 20

SECTION 26 01 30
MANHOLES

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of manholes and manhole installation work is indicated by drawings and specifications.

B. Types of manholes in this section shall include the following:

1. Precast concrete
2. Poured in place

1.2 SUBMITTALS

A. Submit manufacturer's data on manholes including, but not limited to, roughing-in drawings, construction details and structural support data.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, provide manholes with frame and cover, and cable accessories of one of the following:

1. Manholes - A.C. Miller Concrete Products, Inc.
   - Gillespie Precast, LLC

2. Frame and Cover - Neenah Foundry Co.

2.2 STANDARD MANHOLES

A. Manholes shall be a precast concrete box with interior dimensions of 48" wide x 48" long x 48" deep with 6" walls, floor and top.

B. Floor shall be provided with a ground rod hole, pulling irons and a 12" diameter x 12" deep sump.

C. Top shall be a precast 6" slab with a circular opening suitable for a manhole frame opening of 32-1/2.

D. The precast 6" top slab shall be sealed where it joins the manhole. The entire exterior surface of the manhole shall be coated with a bitumastic type waterproof coating prior to installation.

2.3 MANHOLE FRAME AND COVER

A. Frame and cover shall be a round, heavy duty, cast iron frame and solid cover with machined horizontal bearing surfaces. Total weight to be approximately 365 pounds.

B. Frame and cover dimensions shall be as follows:

1. Overall frame size = 38-1/2"
2. Clear opening size = 32-1/2"
3. Overall frame height = 4"

C. Cover shall have the word, "Electric", cast into it.

D. Frame and cover shall be similar in manufacture to Neenah Foundry Company Model No. R-1792-HL.

2.4 GROUND ROD AND CLAMP

A. Ground rod shall be a rigid steel rod with a heavy duty, uniform, non-porous copper coating. Rod to be 3/4" dia. x 10'-0" long. Clamp to be cast of high copper content bronze alloy.

B. Ground rod assembly to consist of the following:

1. Ground rod - Blackburn Cat. No. W5810
2. Ground Clamp - Blackburn Cat. No. J-JR.

PART 3 – EXECUTION

3.1 INSTALLATION OF MANHOLES

A. Install manholes in accordance with manufacturer's written instructions and complying with applicable portions of NEC and NECA's "Standard of Installation."

B. Manholes shall be oriented in accordance with duct bank requirements as indicated on the electrical site plan. The depth of the manhole shall be as required to allow the frame and cover to set level with finished grade.

C. Manholes shall not be set in an area or at an elevation which will allow surface water or runoff to enter manhole through the cover. Should this occur, this Contractor will be required to raise the frame and cover and regrade the area.

3.2 FIELD QUALITY CONTROL

A. Contractor shall inspect the conduit entrances into the manhole looking for broken ducts and/or rough edges and repairing the findings. Contractor shall also check that conduit entrances are sealed to keep out ground water.

B. All manholes shall be cleaned of dirt and construction debris. All spare conduits shall have a nylon pull cord installed for future use.

END OF SECTION 26 01 30

SECTION 26 01 35
ELECTRICAL BOXES & FITTINGS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. This section is a Division 26 Basic Materials and Methods section, and is a part of each Division 26 section making reference to electrical wiring boxes and fittings specified herein.

1.2 DESCRIPTION OF WORK

A. Types of electrical boxes and fittings in this section include the following:

Outlet boxes.
Junction boxes.
Pull boxes.
Conduit bodies.
Bushings.
Locknuts.
Knockout closures.

PART 2 – PRODUCTS

2.1 INTERIOR METALLIC OUTLET BOXES

A. Provide galvanized flat rolled sheet steel interior outlet non-gangable wiring boxes, of types, shapes and sizes, including box depths, to suit each respective location and installation; construct with stamped knockouts in back and sides and with threaded screw holes with corrosion-resistant screws for securing box covers and wiring devices.

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, which are compatible with outlet boxes being used and fulfilling requirements of individual wiring situations. Choice of accessories is Installer's option.

C. Manufacturer: Subject to compliance with requirements, provide interior outlet boxes of one of the following:

Appleton Electric Co.
Bell Electric/Square D Co.
Pass and Seymour, Inc.
RACO, Inc.
Steel City/Midland-Ross Corp.

2.2 WEATHERPROOF OUTLET BOXES

A. Provide corrosion resistant cast-metal weatherproof outlet wiring boxes, of types, shapes and sizes, including depth of boxes, with threaded conduit ends, cast-metal face plates with spring-hinged waterproof caps suitably configured for each application, including face plate gaskets and corrosion-resistant fasteners.

B. Manufacturer: Subject to compliance with requirements, provide weatherproof outlet boxes of one of the following:

Arrow-Hart Div., Crouse-Hinds Co.
Bell Electric/Square D Co.

Harvey Hubbell, Inc.
O-Z/Gedney Co.
Slater Electric Co.

C. Refer to Section 260140 – WIRING DEVICES for exterior receptacle outlet boxes.

2.3 JUNCTION PULL BOXES

A. Provide galvanized code-gauge sheet steel junction and pull boxes, with screw-on covers; of types, shapes and sizes, to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers.

B. Manufacturers: Subject to compliance with requirements, provide junction and pull boxes of one of the following:

Adalet-PLM Div., Scott and Fetzer Co.
Appleton Electric Co.
Arrow-Hart Div., Crouse-Hinds Co.
Bell Electric/Square D Co.
GTE Corporation
Keystone Columbia, Inc.
O-Z/Gedney Co.
Slater Electric Co.
Spring City Elect. Mfg. Co.

2.4 CONDUIT BODIES

A. Provide galvanized cast-metal conduit bodies, of types, shapes, and sizes, to suit respective locations and installation, construct with threaded-conduit-entrance ends, removable covers, and corrosion- resistant screws.

B. Manufacturers: Subject to compliance with requirements, provide conduit bodies of one of the following:

Appleton Electric Co.
Crouse-Hinds Co.
Gould, Inc.
Killark Electric Mfg. Co.
O-Z/Gedney Co.
Spring City Electrical Mfg. Co.

2.5 BUSHINGS, KNOCKOUT CLOSURES AND LOCKNUTS

A. Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts and insulated malleable iron conduit bushings, offset connectors, of types and sizes to suit respective uses and installation.

B. Manufacturers: Subject to compliance with requirements, provide bushings, knockout closures, locknuts and connectors of one of the following:

Appleton Electric Co.
Burndy Corp.
Crouse-Hinds Co.
Gould, Inc.
O-Z/Gedney Co.
RACO, Inc.
Steel City/Midland-Ross Corp.

Thomas and Betts Co., Inc.

PART 3 – EXECUTION

3.1 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS

A. Install electrical boxes and fittings, complying with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

B. Coordinate installation of electrical boxes and fittings with wire/cable and raceway installation work.

C. Provide weatherproof outlets for interior and exterior locations exposed to weather or moisture.

D. Provide knockout closures to cap unused knockout holes where blanks have been removed.

E. Install boxes and conduit bodies in those locations to ensure ready accessibility of electrical wiring.

F. Avoid using round boxes where conduit must enter box through side of box, which would result in difficult and insecure connections when fastened with locknut or bushing on rounded surface.

G. Fasten boxes rigidly to substrates or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry.

H. Provide electrical connections for installed boxes.

I. Pull boxes and junction boxes shall be furnished and installed in all conduit runs at intervals not exceeding 100 feet maximum.

J. Identify each circuit in all pull boxes and junction boxes whether the box contains one or more circuits.

END OF SECTION 26 01 35

SECTION 26 01 40
WIRING DEVICES

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. The extent of wiring device work is indicated by drawings, schedules and specifications. Wiring devices are defined as single discrete units of the electrical distribution system which are intended to carry but not utilize electric energy.

B. Types of electrical wiring devices in this section include the following:

Receptacles.
Switches.
Device plates.
Contactors
Energy Control Devices

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data on electrical wiring devices.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following (for each type of wiring device):

Legrand Co.
Hubbell, Inc.
Leviton Mfg. Co.
Lutron Electronics Co., Inc.
Square D Co.
Eaton Corp.
Siemens
Wattstopper
Sensor Switch

2.2 FABRICATED WIRING DEVICES

A. Provide factory fabricated wiring devices, in types, styles, colors, and electrical ratings for applications indicated and complying with NEMA Standards Pub. No. WD 1. Where types and grades are not indicated, provide proper selection as determined by Installer to fulfill wiring requirements, and complying with NEC and NEMA Standards for wiring devices. Color selection to be verified by Contractor with Architect/Engineer.

2.3 RECEPTACLES

A. All simplex receptacles shall be extra heavy duty, 20 amperes, 125 volts, 2 pole, 3 wire grounding, with green hexagonal equipment ground screw, with metal plaster ears, side wiring, NEMA configuration 5-20R unless otherwise indicated. Hubbell Cat. #HBL5361, or approved substitute.

B. All duplex receptacles shall be extra heavy duty, 20 amperes, 125 volts, 2 pole, 3 wire grounding type with green hexagonal equipment ground screw, with metal plaster ears, side wiring, NEMA configuration 5-20R unless otherwise indicated. Hubbell Cat. #HBL5362, or approved substitute.

C. Controlled receptacles shall be similar to above, except face of device, indicated with permanent controlled receptacle markings.

D. Special Purpose Receptacles: Provide polarized grounding type special purpose receptacles of the required amperage and voltage ratings, extra heavy duty. Device shall include a green hexagonal equipment ground screw.

E. All ground fault receptacles shall be extra heavy duty duplex, tamper resistant, 20 amperes, 125 volts, 2 pole, 3 wire grounding type with green hexagonal equipment ground screw, integral ground fault circuit interrupter, UL rated Class A, Group 1, with metal plaster ears, side wiring, NEMA Configuration 5-20R, self-testing with red and green LED indicator lights. Device shall include solid state ground-fault sensing and signaling, with a 5 milliampere ground fault trip level, plus or minus 1 milliampere. Hubbell Cat. #GFR5362SG, or approved substitute.

1. Whether indicated or not on the floor plans, the Electrical Contractor shall furnish and install GFI protected devices in kitchen areas on countertops near sinks, water coolers, refrigerators, on rooftop equipment, on exterior walls; and as indicated by the N.E.C., it shall be the discretion of the Electrical Contractor to provide GFI receptacles or GFI circuit breaker. Receptacles protected by GFI circuit breakers shall be permanently labeled on the faceplate as GFCI.

2.4 SWITCHES

A. Toggle Switch: Provide extra heavy duty, industrial series flush toggle, 1 pole, 2 pole, 3-way, 4-way AC quiet switch rated 20 amperes @ 120/277 volts with green hexagonal equipment ground screw, metal plaster earls, and side wired screw terminals. Similar to Hubbell Series HBL Series or approved substitute.

B. Toggle Switch with Pilot Light: Provide extra heavy duty industrial series, flush toggle, single pole, AC quiet switch rated 20 amperes @ 120 volts with green hexagonal equipment ground screw, metal plaster ears, side-wired screw terminals and 1/25 watts, 125-volt neon pilot light, designed to mount within a single gang outlet box. Similar to Hubbell HBL or approved substitute.

C. Three Position Switch: Provide extra heavy-duty industrial series, flush toggle, single pole, three position, momentary contact, center position OFF, AC quiet switch rated 20 amperes @ 120/277 volts, with green hexagonal equipment ground screw, metal plaster ears, and side-wired screw terminals. Similar to Hubbell Series HBL or approved substitute.

D. Key Switch: Provide extra heavy duty, industrial, 1 pole, 2 pole, 3-way, 4-way barrel key locking switch rated at 20 AMPs @ 120/277 volts with green grounding screw, metal plaster ears and side wired screw terminals. The tumbler shall be a six-point cylinder type. All project keyed switches to be keyed alike. Similar to Hubbell 122*RKL series.

2.5 DEVICE PLATES

A. Provide switch and receptacle outlet wall plates for wiring devices, of types, sizes, and with ganging and cut outs required by the devices being installed. Construct with metal screws for securing plates to devices; screw heads colored to match finish of plates; plates colored to match wiring devices to which attached. Provide device plates possessing the following additional construction features: **Receptacle outlet plates to be permanently marked with panel designation and circuit number on back side of plate.**

1. Metal Plates to be stainless steel of non-corrosive and non-magnetic 302 alloy, .032" nominal thickness. Plates shall have brushed satin finish.

B. Weatherproof device plates shall have spring-hinged waterproof cap suitably configured for each application, including face plate gaskets and corrosion-resistant fasteners. Boxes and devices shall be recessed, weatherproof with smoke gray opaque in-use covers. Intermatic Cat. #WP1000(H)GRC.

C. Mechanical spaces where concealed work is impractical, such as masonry poured block walls, Provide 4” square boxes, surface mounted, with ½” deep surface mounted device plates consisting of same material for devices indicated on plans, whether single or double gang. Use of plaster flange and standard cover plate will not be acceptable.

2.6 CONTACTORS

A. Electrically Held Power Lighting Contactor: Shall be rated 30 to 200 AMPs for 2 thru 5-pole versions and 300 to 800 AMPs for 2 and 3 pole versions, as indicated on the Floor Plan. Contactor shall have factory wired control and clearly marked termination points, designed for mixed load ratings with a UL listed short-circuit rating up to 100,000 amperes. Contactor shall be housed in a NEMA Type I, general purpose enclosure and be similar to Square D Company, Type "S", Class 8903 or approved substitute.

B. Mechanically Held Power Lighting Contactor: Shall be rated 30 to 200 AMPs for 2 thru 5 pole versions and 300 to 800 AMPs for 2 and 3 pole versions, as indicated on the Floor Plan. Contactor shall have factory wired control with coil clearing contacts and clearly marked termination points, designed for mixed load ratings with a UL listed short-circuit rating up to 100,000 amperes. Contactor shall be housed in a NEMA Type I, general purpose enclosure and be similar to Square D Company, Type "S", Class 8903 or approved substitute.

C. Multiple Lighting Contactor: Shall be an electrically or Mechanically held device with 2 thru 12 poles rated 30 AMPs ballast and 20 AMPs tungsten, as indicated. Mechanically held contactor shall have factory wired control with coil clearing contacts and clearly marked termination points. Contactor shall be housed in a NEMA Type I, general purpose enclosure and be similar to Square D Company Types "L" and "LX", Class 8903 or approved substitute.

D. General: All contactor control setups shall include all required interface relays needed to function with maintained or momentary contact switches, time clocks and photocell controls. Control circuits and coil voltages shall be 120 volts A.C. single phase. Where system voltage is 277/480 volts, a control power transformer shall be furnished and installed within the contactor enclosure. Transformer shall be sized to handle the contactor's coil load as well as all associated control devices.

2.7 ENERGY CONTROL DEVICES (Occupancy Sensors)

A. Low Voltage:

1. Ceiling mounted sensor shall be Dual Technology Passive Infrared and Ultrasonic with 360° coverage up to 2o feet. Device accepts 12 to 24-volt AC or DC. Device shall be similar to Sensor Switch Cat. No. CM-PDT or approved substitute.

2. High bay areas with ceilings above 12’: Surface mounted sensor shall be (PIR) passive infrared with 360˚ coverage, up to 40 feet. Device requires 24VDC. Device shall be of type Wattstopper, HB300B-L3 or L7 lens, or approved substitute.

3. Sensor power pack shall be a low voltage power supply with an input of either 120 volts or 277 volts AC and an output of 24 volts DC @ 150 mA. Device shall contain a 20 AMP isolated load control relay. When relay is used, power supply output shall be reduced to 24 volts DC @ 114 mA. Device shall be similar to Sensor Switch PP-20 or approved substitute.

PART 3 – EXECUTION

3.1 INSTALLATION OF WIRING AND CONTROL DEVICES

A. Install wiring devices as indicated, in compliance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate with other work, including painting, electrical box and wiring work, as necessary to interface installation of wiring devices with other work.

C. Install wiring devices only in electrical boxes which are clean, free from building materials, dirt and debris.

D. Provide electrical connections for wiring and control devices.

E. Delay installation of all wiring and control devices until wiring work is completed.

F. Isolated Ground Receptacle Devices shall be connected to the system ground by way of an insulated ground conductor color coded green with a yellow stripe.

3.2 PROTECTION OF WALL PLATES AND RECEPTACLES

A. At time of Substantial Completion, replace those items which have been damaged, including those burned and scorched by faulty plugs.

3.3 GROUNDING

A. Provide electrically continuous, tight grounding connections for wiring and control devices.

3.4 TESTING AND COMMISSIONING

A. Prior to energizing circuitry, test wiring devices for electrical continuity and proper polarity connections. After energizing circuitry, test wiring devices to demonstrate compliance with requirements.

B. After energizing circuitry, the Electrical Contractor shall test and adjust all control devices to provide optimum operation and performance.

C. All areas where energy control devices are specified shall be verified for full coverage and accurate operation. If any area is determined by the Owner, Architect, or Engineer to have inadequate coverage or operation, Contractor shall provide additional energy control devices to remedy the coverage or operation issue. For bidding purposed, own 5 extra devices fully installed. After successful commissioning, uninstalled devices shall be handed over to the Owner for spare devices. Device types shall be as required for commissioning, or as selected by Owner for space devices as applicable.

END OF SECTION 26 01 40

SECTION 26 01 55
MOTOR STARTERS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of motor starter work is indicated by drawings, schedules and specifications.

B. Refer to sections of other divisions of these specifications for driven equipment specified without motor starters. Motor starters for such equipment are the work of this section.

C. Types of motor starters in this section include the following:

Manual.
Magnetic Full Voltage, Non-Reversing.
Combination Disconnect Switch and Magnetic Starter.
Adjustable Frequency Drive (AFD)

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data on motor starters and accessories.

1.3 COORDINATION

A. The drawings and details there upon are scheme and/or diagrammatic in nature, and indicate the need and intent of the design. These are to be used for general guidance only. It shall be the responsibility of the Electrical Contractor to coordinate with other Division subcontractors, the installation of all motor starters, the need for control devices including the wiring and conduit, to and from the device.

B. This coordination shall be carried out prior to actual installation. This shall be done to eliminate the possibility of conflicts between trades on items such as access, clearances and maintenance issues that may arise after completion of coordination.

C. During the coordination phase of the project, the Electrical Contractor shall consult with Division 1 thru 23 subcontractors with regard to base design equipment characteristics. Any differences from the electrical plans and specifications shall be considered a change. The trade's contractor making the change at no additional cost to the Owner or delay in project completion shall handle these additional costs.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following (for each type and rating of motor starter):

Allen-Bradley Co.
Cutler Hammer Products
Furnas Electric Co.
Square D Co.
Siemens

2.2 MOTOR STARTERS

A. Provide motor starters and ancillary components; of types, sizes, ratings and electrical characteristics indicated

which comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete installations.

B. Fractional HP Manual Motor Starters: Provide manual, single phase, fractional HP motor starters for each motor rated less than 1/2 HP, of types, ratings and electrical characteristics indicated. Equip unit with thermal overload relay for protection of 120 volt AC motors. Provide starters with quick-make, quick-break, trip free toggle mechanisms, selector switches for hand-off-automatic control; mount starter in NEMA Type 1 or Type 4 enclosure as indicated or required by the NEC.

C. Magnetic Motor Starter: Provide magnetic full voltage, non-reversing starters for each motor rated 1/2 HP and more of types, ratings and electrical characteristics indicated; equip with solid state overload relays, control transformers with 120V secondary, with one secondary fuse and one grounded secondary lead, two normally open and two normally closed auxiliary contacts, hand-off- automatic selector switch, red and green pilot lights wired and mounted through front of the enclosure. Mount starter in NEMA Type 1 or Type 4 enclosure as required by the NEC.

D. Combination Disconnect Switch Magnetic Starter: Provide full-voltage, non-reversing, combination non-fused disconnect switch and magnetic starter for each motor rated 1/2 horsepower and more, of types, ratings and electrical characteristics indicated; equip with solid state overload relays, control transformer with 120 volt secondary, one secondary fuse and one grounded secondary lead, two normally open and two normally closed auxiliary contacts, hand-off- automatic switch, red and green pilot lights wired and mounted through the front of the enclosure. Mount starter in NEMA Type 1 or Type 4 enclosure as required by the National Electrical Code (NEC).

E. Three (3) phase, full voltage, non-reversing magnetic motor starters, horsepower rating with minimum NEMA size #0 shall be as follows:

NEMA Size	Continuous Rating	Maximum Horsepower	
		208 Volt	480 Volt
0	18 AMPs	3HP	5HP
1	27 AMPs	7-1/2HP	10HP
2	45 AMPs	10HP	25HP
3	90 AMPs	25HP	50HP
4	135 AMPs	40HP	100HP
5	270 AMPs	75HP	200HP

Motor full-load current shall not exceed continuous ampere rating of starter.

F. Adjustable Frequency Drive (AFD): The AFD shall convert the input AC main power to an adjustable frequency and voltage. The output frequency and voltage of the AFD shall be adjustable to maintain a constant voltage/hertz ratio throughout the operating range. The AFD shall be designed to operate from a 480 volt, three phase, 60 hertz main supply that is within +10% or -10% of nominal line voltage. The AFD control technique shall employ the pulse width modulated (PWM) technology.

1. Ratings:

a. The AFD shall be capable of supplying 120% of rated full load current for one minute at maximum ambient temperature.

b. Unit shall be rated for installation in a power system capable of delivering up to 65,000 RMS symmetrical amperes.

c. Minimum power factor shall be .95 throughout the entire speed range.

d. The AFD efficiency shall be 98% at full speed.

2. Adjustments:

a. The acceleration and deceleration ramp rates shall be adjustable from 1 to 60 seconds.

b. The overload trip shall be adjustable from 0 to 100% of rated output current.

c. The current limit shall be adjustable from 60 to 120% of rated output current to maximize starting torque.

d. Voltage boost shall be adjustable from 100 to 400% of nominal voltage/hertz ratio at 1 hertz tapering to 100% at 20 Hertz.

e. The drive shall provide a control for adjusting the minimum frequency setting up to 45 Hertz and a maximum operating frequency adjustable over a range of 40 to 60 Hertz.

3. Protection:

a. A non-adjustable instantaneous overcurrent trip shall be set to 250% of rated output current.

b. AFD protection shall be accomplished with fuseless electronic protective circuits, to protect from the following conditions:

- Short circuit at AFD output.
- Ground fault at AFD output.
- Open circuit at AFD output.
- Input undervoltage.
- DC bus overvoltage.
- Loss of input phase.
- AC line switching transients.
- Instantaneous overload.
- Sustained overload exceeding 100% of rated current.
- Overtemperature.

4. Control:

a. All the following operator controls shall be mounted to the front panel which is integral to the AFD:

- Manual speed potentiometer.
- Hand-Off-Auto (HOA) switch. The AFD shall accept an input signal of 4 to 20 Ma. DC. as an automatic speed reference signal when the AFD is in the automatic mode of operation. The manual speed potentiometer shall control the AFD when the switch is in the manual mode.
- The AFD shall be furnished with an isolated follower with a setpoint control of 4 to 20 Ma. DC with PI control from an isolated ground signal.

5. Operator Interface:

   a. The AFD shall be furnished with an alphanumeric display and keypad to allow the operator access to drive modes, parameters and status conditions.

   b. Operator control and setup functions shall include the following:

      (1) Frequency setpoint
      (2) Acceleration/Deceleration time
      (3) Minimum/Maximum Output Frequencies
      (4) Proportional Gain
      (5) Integral Gain
      (6) Setpoint
      (7) Drive Reset
      (8) Elapsed Time
      (9) Enable PI (Setpoint) Control
      (10) Auto Reference Source Select

   Operating status information will consist of the following:

      (1) Frequency Output
      (2) Output Current
      (3) Output Voltage
      (4) Accel/Decel Ramp Time
      (5) Forward/Reverse Direction
      (6) Hand/Auto Local Indicator
      (7) Elapsed Time

      The diagnostic and fault conditions available via the operator interface will include the following:

      (1) Output Frequency
      (2) Output Current
      (3) Output Voltage
      (4) Shutdown Reference Status
      (5) Jog Status
      (6) Mode of Operation
      (7) Input Signal Levels
      (8) Faults
      (9) Overload Timer Activated
      (10) Motor Current Limit

6. Enclosure:

   a. The enclosure shall be NEMA Type 1 with a dead front and back construction with all components and load, line and control terminations fully front accessible. The enclosure shall be self-ventilated and have provisions for top and bottom entry of conduit and wire.

PART 3 – EXECUTION

3.1 INSTALLATION OF MOTOR STARTERS

A. Install motor starters in accordance with manufacture's written instructions, applicable requirements of NEC, NEMA Standards, and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

B. The Electrical Contractor shall consult and cooperate with the Control Contractor in assisting him in making control connections to the automatic position of the selector switch and to the auxiliary contacts.

C. Motor Data: Before installing wiring for motors and starters, the Electrical Contractor shall consult the respective parties furnishing the equipment and obtain from them all data necessary to properly connect the apparatus, and for selection of thermal overload relays in accordance with motor nameplate. Any variance in loads or electrical characteristics from the contract drawings should be reported to the Engineer before proceeding with the work.

D. When packaged equipment is furnished, all unit starters shall be furnished, mounted and wired by the installing contractor. The Electrical Contractor shall furnish and install a disconnect switch, as specified in Section 260170, and wire between unit's main terminal block and the disconnect switch.

E. When packaged rooftop equipment is furnished, the unit disconnect switch and all starters shall be furnished, mounted and wired by the installing contractor. The Electrical Contractor shall wire between the line side of the disconnect switch and the building system.

F. Should the Electrical Contractor elect to furnish and install an electric alternator with magnetic starters in lieu of the duplex motor controller, he shall provide all control wiring needed to make the alternator and the starters function as a unit.

G. Provide connections for motor starters.

3.2 ADJUST AND CLEAN

A. Inspect operating mechanisms for malfunctioning and where necessary adjust units for free mechanical movement.

B. Touch-up scratched or marred surfaces to match original finish.

3.3 FIELD QUALITY CONTROL

A. Subsequent to wire/cable hookup, energize motor starters and demonstrate functioning of equipment in accordance with requirements.

END OF SECTION 26 01 55

SECTION 26 01 60
PANELBOARDS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of panelboard load-center and enclosure work, including cabinets and cutout boxes, is indicated by drawings and schedules.

B. Types of panelboards and enclosures in this section include the following:

Lighting and Appliance Panelboards.
Distribution Panelboards.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data including specifications, installation instructions and general recommendations, for each type of panelboard required. Include data substantiating that units comply with requirements.

B. Shop Drawings: Submit dimensioned drawings of panelboards and enclosures showing layouts of enclosures and required individual panelboard devices, including by not necessarily limited to, circuit breakers, contactors, and accessories, including wiring diagrams of contactors.

1.3 COORDINATION

A. The drawings are scheme and/or diagrammatic in nature, and indicate the need and intent of the design. These are to be used for general guidance only. It shall be the responsibility of the Electrical Contractor to coordinate, with other Division Subcontractors, the installation of all raceways, raceway supports, junction boxes and required fittings. This coordination will include conduit layout to allow access to equipment for maintenance.

B. This coordination shall be carried out prior to actual installation; this shall be done to eliminate the possibility of conflicts between trades on items such as access, clearances and maintenance issues that may arise after completion of construction.

C. Should the coordination not be carried out prior to installation, and a conflict exists, the installing contractor shall remove and reinstall the equipment as required to clear the conflict at no additional cost to the Owner and no delay in project completion.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following (for each type of panelboard and enclosure):
Cutler Hammer, Inc. (Eaton)
Square D Company
Siemens

2.2 PANELBOARDS

A. General:

1. Panelboards shall comply with the following industry standards:

a. UL Listing/Approval
b. UL Standards:
Panelboards - UL67
Cabinet & Boxes - UL50
c. National Electric Code
d. NEMA Standard -PBI

2. Interiors:

a. All interiors shall be completely factory assembled. They shall be so designed that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors, so that circuits may be changed without machining, drilling and tapping.

b. Branch circuits shall be arranged using double row construction. A nameplate shall be provided listing panel type and rating.

c. Unless otherwise noted, full size insulated neutral bars shall be included. Bus bar taps for panels with single pole branches shall be arranged for sequence phasing of the branch circuit devices. Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection. A ground bus will be included in all panelboards.

3. Boxes: Boxes shall be a minimum 20 inches wide and manufactured from galvanized steel. Provide minimum gutter space in accordance with the National Electric Code.

4. Trim:

a. Switching device handles shall be accessible. Panel access doors shall not uncover any live parts. Doors shall have flush type cylinder lock and catch except doors over 48" in height shall have auxiliary fastenings top and bottom of door in addition to the flush type cylinder lock and catch. Panelboard trim clamps shall be of the indicating type. Upon removal of screws behind door, the panel interiors become service accessible via piano hinged trim front.

b. Panel access door hinges shall be concealed. All locks shall be keyed alike; directory frame shall be welded metal and having a transparent cover shall be furnished with each door.

c. All exterior and interior steel surfaces of the trim shall be properly cleaned, primed with a rust inhibiting phosphatized coating and finish with a gray ANSI 61 paint. Trims for flush panels shall overlap the box for a least 3/4 inch all around. Surface trims shall have the same width and height as the box. Trims shall be mountable by a screwdriver and without the need for special tools.

5. Main Bus and Branch Circuits: All main bus bars shall be full size aluminum, sized in accordance with U.L. standards to limit the temperature rise on any current carrying part to a maximum of 50 degrees C above an ambient of 40 degrees C maximum.

B. Distribution Panelboards:

1. Panels shall be provided with molded case circuit breakers tested and U.L. labeled per U.L. 489.

2. Circuit breakers 100 ampere through 400 ampere frame sizes shall be thermal-magnetic trip with inverse time current characteristics.

3. Where multiple pole circuit breakers are indicated, provide with common trip so overload on one pole will trip all poles simultaneously. Molded case circuit breakers shall have a minimum 22,000 symmetrical RMS interrupting capacity at 240 volts.

C. Lighting and Appliance Panelboards:

1. Provide switching and protective devices in quantities, ratings, types indicated, with anti-turn solderless pressure type lug connectors approved for copper conductors. Circuit breakers shall be the bolt-on, molded case, thermal magnetic type, with toggle handles that indicate when tripped. Where multiple pole circuit breakers are indicated, provide with common trip so overload on one pole will trip all poles simultaneously.

2. Panelboards for use at 240 volts AC maximum shall incorporate circuit breakers as shown rated at 10,000 A.I.C. symmetrical at 240 volts.

3. Panelboards for use at 480/277 volts AC maximum shall incorporate circuit breakers as shown rated at 14,000 A.I.C. symmetrical at 480 volts.

PART 3 – EXECUTION

3.1 INSTALLATION OF PANELBOARDS

A. Install panelboards and enclosures where indicated in contract documents and, in accordance with the equipment manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

B. Anchor enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically secure.

C. Provide all required electrical and grounding connections within the panelboards and enclosures.

D. The Electrical Contractor shall provide directories compiled using a software program that is Windows compatible. Program shall handle multiple panels, calculate panel electrical loads from user supplied data, maintain a history of repairs and upgrades by circuit, and be capable of printing panel directories and summaries. Verify compatibility with Owner’s operating system.

E. Provide two discs to owner containing software and project panel directories and summaries.

END OF SECTION 26 01 60

SECTION 26 01 65
SWITCHBOARDS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of switchgear and switchboards is indicated by drawings and schedules.

B. Types of switchgear and switchboards in this section include the following:

Dead-Front Switchboards.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data on switchgear and switchboards.

B. Shop Drawings: Submit dimensioned drawings of switchgear and switchboards showing accurately scaled basic sections including, but not necessarily limited to, auxiliary compartments, section components, and combination sections.

1.3 COORDINATION

A. The drawings are scheme and/or diagrammatic in nature, and indicate the need and intent of the design. These are to be used for general guidance only. It shall be the responsibility of the Electrical Contractor to coordinate, with other Division Subcontractors, the installation of housekeeping equipment pad, switchboard cabinet structures, feeders, branch circuits, switchboard hardware and required fittings. This coordination will include conduit layout to allow access to equipment for maintenance.

B. This coordination shall be carried out prior to actual installation; this shall be done to eliminate the possibility of conflicts between trades on items such as access, clearances and maintenance issues that may arise after completion of construction.

C. Should the coordination not be carried out prior to installation, and a conflict exists, the installing contractor shall remove and reinstall the equipment as required to clear the conflict at no additional cost to the Owner and no delay in project completion.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following:

Dead-Front Switchboards

Cutler Hammer, Inc. (Eaton)
Square D Co.
Siemens

2.2 EQUIPMENT AND COMPONENTS

A. Furnish the service entrance switchboard as indicated in contract documents. The switchboard shall meet the latest requirements of Underwriters Laboratories' Standard No. 891, NEMA PB2 and the National Electric Code. The switchboard shall be furnished with an Underwriters Laboratories' label.

B. Enclosure Construction: The switchboard shall be deadfront with front accessibility required. The switchboard frame shall be of formed code gauge steel rigidly welded and bolted together to support all coverplates, bussing and component devices during shipment and installation. Steel base channels shall be bolted to the frame to rigidly support the entire shipping section for moving on rollers and floor mounting. Each switchboard section shall have an open bottom and an individually removable top plate for installation and termination of conduits. The switchboard enclosure shall be painted on all exterior and interior surfaces. The paint finish shall be a meduim light gray, ANSI #49, applied by the electro-deposition process over an iron phosphate pre-treatment. All front covers shall be screwed on and removable and all doors shall be hinged with removable hinge pins. Top and bottom conduit areas shall be clearly indicated on shop drawings.

C. Bussing: The switchboard bussing shall be of a sufficient cross-sectional area to meet U.L. Standard 891 temperature rise. Through bus shall be extruded aluminum plated by the Alstan 70 process. The through bus shall have an ampacity where indicated on the single line riser diagram and shall be rated to withstand a short circuit current rating of 50,000 RMS symmetrical ampers. The through bus supports, connections and joints are to be bolted with hex-head bolts and belleville washers to minimize maintenance requirements and shall have provisions for the addition of future sections.

D. Short Circuit Current Rating: Each switchboard, as a complete unit, shall be given a single short circuit current rating by the manufacturer in accordance with U.L. specifications, on equipment constructed similarly to the subject switchboard.

E. Main Circuit Breaker: The service disconnect device shall be a molded case circuit breaker totally front accessible and front connectable. The circuit breaker shall be provided with ground fault protection.

F. Branch Circuit Breakers: Group mounted molded case circuit breakers shall be totally front accessible. The circuit breakers shall be mounted in the switchboard to permit installation, maintenance and testing without reaching over any line side bussing. The circuit breakers are to be removable by the disconnection of only the load side cable terminations and all line and load side connections are to be individual to each circuit breaker. No common mounting brackets or electrical bus connectors will be acceptable.

PART 3 – EXECUTION

3.1 INSTALLATION OF SWITCHGEAR AND SWITCHBOARDS

A. Install switchgear and switchboards where shown, in accordance with manufacturer's written instructions, with recognized industry practices to ensure that switchgear and switchboards comply with requirements of NEMA and NEC Standards, and applicable portions of NECA's "Standard of Installation".

B. Tighten electrical bus connections and mechanical fasteners.

C. Provide connections within switchboard.

3.2 ADJUST AND CLEAN

A. Adjust operating mechanisms for free mechanical movement.

B. Touch-up scratched or marred surfaces to match original finish.

3.3 FIELD QUALITY CONTROL

A. Prior to energization of switchboards, check with ground resistance tester phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled.

B. Prior to energization, check switchboards for electrical continuity of circuits, and for short circuits.

C. Subsequent to wire and cable hook-ups, energize switchboards and demonstrate functioning in accordance with requirements.

END OF SECTION 26 01 65

SECTION 26 01 70
MOTOR AND CIRCUIT DISCONNECTS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of motor and circuit disconnect switch work is indicated by drawings and schedules.

B. Types of motor and circuit disconnect switches in this section include the following:

Equipment disconnects.
Appliance disconnects.
Motor-circuit disconnects.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data including specifications, installation instructions and general recommendations, for each type of motor and circuit disconnect switch required.

1.3 COORDINATION

A. The drawings are scheme and/or diagrammatic in nature, and indicate the need and intent of the design. These are to be used for general guidance only. It shall be the responsibility of the Electrical Contractor to coordinate, with other Division Subcontractors, the installation of all motor and circuit disconnect switches, supporting hardware, including wiring and conduit, to and from the equipment. This coordination will include conduit layout to allow access to equipment for maintenance.

B. This coordination shall be carried out prior to actual installation; this shall be done to eliminate the possibility of conflicts between trades on items such as access, clearances and maintenance issues that may arise after completion of construction.

C. Should the coordination not be carried out prior to installation, and a conflict exists, the installing contractor shall remove and reinstall the equipment as required to clear the conflict at no additional cost to the Owner and no delay in project completion.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following (for each type of switch):

Cutler-Hammer, Inc. (Eaton)
Square D Company
Siemens

2.2 FABRICATED SWITCHES

A. Safety Switches: Safety switches shall be of sizes noted on the drawings, fusible or non-fusible and contained in a general-purpose enclosure. All switches shall be type HD and have quick-make, quick- break operation. All switches shall be of proper horsepower rating as applicable and have dual interlocks designed to interlock the switch box door with the switch operating mechanism. Unit shall be provided with a suitable means of interlock release. An arrangement shall be provided for locking the operating handle in the "ON" or "OFF" position. Safety switches shall have the proper type metal enclosure, i.e., standard, weatherproof, etc., to suit their

specific location as required by the National Electrical Code.

B. Fuses: Provide fuses for safety switches, as recommended by switch manufacturer, of classes, types and ratings needed to fulfill electrical requirements for service indicated.

C. When packaged rooftop equipment is furnished, the unit disconnect switch shall be furnished, mounted and wired by the installing contractor.

D. When rooftop exhaust fans rated less than 1/2 HP at 120 volts, single phase, are furnished, except utility sets, the unit disconnect switch shall be furnished, mounted and wired by the installing contractor.

PART 3 – EXECUTION

3.1 INSTALLATION OF MOTOR AND CIRCUIT DISCONNECT SWITCHES

A. Install motor and circuit disconnect switches where indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA, and NECA's "Standard of Installation", and in accordance with recognized industry practices to ensure that products fulfill requirements.

B. Install disconnect switches used with motor-driven appliances, and motors and controllers within sight of controller position unless otherwise indicated.

C. Provide electrical connections for motor and circuit disconnect switches.

END OF SECTION 26 01 70

SECTION 26 01 80
OVERCURRENT PROTECTIVE DEVICES

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of overcurrent protective device work is indicated by drawing schedules and specifications.

B. Types of overcurrent protective devices in this section include the following:

1. Service entrance rated disconnect.
2. Molded case circuit breaker.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data on overcurrent protective devices, including: voltages and current ratings, interrupting ratings, current limitations, internal inductive and non-inductive loads, time-current trip characteristic curves, and mounting requirements.

B. Shop Drawings: Submit layout drawings of overcurrent protective devices, showing spatial relationships of units to associated electrical equipment, and connections to electrical power supplies.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include the following:

1. Circuit-Breakers

Cutler-Hammer, Inc. (Eaton)
Square D Co.
Siemens

2.2 CIRCUIT BREAKERS

A. Except as otherwise indicated, provide circuit breakers and ancillary components, of types, sizes, ratings and electrical characteristics indicated, which comply with manufacturer's standard design, materials, components, and construction in accordance with published product information, as required for a complete installation.

B. Service Entrance Rated Disconnect: The service disconnect device shall be a molded-case circuit breaker totally front accessible and front connectable. The circuit breaker shall be a three pole device suitable for operation on a 480 volt, 60 Hertz system. Circuit breaker shall have 65,000 RMS symmetrical amperes interrupting rating, and shall be UL approved for Service Entrance equipment.

C. Molded-Case Circuit Breakers: Provide factory assembled, molded-cased circuit breakers of frame size indicated; 120/208 volts, and 277/480 volts 60 Hertz, one, two, or three poles with a short circuit symmetrical ampere interrupting rating as indicated by the panel schedule and/or as shown by the single line riser diagram. Provide circuit breakers with permanent thermal instantaneous magnetic trips in each pole with ampere ratings as indicated. Construct with overcenter, trip-free, toggle type operating mechanisms with quick-make, quick- break action and positive handle trip indication. Construct devices for

mounting and operating in any physical position and operating in an ambient temperature of 40 degrees C. Provide circuit breakers with mechanical screw type connector lugs, AL/CU rated.

PART 3 – EXECUTION

3.1 INSTALLATION OF OVERCURRENT PROTECTIVE DEVICES

A. Install overcurrent protective devices as indicated in contract documents, in accordance with the manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements. Comply with NEC Standards for Installation of overcurrent protective devices.

B. Coordinate with other work, including electrical wiring work, as necessary to interface installation of overcurrent protective devices with other work.

C. Fasten circuit breakers without causing mechanical stresses, twisting or misalignment being exerted by clamps, supports, or cabling.

3.2 ADJUST AND CLEAN

A. Inspect circuit-breaker operating mechanisms for malfunctioning and, where necessary, adjust units for free mechanical movement.

3.3 FIELD QUALITY CONTROL

A. Prior to energization of overcurrent protective devices, test devices for continuity of circuitry and for short-circuits. Correct malfunctioning units, and then demonstrate compliance with requirements.

END OF SECTION 26 01 80

SECTION 26 01 90
SUPPORTING DEVICES

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Types of supports, anchors, sleeves and seals specified in this section include the following:

Hangers.
Riser Clamps.
C-clamps
I-beam clamps.
One-hole conduit straps.
Two-hole conduit straps.
Round steel rods.
Lead expansion anchors.
Toggle bolts.
U-Channel Strut Systems.

PART 2 – PRODUCTS

2.1 MANUFACTURED SUPPORTING DEVICES

A. Provide supporting devices, complying with manufacturer's standard materials, design and construct in accordance with published product information, and as required for a complete installation, and as herein specified.

B. Supports: Provide supporting devices of types, sizes and materials having the following construction features:

Hangers: For supporting EMT conduit, electro-galvanized steel, with 1/4" minimum diameter hole for round steel rod; approximately MSS types 5, 7, 9 or spring steel conduit clips.

Reducing Couplings: Steel rod reducing coupling, 1/4" minimum black steel.

C-Clamps: Black malleable iron, 1/4" minimum rod size.

I-Beam Clamps: Black steel, 1-1/4" x 3/16" stock; 3/8" cross bolt; flange width 2"; approx. 52 pounds per 100 units.

One-Hole Conduit Straps: For supporting EMT conduit, electro- galvanized steel.

Two-Hole Conduit Straps: For supporting EMT conduit, electro-galvanized steel; 3/4" strap width; and 2-1/8" between center of screw holes.

Hexagon Nuts: For 1/4" rod size; galvanized steel.

Round Steel Rod: Black steel; 1/4" min. dia.

Offset Conduit Clamps: For supporting rigid metal conduit; black steel.

C. Anchors: Provide anchors of types, sizes and materials indicated; and having the following construction features:

Lead Expansion Anchors: 1/4" - 20 Minimum.

Toggle Bolts: Springhead; 3/16 x 4".

D. Manufacturer: Subject to compliance with requirements, provide anchors of the following:

Ackerman Johnson Fastening Systems, Inc.
Elcen Metal Products Co.
Ideal Industries, Inc.
Rawlplug Co., Inc.
Star Expansion Co.
U.S. Expansion Bolt Co.
Erico Products, Inc. (Caddy)
Hilti, Inc.

E. U-Channel Strut Systems: Provide U-channel strut system for supporting electrical equipment, 16-gauge hot dip galvanized steel, construct with 9/16" dia. holes, 8" o.c. on top surface, with standard hot dip galvanized finish, and with the following fittings which mate and match with U-channel.

Beam clamps.
Thinwall conduit clamps.
Conduit hangers.
U-bolts.

F. Manufacturers: Subject to compliance with requirements, provide channel systems of one of the following:

B-Line Systems, Inc.
Elcen Metal Products Co.
Power-Strut Div.; Van Huffel Tube Corp.
Unistrut Div.; GTE Products Corp.
Hilti, Inc.

PART 3 – EXECUTION

3.1 INSTALLATION OF SUPPORTING DEVICES

A. Install hangers and anchors in accordance with manufacturer's written instructions and with recognized industry practices to insure supporting devices comply with requirements. Comply with requirements of NECA, NEC and ANSI/NEMA for installation of supporting devices.

B. Install hangers, supports, clamps and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible. Install supports with maximum spacings.

END OF SECTION 26 01 90

SECTION 26 01 95
POWER SYSTEM STUDIES

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Short Circuit Coordination Study:

1. Short circuit studies, protective device evaluation studies and protective device coordination studies shall be performed by the switchboard manufacturer. The studies shall be submitted to the Engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment for manufacture.

2. The studies shall include all portions of the electrical distribution system from the utility service equipment to all downstream distribution and branch panelboards, including normal and emergency equipment.

B. Arc Fault Calculations and Labeling:

1. Complete arc fault available current calculations and labeling shall be provided by the Electrical Contractor. Calculations may be performed by a subcontractor such as the switchboard manufacturer. Calculations shall be submitted to the Engineer prior to manufacture of labels, for review and approval.

2. Calculations shall include all portions of the electrical distribution system from the utility service equipment installed in the new Courthouse building (Bid Pac B) to <u>all</u> downstream distribution and branch panelboards (including new and those installed under Bid Pac B); and from generator to <u>all</u> emergency distribution and transfer switches (including new and those installed under Bid Pac B).

3. Electrical Contractor shall provide permanent labels on all electrical distribution system equipment as listed above. Labels shall indicate maximum available arc fault current per NEC 2011, Article 110. In addition, labels shall indicate level of personal protective equipment appropriate for the hazard, as defined in NFPA 70E.

PART 2 – DATA ACQUISITION

2.1 DATA COLLECTION FOR THE STUDIES

A. The Contractor shall provide the required data for preparation of the studies. The switchboard manufacturer shall furnish the contractor with a listing of the required data immediately after award of the contract.

B. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to release of the equipment for manufacture.

C. The Contractor shall be responsible for provision of all feeder lengths required for all calculations.

2.2 SHORT CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

A. The short circuit study shall be performed with the aid of a digital computer program and shall be in accordance with ANSI C37.5-1969 (R1975), IEEE Std. 320-172 and IEEE Std. 141-1976.

B. The study input data shall include the Power Company's short circuit contribution, resistance and reactance components of the branch impedances, the X/R ratios, base quantities selected, and other source impedances. This data shall be obtained by the contractor from Delmarva Power.

C. Short circuit close and latch duty values and interrupting duty values shall be calculated on the basis of assumed

three-phase bolted short circuits at each switchgear bus, medium voltage controller, switchboard, low voltage motor control center, distribution panelboard, pertinent branch circuit panel and other significant locations through the system. The short circuit tabulations shall include symmetrical fault currents and X/R ratios. For each fault location, the total duty on the bus, as well as the individual contribution from each connected branch, shall be listed with its respective X/R ratio.

D. A protective device evaluation of circuit breakers, disconnect switches, and fuses by tabulating and comparing the short circuit ratings of these devices with the calculated fault currents. Appropriate multiplying factors based on system X/R ratios and protective device rating standards shall be applied. Any problem areas or inadequacies in the equipment due to short circuit currents shall be promptly brought to the Engineer's attention.

2.3 PROTECTIVE DEVICE COORDINATION STUDY

A. A protective device coordination study shall be performed to provide the necessary calculations and logic decisions required to select the protective relay characteristics and settings, ratios and characteristics of associated current transformers, and low voltage breaker trip characteristics and settings.

B. The coordination study shall include all medium and low voltage classes of equipment from the building service protective devices down to and including the largest rated device in the MCC low voltage motor control center and panelboard. The phase and ground overcurrent protection shall be included as well as settings of all other adjustable protective devices.

C. The time-current characteristics of the specified protective devices shall be drawn on Keuffel and Esser Log - log paper. The plots shall include complete titles, representative one-line diagram and legends, significant motor starting characteristics, complete parameters of transformers, complete operating bands of low voltage circuit breaker trip curves and fuses. The coordination plots shall indicate the types of protective devices selected, proposed relay taps, time dial and instantaneous trip settings, transformer magnetizing inrush and ANSI transformer withstand parameters, cable thermal overcurrent withstand limits and significant symmetrical and asymmetrical fault currents. All restrictions of the National Electrical Code shall be adhered to and proper coordination intervals and separation of characteristic curves shall be maintained. The coordination plots for phase and ground protection devices shall be provided on a system basis. A sufficient number of separate curves shall be used to clearly indicate the coordination achieved.

D. The selection and settings of the protective devices shall be provided separately in a tabulated form listing circuit identification, IEEE device number, current transformer ratios and connection, manufacturer and type, range of adjustment and recommended settings. Any discrepancies, problem areas, or inadequacies shall be promptly brought to the Engineer's attention.

2.4 STUDY REPORT

A. The results of the Power System Study shall be summarized in a final report. Submit six (6) bound copies of final report.

B. The report shall include the following sections:

1. Description, purpose, basis and scope of the study and a single line diagram of that portion of the power system which is included within the scope of the study.

2. Tabulations of circuit breakers, and other protective device ratings versus calculated short circuit duties, and commentary regarding same.

3. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, and commentary regarding same.

4. Fault current calculations including a definition of terms and guide for interpretation of computer printout.

PART 3 – EXECUTION

3.1 PROTECTIVE DEVICE TESTING, CALIBRATION AND ADJUSTMENT

A. The equipment manufacturer shall provide the services of a qualified field Engineer any necessary tools and equipment to test, calibrate and adjust the protective relays and circuit breaker trip devices as recommended in the Power System Study.

3.2 ARC FAULT LABELING

A. Contractor shall submit sample of arc fault label during shop drawing review for approval.

END OF SECTION 26 01 95

SECTION 26 04 52
GROUNDING

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Types of grounding in this section include the following:

Grounding:

Underground metal piping.
Underground metal water piping.
Grounding rods.
Service equipment.
Enclosures.
Systems.
Equipment.
Building Structural Steel (Bonding)

PART 2 – PRODUCTS

2.1 GROUNDING

A. Except as otherwise indicated, provide each electrical grounding system indicated, with assembly of materials including, but not necessarily limited to, cables/wires, connectors, terminals (solderless lugs), and other items and accessories needed for complete installation. Where materials or components are not otherwise indicated, comply with NEC, NEMA, and established industry standards for applications indicated.

B. Provide conduit, tube, duct, cable and fittings complying with Division 26 Basic Materials and Methods section, "Raceways", in accordance with the following listing:

Rigid steel conduit.
Electrical metallic tubing.
Flexible metal conduit.
Liquid-tight flexible metal conduit.
Rigid metal conduit fittings.
EMT fittings.
Flexible metal conduit fittings.
Liquid-tight flexible metal conduit fittings.

2.2 ELECTRICAL GROUNDING CONDUCTORS

A. Unless otherwise indicated, furnish a green insulated equipment grounding conductor for all feeders and branch circuits, matching power supply wiring materials and sized according to NEC.

2.3 BONDING PLATES, CONNECTIONS, TERMINALS & CLAMPS

A. Provide electrical bonding plates, connectors, terminals and clamps as recommended by bonding plate, connector, terminal and clamp manufacturers for applications.

2.4 GROUND RODS & PLATES

A. Ground Rods: Steel with copper welded exterior, 3/4" dia. x 10'.

PART 3 – EXECUTION

3.1 INSTALLATION OF GROUNDING SYSTEMS

A. Install electrical grounding systems in accordance with manufacturer's written instructions and with recognized industry practices to ensure grounding complies with requirements. Comply with requirements of NEC, NESC, NEMA and UL standards for installation of grounding systems.

B. Coordinate with other electrical work as necessary to interface installation of grounding system with other work.

C. Clamp cable connections to ground rods.

D. Install bonding jumpers with ground clamps on water meter piping to electrically bypass water meter.

E. Install clamp-on connectors only on thoroughly cleaned metal contact surfaces, to ensure electrical conductivity and circuit integrity.

3.2 FIELD QUALITY CONTROL

A. Upon completion of installation of electrical grounding system, test ground resistance with ground resistance tester. Where tests show resistance-to-ground is over 25 ohms, take appropriate action to reduce resistance to 25 ohms or less by driving additional ground rods and/or by chemically treating soil encircling ground rods with sodium chloride, calcium chloride, copper sulphate, or magnesium. Then retest to demonstrate compliance.

END OF SECTION 26 04 52

SECTION 26 04 60
TRANSFORMERS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of transformer work is indicated by drawings and schedules.

B. Types of transformers in this section include the following:

Dry type transformers

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data on power/distribution transformers, including certification of transformer performance efficiency at indicated loads, percentage regulation at 100% and 80% power factor, no-load and full-load losses in watts, % impedance at 75 Degrees C, hot-spot and average temperature rise above 40 degrees C ambient, sound level in decibels and standard published data including dimensions and net and shipping weights.

B. Shop Drawings: Submit dimensioned drawings of transformer installations, showing mountings and supports.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following (for each type of transformer):

Dry

Sorgel Electric Division/Square D Company
Cutler-Hammer/Eaton Electrical, Inc.
The ABB Group
Siemens Energy & Automation, Inc.
Approved Substitute.

2.2 POWER/DISTRIBUTION TRANSFORMERS

A. General Requirements:

1. Except as otherwise indicated, provide manufacturer's standard materials and components as indicated in contract documents and by published product information designed and constructed as recommended by manufacturer, and as required for complete installation.

2. All 3-phase transformers sized from 15 Kva thru 750 Kva shall be Energy Star rated and be compliant with NEMA Standard TP-1.

B. Three Phase Distribution Transformers: Provide open ventilated dry- type three phase distribution transformers, 480-volt delta primary, 120/208-volt secondary with KVA rating as indicated on the drawings. Transformers shall be aluminum wound windings, 220°C Class insulation and temperature rise rating of 150 degrees C. Unit shall be provided with six (6) approximately 2-1/2% taps, two (2) above and four (4) below rated primary voltage. A low voltage neutral terminal shall be provided. Coils shall be enclosed by a sheet steel enclosure comprised of readily removable sections having ventilated openings in front cover. Core and coil assemblies shall be mounted on rubber isolation pads. Limit terminal compartment to 75 degrees C. at

full-rated load. Provide wiring connectors suitable for copper wiring. Cushion-mount transformers with external vibration isolation supports. Electrically ground core and coils to transformer enclosure by means of flexible metal grounding strap.

PART 3 – EXECUTION

3.1 INSTALLATION OF TRANSFORMERS

A. Install transformers as indicated in contract documents, and complying with manufacturer's written instructions, applicable requirements of NEC, NEMA and IEEE Standards, and in accordance with recognized industry practices to ensure that products fulfill requirements.

B. Install units on vibration mounts; comply with manufacturer's installation method if any.

3.2 GROUNDING

A. Provide tightly fastened equipment grounding and bonding connections for transformers.

3.3 TESTING

A. Upon completion of installation of transformers, energize primary circuit at rated voltage and frequency from normal power source and test transformers, including, but not limited to, audible sound levels, to demonstrate capability and compliance with requirements. Where possible, correct malfunction units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

END OF SECTION 26 04 60

SECTION 26 04 70
DISTRIBUTION CIRCUITS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Distribution circuit work is indicated by drawings and schedules.

B. The distribution circuits shall include furnishing and installing a complete wire and conduit system between distribution panelboards and branch circuit panelboards.

C. Types of equipment to be furnished and installed in this section include the following:

Rigid Metal Conduit
Intermediate Metal Conduit (IMC)
Electrical Metallic Tubing (EMT)
PVC (Below Slab Only)
Wires and Cables
Junction Boxes
Pull Boxes
Conduit Bodies
Bushings
Locknuts
Supporting Devices

PART 2 – PRODUCTS

2.1 DISTRIBUTION CIRCUITS

A. Furnish and install each distribution circuit indicated, with assembly of materials, including but not necessarily limited to, conduit, wire, pull boxes, junction boxes and other items and accessories needed for a complete installation. Where materials or components are not otherwise indicated, comply with NEC, NEMA and established industry standards for applications indicated.

PART 3 – EXECUTION

3.1 INSTALLATION OF DISTRIBUTION CIRCUITS

A. Install distribution circuits complying with equipment manufacturer's written instructions, applicable requirements of NEC, NEMA, and NECA's "Standard of Installation", and in accordance with recognized industry practices.

B. Multiple circuits within a single raceway shall not be permitted under this section.

END OF SECTION 26 04 70

SECTION 26 04 71
FEEDER CIRCUITS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Feeder circuit work is indicated by drawings and schedules.

B. The feeder circuits shall include furnishing and installing a complete wire and conduit system between distribution panelboards and major 3 phase loads, between power panels and 3 phase motor loads.

C. Types of equipment to be furnished and installed in this section include the following:

Rigid Metal Conduit
Electrical Metallic Tubing (EMT)
Intermediate Metal Conduit (IMC)
Wires and Cables
Junction Boxes
Pull Boxes
Conduit Bodies
Bushings
Locknuts
Supporting Devices

PART 2 – PRODUCTS

2.1 FEEDER CIRCUITS

A. Furnish and install each feeder circuit with assembly of materials, including but not necessarily limited to, conduit, wire, pull boxes, junction boxes and other items and accessories needed for a complete installation. Where materials or components are not otherwise indicated, comply with NEC, NEMA and established industry standards for applications indicated.

PART 3 – EXECUTION

3.1 INSTALLATION OF FEEDER CIRCUITS

A. Install feeder circuits, complying with equipment manufacturer's written instructions, applicable requirements of NEC, NEMA and NECA's "Standard of Installation", and in accordance with recognized industry practices.

B. Multiple circuits within a single raceway shall not be permitted under this section.

END OF SECTION 26 04 71

SECTION 26 04 72
BRANCH CIRCUITS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Branch circuit work is indicated by drawings.

B. The branch circuits shall include furnishing and installing a complete wire and conduit or cable system between panelboards and lighting fixtures, receptacles, fractional horsepower motors, and small single-phase loads.

C. Types of equipment to be furnished and installed in this section include the following:

Rigid Raceways – See Section 260110
Electrical Metallic Tubing (EMT)
MC (Metal Clad) (Concealed Work only)
Wires and Cables
Junction Boxes
Pull Boxes
Conduit Bodies
Bushings
Locknuts
Supporting Devices

PART 2 – PRODUCTS

2.1 BRANCH CIRCUITS

A. Furnish each branch circuit with an assembly of materials, including but not necessarily limited to, conduit, wire, cable, pull boxes, junction boxes and other items and accessories needed for a complete installation. Where materials or components are not otherwise indicated, comply with NEC, NEMA and established industry standards for applications indicated.

2.2 CONVENIENCE BRANCH CIRCUITS

A. Intent:

1. The intent of this portion of the specifications is to describe the requirements of a convenience circuit as it applies to 120-volt receptacles.

2. All convenience branch circuits may consist of more than one 120-volt receptacle.

B. Convenience Circuit - General: A circuit consisting of a phase and neutral conductor, which may share its neutral with other phase conductors provided that the neutral conductor does not become overloaded due to circuit phase relationship. This type of circuit shall also include an equipment grounding conductor as described under the grounding section of the specifications.

C. Convenience Circuit - Dedicated: A circuit consisting of a phase and neutral conductor which DOES NOT share conductors with any other circuits. This type of circuit shall also include an equipment grounding conductor as described under the grounding section of the specifications.

PART 3 – EXECUTION

3.1 INSTALLATION OF BRANCH CIRCUITS

A. Install branch circuits, complying with equipment manufacturer's written instructions, applicable requirements of NEC, NEMA, and NECA's "Standard of Installation", and in accordance with recognized industry practices.

B. Multiple circuits within a single raceway or cable shall be permitted under this section. It shall be the responsibility of the Electrical Contractor to assure that the neutral conductors do not become overloaded due to circuit phase relationship, and isolated grounds not become voided or compromised due to miswiring or wrong connections.

C. The Electrical Contractor shall use metal clad cable in lieu of electrical metallic tubing (EMT) above tile ceilings as fixture drops only. In all areas of exposed construction, electrical metallic tubing (EMT) shall be installed.

END OF SECTION 26 04 72

SECTION 26 05 10
BUILDING LIGHTING

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Lighting fixture work is indicated by specifications, drawings and schedules.

B. Types of lighting fixtures in this section include the following:

1. LED

C. Applications of lighting fixtures required for the project include the following:

1. General Lighting.
2. Supplementary Lighting.
3. Emergency Lighting.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data on building lighting fixtures.

B. Shop Drawings: Submit dimensioned drawings of lighting fixture installations, including but not necessarily limited to, layout, relation to associated panelboards, and connections to panelboards. Submit fixture shop drawings in booklet form with separate sheet for each fixture, assembled in luminaire "type" alphabetical order, with proposed fixture and accessories clearly indicated on each sheet.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Each lighting fixture type specified represents a specific style and quality of fixture acceptable for this project.

B. The Engineer reserves the right to reject any shop drawing and to request a resubmission should the contractor submit a shop drawing of an equivalent manufacturer which is viewed as being of an incompatible style or inferior quality.

C. No fixture shop drawing shall be submitted, nor will any be accepted, for any manufacturer which is not specifically listed for that fixture type. When a fixture manufacturer is listed for a specific fixture type, this does not provide him with the right to submit for fixtures he is not listed under. A bidding Contractor may elect to bid using non listed fixtures for the listed Lighting Representatives. The Engineer and the Architect shall make the final decision on whether the submitted fixture meets the project's requirements during shop drawing review.

D. Should the Contractor be unable to obtain approval of the resubmitted manufacturer, then he should submit the basis of design specified manufacturer/fixture.

2.2 LIGHTING FIXTURES

A. Provide lighting fixtures of the size, type and rating indicated complete with, but not necessarily limited to, housings, lamp holders, reflectors, ballast, lamps, mounting frames, pendants and wiring; wired and connected in place, complete, tested and left in satisfactory operating condition.

B. LED Drivers

1. All LED fixtures shall be provided with integral drivers (unless noted otherwise) and must operate at line voltage as indicated on drawings (unless noted otherwise).

2. LED drivers shall have operating temperature of 50°F - 140°F unless noted otherwise.

3. LED drivers shall carry a 5-year warranty.

C. Fixture Lamps: For the type, number and color of the fixture lamps, refer to the Lighting Fixture Schedule on the drawings.

PART 3 – EXECUTION

3.1 INSTALLATION OF LIGHTING FIXTURES

A. Install lighting fixtures at locations and heights as indicated, in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation", NEMA Standards and with recognized industry practices to ensure that lighting fixtures fulfill requirements of the project.

B. Install lighting fixtures in removable tile ceilings using 3/8" flexible metal conduit with 3 # 12 awg. conductor. Maximum length of flexible lead shall not exceed 60". Flexible lead shall extend from the fixture to the junction box. The junction box shall be securely fastened to the building structure above the removable tile ceiling and shall not serve more than two (2) lighting fixtures, nor shall the junction box support any of the lighting fixtures.

3.2 LIGHTING FIXTURE MOUNTING

A. 1' x 4', 2' x 2' and 2' x 4' fixtures installed in a removable tile ceiling shall be installed using T-Bar grid safety clips as provided by the fixture manufacturer and as required by the NEC.

B. 2'x 2' and 2' x 4' fixtures installed in a removable tile ceiling shall be installed using support wires at all four corners of the fixture. The support wires shall be carried up to the building structure and securely anchored using screwed or bolted hardware. Pressure type clips will not be acceptable. The Electrical Contractor shall be responsible for installing or having installed these four (4) support wires.

C. 1' x 4' fixtures installed in a removable tile ceiling shall be installed using support wires at two (2) corners of the fixture. The support wires shall be carried up to the building structure and securely anchored using screwed or bolted hardware. Pressure type clips will not be acceptable. The Electrical Contractor shall be responsible for installing or having installed these Two (2) support wires.

D. Downlights installed in a removable tile ceiling shall be installed using 24" spreader bars attached to the T-Bar grid system. Two (2) support wires shall be installed, one (1) on each side of the fixture and centered between the spreader bars, these support wires shall be carried up to building structure and securely anchored using screwed or bolted hardware. Pressure type clips will not be acceptable. The Electrical Contractor shall be responsible for installing or having installed these two (2) support wires.

E. Pendant lighting fixtures, either chain, cable or stem hung below a removable tile ceiling shall be installed in accordance with fixture manufacturer's written instructions and recommendations. The Electrical Contractor shall furnish and install support wire or threaded rod from the fixture mounting hardware up to building structure and securely anchor using screwed or bolted hardware. Pressure type clips will not be acceptable. These support devices shall be independent from the ceiling T-Bar grid system, the system may be used as a guide, but in no way shall the T-Bar grid system carry any of the weight produced by the fixture or it's support devices.

F. Surface mounted fixtures installed on removable tile ceilings or dry wall ceilings shall be installed in accordance with fixture manufacturer's written instructions and recommendations.

1. Fixtures installed on removable tile ceilings shall be anchored to the T-Bar grid system using snap-on clips with threaded studs and wing nuts. The Electrical Contractor shall furnish and install a support wire from each snap-on clip carried up to building construction and securely anchor using screwed or bolted hardware.

2. Fixtures installed on dry wall ceilings shall be mounted using spring-loaded toggle bolts. The number and location of the anchors shall depend on the fixture manufacture's written instructions and recommendations. It shall be the responsibility of the Electrical Contractor to follow these instructions and recommendations.

3.3 ADJUST and CLEAN

A. Clean lens, reflectors and interiors of all lighting fixtures of dirt and construction debris upon completion of installation.

B. Protect installed lighting fixtures from damage during the remainder of the construction period.

3.4 FIELD QUALITY CONTROL

A. Upon completion of the installation of the lighting fixtures, and after the building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with project requirements. Where possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

B. At the time of Substantial Completion, replace lamps in lighting fixtures which are observed to be noticeably dimmed after Contractor's use and testing, as judged by the Architect/Engineer. Furnish stock or replacement lamps amounting to 15% (but not less than one (1) lamp in each case) of each type and size used in each type of fixture. Deliver the replacement stock as directed to the Owner's storage area.

1. Refer to Division 1 sections for the replacement/restoration of lamps in lighting fixtures, where used for temporary lighting prior to the time of Substantial Completion.

C. Replace defective and burned out lamps for a period of one (1) year following the time of Substantial Completion.

3.5 GROUNDING

A. Provide tight equipment grounding connections for each lighting fixture installation, in accordance with fixture manufacturer's recommendations and the NEC's requirements.

END OF SECTION 26 05 10

SECTION 26 05 20
ROADWAY & PARKING AREA LIGHTING

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of roadway and parking area lighting work is indicated by drawings and schedules.

B. Applications of roadway and parking area lighting in this section include the following:

Private roadways.
Automobile parking lots.
Pedestrian walkways.
Building entrances.

C. Excavation and backfilling for roadway and parking area lighting poles, standards and foundations are specified in applicable Division 26 General Provisions sections.

D. Concrete for embedding poles, and for pole foundations and footings are specified in applicable Division 26 General Provision sections.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data on roadway and parking area lighting units, including certified dimension drawings of components including, but not necessarily limited to, fabricated poles and standards, and hardware.

PART 2 – PRODUCTS

2.1 GENERAL

A. Provide concrete bases, standards and luminaries of sizes, types and ratings indicated; complete with but not necessarily limited to anchor bolts, housings, lamps, lampholders, reflectors, ballasts, starters, lighting brackets and wiring; wired and connected in place, tested and left in satisfactory operating condition. See schedule on the drawings for types of standards and luminaries. Type letters are keyed with fixture letters indicated at the outlets on the drawings.

B. Material: Extruded aluminum.

C. Configuration: Anchor base type with handhole and cover where indicated.

D. Metal Lighting Standard Accessories: Provide accessories for metal lighting standards, including anchor bolts, as recommended by standard manufacturer of sizes and materials needed to fulfill loading and erection application requirements.

E. Manufacturers: Subject to compliance with requirements, provide products of one of the following (for each type of roadway and parking area lighting unit): As specified under "PRODUCTS".

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install roadway and parking area lighting units as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC, NESC and NEMA standards, and with recognized industry

practices to ensure that lighting units fulfill requirements.

B. Use belt slings or rope (not chain or cable) to raise and set finished poles and standards to protect finishes.

C. Set poles and standards plumb. Support adequately during backfilling, or anchoring to foundations.

3.2 ADJUST AND CLEAN

A. Clean standards and luminaries of dirt and debris upon completion of installation.

B. Protect standards and luminaries from damage during remainder of construction period.

3.3 FIELD QUALITY CONTROL

A. Upon completion of installation of roadway and parking area lighting fixtures, and after building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

B. At the time of Substantial Completion, replace lamps in lighting fixtures which are observed to be noticeably dimmed after Contractor's testing, as judged by Architect/Engineer.

3.4 GROUNDING

A. Provide tight equipment grounding connections for each lighting fixture installation.

END OF SECTION 26 05 20

SECTION 26 06 01
LIGHTNING PROTECTION SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Lightning protection system work is indicated by specifications.

B. Types of lightning protection system equipment and components specified in this section include the following:

Air terminals.
Conductors.
Connectors.
Cable Splicers.
Ground rods.
Rod clamps.
Bonding plates.

1.2 QUALITY ASSURANCE

A. ANSI/NFPA Compliance: Comply with NEC and NFPA No. 780, "Lightning Protection Code", as applicable to materials and installation of lightning protection components, and wiring.

B. UL Compliance: Comply with UL 96, "Lightning Protection Components" pertaining to design, materials and sizing of lightning protection components and devices. Provide components and devices which are UL listed and labeled.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's data on lightning protection equipment, components and devices.

B. Shop Drawings: Submit dimensioned layout drawings of all lightning protection system equipment, components and devices including conductor sizing, routing and connections.

C. UL Certificate: Provide Owner with UL Master Label for overall system which shall be suitable for fastening to building for display. Comply with UL 96A, "Installation Requirements for Lightning Protection Systems."

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide lightning protection and components of one of the following manufacturers and their representative:

East Coast Lightning Equipment
Erico Lightning Protection
Heary Bros., Inc.

National Lightning Protection Corp.
Denver, Colorado 80216
Thompson Lightning Protection, Inc.

2.2 LIGHTNING PROTECTION SYSTEM COMPONENTS

A. Provide lightning protection system equipment and components, of types, sizes, and ratings for service

indicated, which comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for a complete installation. Where type or material is not otherwise indicated, comply with NFPA 780 and UL 96 Standards.

2.3 ANCILLARY COMPONENTS

A. Air Terminal: Copper with low solid bronze base; 3/8-inch diameter extending 10 inches above the object they protect.

B. Conductors: Copper cable; 28 strand, 16 gauge; 220 lb. per 1000 feet; structural steel columns may be substituted for the down conductors.

C. Connectors: Solid bronze cable connector with stainless steel pressure screws.

D. Ground Rod: Copper clad, 5/8-inch diameter x 10 feet.

E. Rod Clamp: Bronze ground rod clamp with stainless bolts.

F. Bonding Plate: Cast bronze flat metal bonding plate with mild steel welding plate 1/4"x4"x4" for attachment to steel columns or beams. Steel plate to be electrically welded to the steel column or beam. Plate shall be furnished with four stainless steel bolts and nuts to attached bonding plate welding plate.

PART 3 – EXECUTION

3.1 INSTALLATION OF LIGHTNING PROTECTION SYSTEMS

A. Install lightning protection systems, in accordance with equipment manufacturer's written instructions, in compliance with applicable requirements of NFPA 780 and with UL 96A lightning protection standards, to ensure that lightning protection system complies with requirements.

B. Interconnect metals as required by the Underwriters' Laboratories code such as cold water pipe, sewer, etc., with lead coated copper strap type pipe bonding clamps.

C. Conceal down conductors within building construction.

D. Coordinate with roofing work, as necessary to interface the installation of the lightning protection system.

E. Install conductors with direct paths from air terminals to ground connections. Do not use metal casings of structure/equipment as a ground path. Avoid sharp bends and narrow loops.

3.2 TESTING

A. Upon completion of installation of lightning protection system, test resistance-to-ground level. Where tests show resistance-to-ground is over 25 ohms, the Contractor shall take appropriate action to reduce resistance to 25 ohms or less by driving additional ground rods and/or treating soil in the proximity to the ground rod with sodium chloride, calcium chloride, copper sulphate, or magnesium. Then retest to demonstrate compliance with requirements.

END OF SECTION 26 06 01

SECTION 26 07 31
WIRELESS CLOCK SYSTEM

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS & SCOPE

A. Furnish and install a complete new Wireless Clock System with Bell Scheduling System using the Primex XR Time Synchronization system and the OneVue Bell Scheduling system.

B. Furnish and install all system devices, accessories, and material in accordance with these specifications and drawing to provide a complete and operating system.

C. All bids shall be based on the equipment as specified herein. The model designations are that of Prime. The specifying authority must approve any alternate system

D. System shall include the System Devices

1. Transmitter (Master)
2. Satellite Transmitter
3. Analog Clocks

1.2 RELATED SECTIONS

A. Division 26 “Electrical”

1.3 REFERENCES

System devices specified shall meet or exceed the requirements of the following:

A. National Fire Protection Association (NFPA): 1. NFPA 70 - National Electrical Code (NEC).

B. Manufacturer Installation and User Guides.

1.4 DEFINITIONS

A. GPS: Global Positioning System, a worldwide system that employs a constellation of satellites in an integrated network to determine geographic location anywhere in the world, and which employs and transmits Universal Coordinated Time, the world’s most accurate and reliable time.

B. NTP: Network Time Protocol, used for synchronizing the clocks on computer networks and devices from either a public server or a separate server on a private local area network.

C. UTC: Universal Coordinated Time

1.5 SYSTEM DESCRIPTION

A. System shall continually wirelessly synchronize clocks and/or timers, and shall be capable of clock readouts in multiple time zones where desired.

B. System shall operate on a 72MHz frequency. The 72MHz frequency transmitter efficiently sends time synchronization signals through commercial building materials to ensure all devices receive important time updates, even for Daylight Saving Time and after a power outage.

C. The system transmitters can be configured with a variety of power output levels to provide coverage for a single building or an entire campus.

D. The system supports an FCC license for operation of a 72MHz transmitter result in safe and interference free operation for users.

E. System shall provide time data wirelessly from a master time source. This time source will be the clock from a defined NTP server that the system transmitter can access via the customer Local Area Network (LAN). The master time will be synchronized to UTC.

F. Hard wiring for data communication will not be required to the clocks installed for the system.

G. Clocks shall automatically adjust for Daylight Saving Time in locations where DST is observed.

H. Each clock and/or timer and every other component in the system shall use both precise time and synchronized time.

I. Analog Clocks shall be synchronized to within 10 milliseconds 6 times per day when operating clock strikes 2:01 AM, 6:01 AM, 10:01 AM, 2:01 PM, 6:01 PM, and 10:01 PM, and the system shall have an internal oscillator that maintains plus or minus one second per day between synchronization, so that clock accuracy shall not exceed plus or minus 0.2 seconds.

J. The system shall include an internal clock reference so that failure to detect the master time source shall not result in the clocks failing to indicate time. Additionally, system transmitters will have an internal battery backup of up to eight hours in the event of a power failure so that settings and the correct master time will be instantly recalled upon restoration of power.

K. System shall incorporate a “fail-safe” design so that failure of any component shall not cause failure of the system. Upon restoration of power or repair of failed component, the system shall resume normal operation without the need to reset the system or any component thereof.

L. If transmitter stops transmitting valid time signals due to power failure, the clocks will continue to function as accurate quartz clocks until a valid time signal is decoded. If signal transmission is not restored after 48 hours, the second hand will “two-step” as a visual indicator that the signal has been lost. Should the clocks lose both power and signal, the clocks will not function.

M. Clock locations shall be as indicated and clocks shall be fully portable, capable of being relocated at any time.

N. System must operate in accordance with a “Radio Station Authorization”, Form FCC 601 – LM, granted by the Federal Communications Commission (FCC). This license will be issued to and held by the end user.

1.6 REGULATORY REQUIREMENTS

A. Equipment and components furnished shall be of Manufacturer latest model.

B. System shall be installed in compliance with local and state authorities having jurisdiction.

C. The end user will hold a license, known as a “Radio Station Authorization” granted by the FCC. This license grants the end user protected use for wireless transmission at the designated frequency. This license will designate a unique “call sign” for each end user.

D. Transmitter and receiver shall comply with Part 90 of FCC rules as follows: This device may not cause harmful interference. This device must accept interference received, including interference that may cause undesired operation. Transmitter frequency shall be governed by FCC Part 90.35. Transmitter output power shall be governed by FCC Part 90 257 (b).

1.7 SUBMITTALS

A. Product Data: Submit complete catalog data for each system device and components, describing physical characteristics and method of installation.

B. Samples: Submit one specified system device model(s) for approval. Approved sample(s) shall be tagged and shall be installed at location directed.

C. Manufacturer Instructions: Submit complete installation, set-up and maintenance instructions.

D. Floor plans indicating the location of system transmitter(s), approved by manufacturer, will be submitted to Owner prior to installation.

1.8 SUBSTITUTIONS

A. Proposed substitutions, to be considered, shall be manufactured of equivalent materials that meet or exceed specified requirements of this Section.

B. Proposed substitutions shall be identified not less than 10 days prior to bid date.

C. Other systems requiring wiring and/or conduit between master and clocks and/or timers will not be accepted.

D. Other systems using wireless technology in an unlicensed frequency range will not be accepted.

E. Other systems using wireless technology where the license is held by any party other than the end user will not be accepted.

1.9 QUALITY ASSURANCE

A. Permits: Operating license for the transmitter from the FCC.

B. Qualifications: Manufacturer: Company specializing in manufacturing commercial time system products with a minimum of 30 continuous years of documented experience including 10 or more years of experience producing GPS wireless time systems. Manufacturer of wireless and Ethernet connected system with a minimum of seven years record of satisfactory manufacturing and support of systems comparable to basis of specified system design.

C. Installer: Company with documented experience in the installation of commercial time systems.

D. Prior to installation a site survey must be performed to determine proper transmitter placement.

1.10 DELIVERY STORAGE AND HANDLING

A. Deliver all components to the site in the Manufacturer original packaging.

B. Packaging shall contain Manufacturer name and address, product identification number, and other related information.

C. Store equipment in finished building and in unopened packaging until ready for installation.

1.11 PROJECT SITE CONDITIONS

A. Clocks and/or Timers shall not be installed until painting and other finish work in each room is complete.

1.12 SYSTEM START-UP

A. At completion of installation and prior to final acceptance, turn on the equipment; ensure that all equipment is operating properly, and that all system devices and components are functioning.

1.13 WARRANTY

A. Manufacturer will provide a 5-year limited warranty on system transmitters, clocks, digital timers, timer control switches, wireless tone generators, and GPS receivers.

B. All other system components shall have a 1-year limited warranty, including external antennas and components, wireless data receivers, universal power supply (UPS) backups, and bell controller devices.

PART 2 – PRODUCTS

2.1 SECTION INCLUDES

A. The system and equipment is specified as described in this section.

B. All bids shall be based on the equipment as specified herein. The model designations are that of Primex, Inc. The specifying authority must approve an alternate system.

2.2 MANUFACTURER

A. System shall be manufactured by:

Primex, Inc., 965 Wells Street, Lake Geneva, WI 53147 | Phone: (800) 537-0464 | Fax: (262) 248-0061 | Email: info@primexwireless.com | www.primexwireless.com

2.3 SYSTEM OPERATION

A. The system shall perform in the sequence of operation as described.

1. Configure and install system appliance detailed in Manufacturer installation instructions.

2. Configure and install system devices per model specifications detailed in Manufacturer installation instructions.

B. Transmitter Operation

1. When power is first applied to the transmitter, it checks for and displays the software version. It then checks the position of the switches and stores their position in memory. The transmitter looks for the master time source.

C. Master Time Source Operation

1. NTP Time Source: With the transmitter in NTP mode, it connects over the Ethernet to the IP address of the NTP server. This IP address is programmed into the transmitter as part of its configuration. Once the connection to the NTP server is acknowledged, it downloads time data and synchronizes its internal master clock to NTP time. The transmitter then starts to transmit its internal time once every second. The transmitter updates its internal clock in this mode once per hour.

D. Clock and/or Timer Operation

1. After initial setup, the clock and/or timer will shut off the receiver. Six times each day an Analog Clock microprocessor will activate the receiver and starting with the stored channel it will again look

for a valid time signal. Every 10 minutes a Digital Clock/Timer will activate the receiver and starting with the stored channel it will again look for a valid time signal. If necessary, the clocks will resynchronize to the correct time.

2. If an Analog clock has not decoded a valid time signal for a pre-determined number of days, it will go to a step mode. Low battery voltage is a common cause of the clock to not properly decode a time signal. If a clock goes into step mode, replace the batteries first and then determine if the clock synchronizes to master time source before attempting other troubleshooting methods.

2.4 EQUIPMENT

A. The system shall include all equipment as specified.

1. Transmitter Equipment

A. Per specification, supply following model(s).

Model	**Antenna**	**Time Source**
1 Watt Transmitter (49 channel)	Internal	NTP or GPS

2. Transmitter 1 Watt

a. 1-Watt maximum transmission (at transmitter)

b. 72MHz frequency range

c. 49 channels available (pre-programmed prior to shipping)

d. Daylight Saving Time bypass switch

e. Time zone adjustment switch (pre-programmed for transmitter with external antenna prior to shipping)

f. LCD display for time, date, and signal verification

g. Dimensions: 17.0”L x 12.0”W x 1.7”D (43.2cm x 30.5cm x 4.32cm)

h. Power Supply: Input: 120 VAC, 50/60 Hz, 0.6 Amp | Output: 9 VDC, 2.78 Amp (6 ft. cord, 1.83m)

i. Operating Range: 32°- 122°F (0° - 50°C)

j. Transmitter with Internal Antenna

Antenna: 46.0”L (116.8cm)
Weight: 7.75 lbs. (3.5kg)
Internal Antenna Model only: Transmitter shall transmit time continuously to all clocks in the system.

k. Internal clock: Transmitter shall contain an internal clock such that failure to update time from source will not disable the operation of the clocks.

l. Transmitter shall include a surge suppressor/battery backup and a mounting shelf.

m. Transmitter shall have the following switches

(1) Time zone adjustment switches for all time zones in the world. Includes: Eastern, Central, Mountain, Pacific, Alaska, and Hawaii.
(2) 49 channel transmitter - Switch to allow the following configuration: Daylight Saving Time bypass option, 12-hour or 24-hour display, GPS or NTP time source, Local or LAN configuration, UTC+ or UTC-, 30 minute UTC offset option CANADA (for Newfoundland).

n. Transmitter housing shall incorporate a display, which shall include the following:

(1) Time readout
(2) AM and PM indicator if 12-hour time display is set
(3) Day and date readout
(4) Time zone indicator including Standard or Daylight Savings Time
(5) On screen menu to verify diagnostics, errors, time updates, and switch settings, toggled by sequence of push buttons next to display.
(6) Status LEDs: The LED signal indicator consists of three visual LEDs that indicate the status of the transmitter. The green LED indicates one of the three statuses, including (1) solid green: transmitter is transmitting, (2) not illuminated: transmitter has not received an initial time signal after power up and/or reset, and (3) flashing: transmitter is not broadcasting due to standby mode or there is a condition that is causing the transmitter not to broadcast properly. The yellow LED indicates one of the two statuses, including (1) not illuminated: no warning conditions, (2) flashing: transmitter has not received a time update for 48 hours or a 1PPS (one pulse per second) has not been detected within the last 48 hours. The red LED indicates one status, (1) solid red: defined error condition exists.

3. NTP or GPS Time Source

a. 49 channel transmitter will allow for either NTP time input or GPS satellite time input with use of a GPS Receiver unit. Unit shall obtain current UTC time from either satellite via GPS or via NTP through an Ethernet port.

4. Satellite Transmitter

a. Satellite Transmitter shall receive the signal from a Wireless Receiver Switch and transmit the signal to the system devices in its vicinity, which are out of range from the system transmitter.

b. Transmitter shall include a wireless receiver switch, surge suppressor/battery backup, and mounting shelf.

c. A 5-foot (1.52m) RS232 cable connects receiver switch to the satellite transmitter.

d. Antenna mounted on top of the switch housing, 12.5-inch L (31.75cm).

5. Analog Clocks

a. Analog clocks shall be wall mounted.

b. Face shall be white. Hour and minute hands shall be black.

c. Additional colors, finishes, and dial faces are available from Manufacturer.

d. Clock faces can be customized by Manufacturer to display organization name or logo as specified.

e. Clock frames and lenses are of durable thermoplastic.

f. Clocks shall have a tamper proof/theft resistant clock-lock mounting slots.

g. Analog clocks shall be capable of automatically adjusting for Daylight Saving Time. An on-off switch located on the transmitter shall disable this function if desired.

h. Clock shall have either a battery-power or a 120 VAC power supply built into the clock assembly.

i. If power is interrupted, the clock will stop until power resumes. Upon resumption of power, the clock will self-correct to the current time.

j. Battery-operated analog clocks shall have up to a 5-year battery life. Battery life is based on common operating conditions and may very due to installed site conditions.

k. Installer will furnish clock batteries in accordance with Manufacturer instructions.

l. Time shall be automatically updated from the transmitter 6 times per day.

m. If the transmitter stops transmitting valid time signals due to power failure, the clocks will continue to function as accurate quartz clocks until a valid time signal is decoded. If signal transmission is not restored after 96 hours, the second hand will “two -step” as a visual indicator that the signal has been lost. Should the clocks lose both power and signal, the clocks will not function.

n. Analog clock receivers shall be as follows: Receiver sensitivity: >-110 dBm, Receiver power: Dual Alkaline batteries or AC-powered, Antenna type: internal, Antenna gain: -7 dBd

o. SUPPLY MODELS - Traditional Series Analog Clocks

(Power Source) Description
(Battery) 12.5” (31.75cm) Black
(Battery) 16" (40.64cm) Black (Gym and Multi-Purpose Rooms)

6. Accessories

a. **Analog Clock Wire Clock Guard**
Description:
16" Clocks (40.64cm): 18" square x 3"D (45.72cm square x 7.6cm D)

b. 1-Watt Transmitter Rack
18 GA metal
Epoxy coated
18”L x 3“H x 16.5“D (45.7cmL x 7.6cmH x 41.9cmD)

Description
1-Watt Transmitter Rack
Transmitter accessory pack - transmitter Rack and UPS
Event Bell Controller Device

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine conditions with the Installer present for compliance with requirements and other conditions affecting the performance of the system and the system devices.

B. Do not proceed until unsatisfactory conditions have been corrected.

C. Verify that construction is complete in spaces to receive equipment and that rooms are clean and dry.

D. Verify that 120 volt electrical outlet is located within 6 feet (1.83m) of location of transmitter and the outlet is operational and properly grounded.

E. Code Blue and Elapsed Timer: Verify single gang electrical box for switch control is mounted and within 15 feet (4.5m) of elapsed timer. Verify pathway for connecting cable is available and compliant to local building codes.

F. AC-powered devices: Verify that electrical power outlet is near location of clock or timer and the outlet is operational and properly grounded.

3.2 INSTALLATION

A. General: Install system devices in accordance with applicable codes.

B. Install system devices in accordance with Manufacturer written instructions.

C. Provide all system equipment necessary for a complete and operable system.

D. Clearance around all sides of the transmitter to comply with local building codes.

E. If NTP will be used as master time source:

1. Connect CAT6 EIA/TIA standard Ethernet cable from transmitter LAN port to available network drop.

2. Set GPS/LAN DIP switch to NTP.

F. Transmitter (INTENAL Antenna Only)

1. Local transmitter where indicated, a minimum of 2 to 3 feet (0.6 to 1 meter) above the floor, away from large metal objects, such as filing cabinets, lockers, or metal framed walls.

2. Transmitter(s) will be placed at locations indicated within specifications and drawings.

3. Connect antenna to transmitter, using care not to strip threads.

4. Connect power supply to the transmitter.

5. Set the channel number on the display to correspond to the FCC license.

6. Plug power supply into electrical outlet.

G. Analog Clocks

1. Furnish all equipment necessary for a complete and operational system.

2. Perform the following operations with each clock:

a. Configure and set clock to correct time in accordance with manufacturer instructions.
b. Observe clock until valid signals are received and clock adjusts itself to correct time.
c. Install each clock per its model mounting specifications per manufacturer instructions and mounting instructions at the indicated location.

3.3 FIELD INSPECTION

A. Inspection: Make observations to verify that system devices and components are properly labeled.

B. Prior to final acceptance, inspect each system device and component, adjust as required, and replace parts which are found defective.

C. At completion of system device installation and prior to final acceptance, turn on the equipment; ensure that all equipment is operating properly, and that the system software and all system devices and components are functioning.

D. Wire Guards: Secure to wall, using approved theft-resistant fasteners.

3.4 MANUFACTURER SERVICES

A. System software and system device installation and user guides shall be provided.

B. If needed, provide technical assistance as demonstrated in the manufacturer guides, on product start-up and system set-up, to owners or installers representatives via phone, fax, or email.

3.5 CLEANING

A. Prior to final acceptance, clean exposed surfaces of devices, using cleaning methods recommended by Manufacturer.

B. Remove temporary labels from clock faces. Do not remove labels from backs of clocks.

3.6 DEMONSTRATION

A. Provide training to Owner’s representative on setting, adjusting, and configuring device and routine maintenance.

B. Provide training to Owner’s representative on installing the software, adjusting and programming the transmitter, setting and adjusting system devices and routine maintenance.

3.7 PROTECTION

A. Protect finished installation until final acceptance of the project.

3.8 TESTING

A. All devices must be tested at their operational installation location under normal operational conditions to ensure reception of signal.

END OF SECTION 26 07 31

SECTION 26 07 40
NETWORK CABLING SYSTEMS

PART 1 – GENERAL

1.1 GENERAL PROVISIONS

A. Refer to other sections for General Requirements, etc., which shall apply to the work specified in this section. The following specifications for network cabling are based on the Communications Cabling Construction Standards generated and implemented for all State of Delaware schools and was developed by the State of Delaware, Department of Technology and Information (DTI).

B. In general, the network sub-contractor will furnish, install and test all cabling and terminations herein specified for distribution of the station/field wiring.

C. The Electrical Contractor shall utilize one of the approved State of Delaware installing contractors as indicated on the State list. The contractors are approved for furnishing, installation and testing of the entire network. The contractor must be certified and authorized for the installation of premises cabling system and shall assume responsibility for certifying the installation and providing a warranty for a period of no less than 25 years.

1.2 SCOPE

A. Perform all work necessary and/or required and furnish all materials and equipment for a complete network cabling system as described herein.

B. The data communications system shall be installed, consisting of the following components:

1. Optical fiber network backbone
2. Twisted pair copper work station cabling
3. Work station outlets
4. Cable support system

C. The MDF shall be connected to each IDF via a single, twelve- strand, composite, single-mode optical fiber cable. Each classroom and office data outlet shall be connected to its respective IDF via a four twisted-pair, Cat 6 data cables.

D. The hardware shall include equipment racks, patch panels, station outlets, Cat 6 data cables, optical fiber cables, all required terminations required copper/fiber patch cablesand labeling to provide for a complete data distribution system.

E. In general, one or more data outlets shall be provided for each computer station in classrooms, library and in offices where indicated on floor plans. The teacher's station outlet located in each classroom shall have data/Voip, and audio cable connections.

1.3 SUBMITTALS

A. Furnish shop drawings and descriptive data, complete with project designations for the following:

1. Equipment Racks
2. Patch Panels
3. Station Outlets
4. Cat 6 Data/Voip Cables
5. Optical Fiber Cables – OS2 Single Mode
6. Cable Support System
7. Wire Management Materials

8. Video cables as indicated in schedule on drawing.

1.4 DOCUMENTATION

A. The contractor shall provide a complete system walk-through, by suitably qualified personnel, to personnel designated by the owner, to instruct them on the installed system's location, operation and maintenance.

B. Prior to assembly and installation, the contractor shall submit the following, on reproducible media, to the engineer for review

1. Final schematic drawings of all circuitry, including outlet conductor assignments and all component callouts.

2. Equipment modifications drawings.

3. Front mechanical drawings of each equipment rack.

C. At the completion of the installation, the contractor shall provide one (1) copy of each of the following:

1. Equipment manufacturer's operation and maintenance manuals for each piece of equipment.

2. "As-built" drawings for all equipment installed.

3. "As-built" drawings on contract blueprints of all wire, cable and conduit placement throughout the building.

4. "From-To" listing of in-building wiring and outlets, listing color coding scheme and conductor assignments.

PART 2 – PRODUCTS

2.1 DELAWARE STATE STANDARDS

A. Authority: Title 29, Chapter 90C provides broad statutory authority to the Department of Technology and Information to implement statewide and interagency technology solutions, policy, standards and guidelines for the State of Delaware's technology infrastructure. "Technology" means computing and telecommunications systems, their supporting infrastructure and interconnectivity used to acquire, transport, process, analyze, store and disseminate information or data electronically. The term "technology" includes systems and equipment associated with e- government and Internet initiatives.

B. Applicability: Applies to all State of Delaware communications and computing resources. DTI is an Executive Branch Agency and has no authority over the customers in Legislative and Judicial Branches, as well as school Districts, and other Federal and Local Government entities that use these resources. However, all users, including these entities, must agree to abide by all policies, standards promulgated by DTI as a condition of funding, access and continued use of these resources.

C. Purpose: Cable configuration and installation is critical to providing connectivity in State buildings. This standard provides guidance for the design and installation of cabling. This standard provides guidance and requirements for data, voice, and CATV structured cabling systems and support infrastructure in all State owned and leased facilities and buildings.

D. Scope

1. Areas Covered: This standard covers the best practices and installation requirements for Voice, Data, CATV cabling and support structures including conduits and raceways, Voice and Data rooms and closets.

2. Environments: This standard applies to all State owned and leased building and office spaces. It is concerned with all Data, Voice, and CATV cabling projects, whether they are for new construction or revisions additions and upgrades to existing systems.

E. Process

1. Adoption: These standards have been adopted by the Department of Technology and Information (DTI) through the Technology and Architecture Standards committee (TASC) and are applicable to all information Technology use throughout the State of Delaware.

2. Revision: Technology is constantly evolving; therefore, the standards will need to be regularly reviewed. It is the intent of the TASC to review each standard annually. The TASC is open to suggestions and comments from knowledgeable individuals within the State, although we ask that they be channeled through your Information Resource Manager (IRM).

3. Contractors: Contractors or other third parties are required to comply with these standards when proposing technology solutions to DTI or other State entities. Failure to do so could result in rejection by the Delaware Technology Investment Council. For further guidance, or to seek review of a component that is not rated below, contact the TASC at dti_tasc@state.de.us.

4. Implementation responsibility: DTI and/or the organization's technical staff will implement these best practices during the course of normal business activities, including business case review, architectural review, project execution and the design, development, or support of systems.

5. Enforcement: DTI will enforce these best practices during the course of normal business activities, including business case and architectural review of proposed projects and during the design, development, or support of systems. These best practices may also be enforced by others during the course of their normal business activities, including audits and design reviews.

6. Contact us: Any questions or comments should be directed to dti_tasc@state.de.us.

F. Executive Summary

1. Because of ever-advancing Industry Standards and new Alliances between Cable and Hardware Manufactures and Vendors, this document seeks to enhance and clarify the State of Delaware's wiring and cabling standards and specifications for Structured Cabling Systems. Approved Contractors under State of Delaware Contract # 05-441-TL are required to adhere to these specifications and standards.

2. The structured cabling system will support Voice, Data, and imaging applications within State-owned and - leased office facilities. This document describes the Structured Cabling System requirements to be met in the proposals for Communications cabling by Vendors and Contractors. These requirements encompass all materials, design, engineering, installation, supervision, and training services for a Structured Cabling System.

3. The following are examples of the Structured Cabling Systems that can be bid for new construction and whole building renovations, in which case all building structured cabling wiring is replaced. The choice of a Structured Cabling System is not limited to the Vendors or Manufactures listed below. The Channel Solutions shall be bid when possible. If a Link solution is bid the State Contact, PM, or DTI (Department of Technology and Information) must authorize the installation.

4. In new construction projects, the default cabling infrastructure shall be Category 6 unless specified otherwise. Where building renovations and additions do not require the removal of the existing structured cabling system, the existing cabling in conjunction with new cabling should maintain the system warranties. If the existing structured cabling system is not Category 5e or better, it must be upgraded to CAT6 or better with a matching patch panel.

- Hubbell Premise Wiring
- Ortronics
- Panduit
- Systimax

5. Terms and Conditions of Bids/quotes

   a. An approved Contractors bid submittal should be based on the materials, systems, equipment, and Standards described in this document and in the bid response format of the attached example. Refer to Appendix G. All bids must be submitted in accordance with the specifications and information contained herein, as well as with any addenda, if required.

   b. The bid package shall be accompanied by a presale warranty commitment, binding the Installation Contractor and Manufacturer to the customer-selected extended warranty package as described in State Contract # 05-441-TL page 21 section 3) paragraph b).

   c. At any point in time, should you require clarification or have any questions pertaining to the content of this document, please call The State of Delaware Department of Technology and Information (DTI). 302-739-9500.

G. Objective

1. This document has been developed as a source of information to assist in the design, implementation and maintenance of Voice, Data and Broad Band communications systems. It contains standards and specifications which guide users through structured cabling system design, planning, and installation.

2. To maximize the usefulness of this document, access to the various TIA/EIA (Telecommunications Industry Association/Electronic Industries Alliance), IEEE (Institute of Electrical and Electronics Engineers), BICSI, (Building Industry Consulting Service International), NEC (National Electrical Code), NFPA (National Fire Protection Association) Communications Standards, and implementation and installation Manuals for further reference is required. This document assumes that users have communications knowledge and training in all aspects of design, implementation, installation, and testing of a Voice/Data communications system.

3. This document does not address safety issues associated with use. It is the individual's responsibility to use established and appropriate safety and health practices and to determine the applicability of all regulations.

H. Credits

1. Communications Cabling Construction

   a. Developed by:
      State of Delaware
      Department of Technology & Information
      801 Silver Lake Blvd.
      Dover, DE 19904

2. The content of this document is drawn from experience, as well as other documents and manuals, including the following:

   - NEC 2011/2013 Code book
   - NFPA-70 Publications
   - TIA/EIA Communications Building Wiring Standards
   - IEEE Publications & Standards
   - BICSI Communications Distribution Design and Installation Publications

- MOTOROLA R56 Standards and Guideline for Communications
- Various Manufactures Publications and Requirements

I. Introduction

1. Any Structured Universal Cabling System installed for the Agencies of the State of Delaware is designed to meet known and anticipated technology needs within the State. An advanced building cabling system provides for more than communication services; it provides an infrastructure for an institution's entire communications network. Instead of being a basic utility, it is as important as the high-tech systems that transmit signals over it and is an integral component of the State's overall information network.

2. These designs provide a universal and flexible cabling system for workstations, conference rooms, and laboratories. Today's cabling system must be multi- functional and provide service for telephones, computers, fax machines, LANs, WANs, broad band fiber optic and coaxial systems (CATV, SATV, CCTV.), Data Centers, computer-aided design workstations, Audio Video systems (AV), and other technologies. For a cabling system to be capable of meeting today's technology and institutional demands, it must have high bandwidth capacity and transmission speed while being extremely flexible.

3. This wiring architecture incorporates the applicable ANSI/EIA/TIA standards, BICSI guidelines and the latest technologies. This cabling distribution plan can integrate all types of systems from a variety of vendors. The design uses a subsystem approach, which allows for changes in the system without affecting other parts of the system. The Main Distribution Frame (MDF) and Intermediate Distribution Frame (IDF) Room equipment racks are designed to allow for growth, and the cable routing is accomplished through the provision of cable trays, conduits, sleeves, raceways, and cable hangers where required. Ease of administration and recordkeeping for moves and changes is readily apparent, as is the flexibility that a structured cabling system provides.

4. The wiring medium for the Communications Cable Network consists of Category 6+– 6a 24AWG Unshielded Twisted Pair (UTP) for station cabling and multi pair twisted copper for backbone cabling to support low- speed voice or Data, Category 6+ or 6a for high speed LAN technologies, and 50/125 micron multi-mode fiber optic cable and 50/125 micron multi-mode as well as single mode 8.3/125 micron for even higher bandwidth requirements. The unshielded twisted pair (UTP) Category 6+ or 6a LAN cables can support Data transmission rates of 100, 250 and 500 up to 1000Mb/Sec respectively according to EIA/TIA Standards and manufacturers' specifications.

5. These leading edge components, combined with the open wiring architecture, provide the technology, flexibility, and modularity that allow the system to grow and change to meet changing needs.

6. The central distribution location of the system is the Fiber Optic, coaxial and Copper Main Distribution Frame (MDF) located within the centrally located MDF/IDF Room of each building. Various fiber optic, coaxial and copper riser cables terminate on the MDF and extend to the Communications Rooms/Closets (IDFs) located throughout the buildings. Each building typically has one MDF/IDF Room and a varying number of IDF rooms/closets dictated by the horizontal station cabling limitation of 100 meters for high performance cable. The distance from the information outlet to the termination within the IDF is limited to 90 meters (the permanent link). The IDF room/closet houses the Intermediate Distribution Frame (IDF), Copper and Fiber Optic IDF Patch Panels, Local Area Network (LAN) equipment, and other electronics. Both the riser cables and the horizontal station cables feeding the floor's workstations information outlets terminate in the IDF on Data patch panels, Voice 110 hardware, and Fiber Optic Patch Panels. These termination points act as the cross-connect point between the MDF and the floor that is being served. Large floors are divided into zones, via an imaginary line (within 90 meters of the respective IDF), with each zone being served by its respective IDF room/closet. (See figure 1)

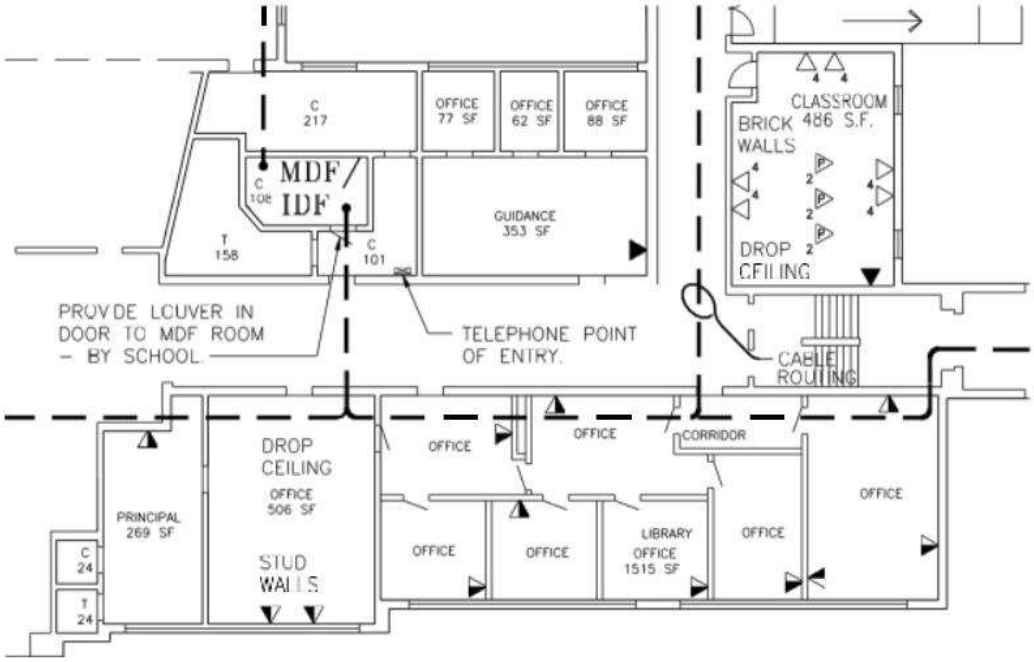
7. Each work area and workstation is served by an information outlet, which provides the jacks for plugging in telephones, computers, broad band coaxial systems, fax machines, modems, and other

devices at the desktop. The information outlets are served by varying sets of cables consisting of fiber optic and copper technologies, which originate in the IDF Room. IDF outlets are typically displayed as varying types of triangles (shaded, half-shaded, etc.) on blueprints. (See figure 2)

8. A subsystem architectural approach, using the latest technologies, provides a comfortable level of assurance that the system will support new applications and industry standards as they emerge.

FIGURE 1

FIGURE 2



J. Procedures

1. Designing a cable system for an institution involves various organizations and individuals and requires a great deal of coordination. Once an institution is designated for wiring, AutoCAD drawings of the floor plans need to be acquired. AutoCAD is a type of computer aided drafting (CAD) format. These files are plotted and converted to blueprints that serve as the working drawings for site surveys and engineering purposes. Based on interviews with the agency's staff and Technical Coordinator will draw triangles on the drawing displaying the locations that information outlets are to be located. Also, tentative locations for the Communications/Data rooms/closets will be marked on the drawings. This information will be approved by the institution's officials and sent to the engineering team.

2. The engineers will survey the building—floor plans for new construction—and evaluate the communications rooms/closets, plan cable routing, and review the information outlet locations. The necessary adjustments will be made during the site survey, and the engineer will leave the site with the proper approvals from the agency's management if there are major changes such as room relocations.

3. The engineering team will then design the cable system for the building. The end product will be submitted to the agency's Technical Coordinator for comment and/or revision. If no adjustments are necessary, the blueprints are issued to the contractor for construction.

K. Horizontal Distribution System

The horizontal structured cable plant is the portion of the communications wiring system that extends from the information outlet to the Communications/Data room/closet.

1. Horizontal Distribution System General

a. The horizontal distribution system includes the:

- Information outlet at the workstation
- Cables connecting the workstation to the Communications/Data room/closet
- Intermediate routing and distribution systems

b. The horizontal distribution system should be configured in a star topology. All communications outlets within a work area should be connected to a single Communications/Data room/closet, as defined by the zone concept.

c. This infrastructure must serve all of the Communications requirements of the agency or owner.

d. Communications applications served by the horizontal system can include:

- Voice (e.g., telephones)
- Data (e.g., terminal connectivity, modems, etc.)
- Local area networks (e.g. Ethernet)
- Audio & Video (e.g., CATV, video conferencing and security monitoring)
- Graphics & Imaging

e. When designing a horizontal distribution system, include capacity to satisfy long- term requirements as well as initial plans. Ensure that the distribution system has the flexibility to accommodate necessary moves, additions, changes, and system growth.

f. After construction, the horizontal distribution system is typically difficult to access. Therefore the time, effort, coordination, and skills required for changes can be extremely costly. In addition, access to the horizontal distribution system frequently causes disruption to the user community.

g. All Horizontal Workstation Communications and broad band coaxial system cabling will be home- run" from the information outlet location to the termination point within the corresponding IDF or MDF/IDF room.

h. Horizontal cable paths will be in a "streets and avenues" manner, typically following main walkways.

i. Horizontal cables are to be fastened onto hangers five feet apart with all cables bundled with tie wraps, and are to have a small amount of slack visible.

j. Cables must be supported by its own support system and not rest on any structures or the hung ceiling. Cables are not to be fastened to ducts, pipes, conduits, or any other existing structures. Cable bundles should be secured to the slab overhead to avoid any conflict with or EMI from flexible electrical conduits, transformers, motors, etc. (Follow the TIA-EIA 569-D.2 Pathways requirements)

k. Some cabling shall run to workstation and other outlets through cavities in the dry wall and openings in sheet metal or wooden studs within the dry wall construction. The sheet metal studs will not have gaskets for this purpose, so it is the Contractor's responsibility to exercise extreme care in snaking cable through these areas, so as to avoid damage to the cable jacketing.

l. The building's horizontal wiring plan is to be installed on all floors from the information outlet to the termination point within the associated IDF Room.

m. Horizontal cable will be installed onto “J” hooks (similar to B-Line BCH series) or equivalent in the ceiling or tops of walls near ceiling. Cables are to be fastened to “J” hooks or equivalent every 5 feet. The cable contractor is to provide and furnish the “J” hooks.

n. All station cable (horizontal) and tie cables that run from relay racks to the wall- mounted frames are to be plenum-rated.

2. Horizontal Communications Cable Specification

a. For each type of information outlet indicated on the attached drawings, the contractor shall furnish all of the following equipment, install it in the correct configuration, and test it.

b. All cabling, outlets, and termination patch panels used for the Category 6 data system must be provided by a single manufacturer and shall be certified as part of the 25 year minimum warranty- Where the installer chooses to use one (1) manufacturer for cabling and a different manufacturer for the outlets and termination patch panels for the Category 6 data system, the two (2) manufacturers must prove to have compliant interconnecting hardware and shall be certified as part of the 25 year minimum warranty.

c. All Category 6 UTP & Fiber cabling is to be handled and terminated in accordance with the Manufacturer’s Premises Communications Application and Installation Guide.

d. In addition to the above manufacturer’s standards, all applicable ANSI/TIA/EIA-568-C Category 6 and Fiber Optic Cable standards are to be strictly adhered to.

e. The fiber optic cable is to be terminated on both ends with an LC type connector on the patch panels.

f. The contractor is to use Plenum cable for all station 4-pair copper, and 12-strand fiber cabling.

g. Plan routes to ensure that the proposed route on the plans falls within the EIA/TIA distance limitations (90 meters after termination) for horizontal cabling.

h. Cables serving information outlets that cannot be routed down wall cavities will be enclosed in latching surface-mount raceways, anchored (not with adhesives) to walls. Contractor will provide all raceway fittings to allow for level and plumb routes from ceiling to information outlet. Proper fill ratios must be observed. Contractor may reference the manufacturer's catalogs or specifications for correct fittings and fill ratios. Contractor must use all accessory fittings required in order to build a neat and functional installation. This same method will apply to routing horizontal cables to workstation outlets where ceilings are not accessible.

i. The IDF Room side of the Category 6a four-pair cables serving a standard outlet will be punched down on individual 110 (Category 6) modular patch panels, 568B wired. The patch panels will be mounted in the relay racks within the IDF rooms.

j. The contractor is to install a 2U wire management panel between all patch panels and above the first panel as well as one below the last panel.

k. In locations that have wall-mounted racks, the rack should be hinged to swing out to access the back of patch panels with associated cable management.

l. Contractor is to label both the front and the rear of the patch panels. The terminations are to follow this sequence: Workstation 001A, 001B, 002A, 002B. It is acceptable to change numbering for floor or closet designation.

3. Zones

a. A zone is a contiguous area in which all horizontal wiring is homed to a single communications closet within 90 meters from the IDF.

b. To maintain an orderly, understandable wiring system, it is imperative that the horizontal distribution system be structured in zones.

c. Within a zone, all communications wiring is run to a single communications closet.

d. Other zones use different Communications/Data rooms/closets. Cross-zone horizontal wiring is prohibited. Connections between zones are provided via the vertical distribution system.

L. Communications/Data Rooms/Closets (General)

1. The Communications/Data room/closet is a concentration point for communications and LAN services. In this room, premise wiring and cabling are terminated and cross-connected. In addition, active networking devices such as switches are placed here. Communications/Data rooms/closets provide a safe area for housing distribution cabling, premise equipment, and termination fields. These rooms/closets are a focal point for communications services.

2. In addition to supporting in-house connectivity, the MDF Communications/Data room/closet often provides a termination point for the local telephone company. The entrance facility, or demarcation point (de-mark), is the location where outside communications services, such as copper telephone lines, fiber optic Data circuits, and CATV, are delivered to the building. Typically, distribution of communications services within the building originates at this point and is the responsibility of the owner.

3. Special considerations must be given when providing the building entrance pathways for the copper, fiber optic, and coaxial cables that service providers will install in to the building de-mark. It is the owner's responsibility to provide this pathway into the building. Contact DTI for standards and specifications for building entrances.

4. The following section details the basic requirements for a Communications/Data room/closet. It may be used to assist in:

   - Designing new Communications/Data rooms/closets
   - Assessing and refining existing Communications/Data rooms/closets to support evolving communications requirements.

5. Design Guidelines: The suggested building practices put forth in this section are recommendations and are subject to field conditions and budget constraints. Local building and electrical codes, practices and requirements may supersede the guidelines presented in this section.

   a. Sizing of Communications/Data rooms/closets

      - The Communications/Data room/closet must have enough space to support required communications systems, including projected growth.
      - The existing system is likely to be replaced in the future
      - A new system may, require more (or less) space
      - The existing system and a new system may need to coexist during a cut-over

   b. Location of Communications/Data rooms/closets

      - Communications/Data rooms/closets should be situated so as to minimize the length and the quantity of cable runs needed for the distribution systems.
      - The maximum horizontal distribution cable distance must be less than 90 meters (295 ft.), independent of media type. This distance represents the cable length from the mechanical termination of the media in the Communications/Data room/closet to the outlet in the work area. This is known as the permanent link.
      - Vertical (backbone) distribution system distance limitations vary and are dependent upon media, topology, and facility issues.

   c. Unacceptable locations for Communications/Data rooms/closets:

      - Anywhere water vapor exists, such as boiler rooms, washrooms, or janitor's closets.
      - Spaces with corrosives, explosives, and combustibles, including acid, ammonia, chlorine, oxygen, and petroleum vapors.
      - Spaces containing steam pipes, drains, or clean-outs.
      - Areas with high traffic volumes (for security reasons, as well as to minimize the risk of inadvertent damage) unless separately enclosed.
      - Areas of high electromagnetic interference (EMI) or radio frequency interference (RFI). Both adversely affect system performance and reliability.

6. General Room Requirements

   a. Electrical

      - All active Communications, Data and Video systems have specific electrical power requirements. Plan electrical service to ensure smooth installation, reliable service, and compliance with manufacturers' warranties. Be sure to consider equipment manufacturer's specifications, National Electric Code (NEC) requirements, State and local codes, ordinances, and requirements.

      - Electrical devices capable of causing line transients, such as fans, pencil sharpeners, radios, calculators, and lights, must be separated electrically from the Communications equipment. To accomplish this, all Communications and Data equipment requires separate electrically isolated ground circuits and/or building grounding. The outlets on these circuits should be labeled and/or color coded. Frequently, orange-colored wall outlets are used to identify power

sources used for computing and communications equipment. Utility outlets are also needed in the Communications/Data room/closet for tools, test sets, and other equipment.

- Each Communications/Data room/closet shall have one 110V, 15 Amp electrical convenience outlet and one 110V, 20 Amp dedicated-circuit electrical outlet for the electronic equipment. This is a minimum requirement based on the typical current draw of the networking equipment to be placed. The 110V 20 Amp dedicated circuit isolated ground electrical outlet(s) should be mounted in convenient location to facilitate the use of the shortest equipment power cords. The recommended location is at the top of the rack or on the ladder tray.

- All electrical isolated ground outlets serving Communications and Data equipment must be attached to non-switched circuits to prevent inadvertent equipment shutdown. It is also recommended that they be on a UPS and/or generator if available.

b. Grounding

- Most Communications and Data equipment requires bounding and grounding of equipment cabinets. Do not use plumbing or conduit (EMT) fixtures as a ground source. Grounding shall meet the NEC and EIA/TIA requirements and practices except where other authorities or codes impose more stringent requirements or practices. (Refer to NEC Chapter 2 article 250 and Chapter 8 Communications Systems, TIA/EIA Standard J-STD-607-D and Motorola R56 Standards and Guideline for Communication site).

- In addition to protecting personnel and equipment from hazardous voltages, the grounding system may reduce the effect of electromagnetic interference (EMI) throughout the structured cable plant. Improper grounding can result in induced currents that disrupt Communications circuits.

- Ensure that the installation conforms with applicable regulations and practices

- Ensure that each Communications/Data room/closet has an appropriate ground buss bar

- Ensure that grounding is available for cross-connect frames, patch panel racks, Telephone and Data equipment, as well as testing and maintenance equipment

c. Space

- A distance of three feet is the preferred clearance from the front, back, and side of a relay rack.

- If there are space constraints, it is acceptable to provide a minimum of two feet of clearance on one rack side for access and a minimum of two feet of front and back clearance for cross-connect fields, patch panels, etc. If possible, locate sleeves, cores, slots, and/or conduits together in one area to maximize usable wall space.

d. Rooms/Closets Sizing

- Determine the number of relay racks required for the termination of patch panels and electronic equipment. Assume that free-standing relay racks will be installed and provide three feet of space on all sides of each.

- Determine the amount of wall space that will be required for the installation of termination equipment. A minimum of four feet should be used as a criterion.

- Determine if the plywood backboard will be furred-out. This equals approximately 4” of space taken from the room.

- Take into account the door swing if the door opens into the room. Ideally the door should open out from the room.

- Determine how much space any sleeves, conduits, or other equipment require.

- Determine the size of the room by constructing a diagram, to sale, of all of these components, taking into account all the walkways and door swings.

- If a very small number of information outlets are being installed, the minimum size a closet can be is 4’ wide and 3’ deep. This assumes a 4’ X 8’X 3/4” plywood backboard, one wall-mounted relay rack that has a fiber optic patch panel, copper patch panels, coax patch panel, LAN hubs and ground buss bar. It is recommended to install plywood on all walls, from the floor to the ceiling.

e. Structural Walls

- Extend from the floor to the deck above (fire wall)

- Be securely fastened to the floor and the deck above

- Conform to national and local construction guidelines

f. Wall Linings

- Each Communications/Data room/closet will contain a minimum of one furred-out or flush sheet of plywood (4’ X 8’) mounted on the wall.

- It is recommended to install plywood floor to ceiling on all walls.

- Securely fasten the plywood to wall framing members to ensure that it can support any attached equipment.

- The plywood is to be 3/4”, A/C grade, and fire-retardant.

- All plywood backboards are to be mounted smooth side out and painted white at time of installation, prior to installation of equipment onto the plywood.

g. Floor Finish

- Keep dust to a minimum in Communications/Data rooms/closets.

- Anti-static Asphalt Tile, Linoleum Tile, or Sealed Concrete is acceptable floor finishes.

h. Ceilings and Doors

- Dropped ceiling height should be at least nine feet from the finished floor to provide adequate space for equipment cabinets and suspended cable trays. Some equipment may require additional height, depending on the manufacturer's specifications. Avoid installing false ceilings in small closets.

- Overhead ceiling vents should be centrally located to maximize air distribution and maintenance access. Avoid placing overhead ceiling vents directly over suspended racks and equipment cabinets.

- All ceiling vents should have diffusers (vent manifolds) securely installed.
- Design doorways with minimum measurements of 36 inches wide. Hinge the doors to open outward.
- All Communications/Data rooms/closets should have door locks and a minimum number of windows, if any. Closets should be kept locked. Provide keys to select personnel who are on-site continuously.

i. Lighting

- Within ceilings, position light fixtures at least eight feet above the finished floor.
- Indirect (reflected) lighting is not recommended.
- If possible, minimize heat and glare by using fluorescent light fixtures with protective covers instead of incandescent fixtures.
- Do not place light fixtures where the light may be blocked or filtered.
- Typically, light fixtures should not be directly above or within 12 inches of cabling, equipment cabinets, termination frames or other free-standing equipment.
- Install light fixtures on power circuits separate from those used for communications equipment.

j. Communication/Data Room/Closet Environment

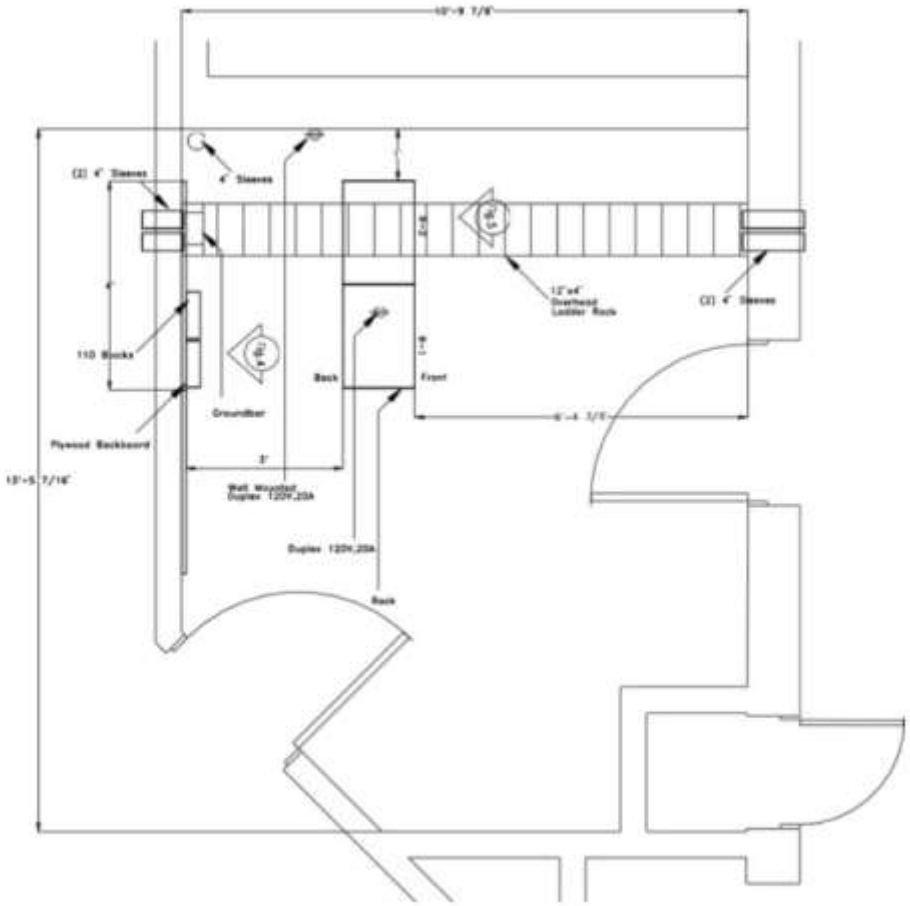
- Manufacturers of most hardware recommend a room environment consisting of a temperature between 72–75° Fahrenheit and a 45–50% humidity level.
- It is recommended that temperature swings do not exceed 10° and humidity remain within a ±5% range.

7. MDF Requirements

a. An MDF Room is a specialized communications closet that may house major communications systems, such as a communications processor, switch and routing equipment. The MDF Room is generally considered to be distinct from an IDF Room because of the complexity of the equipment it contains.

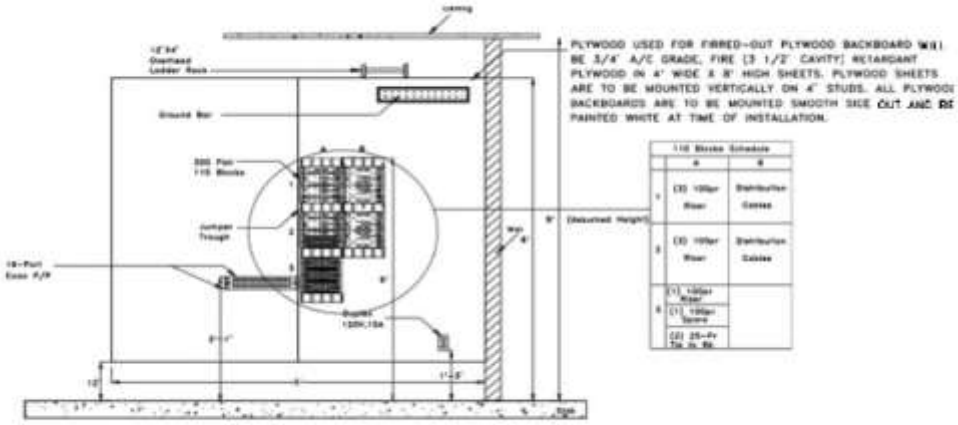
b. A typical Main Distribution Frame (MDF) Room is composed of a wall-mounted plywood backboard and relay racks designed for mounting termination equipment and electronics (see Figure 3). Most MDFs within the building cabling system also serve as an IDF. This is accomplished by providing separate relay racks for each and delineating the wall-mounted frame's 110 blocks for Station cabling (see Figure 4 and Figure 5).

FIGURE 3

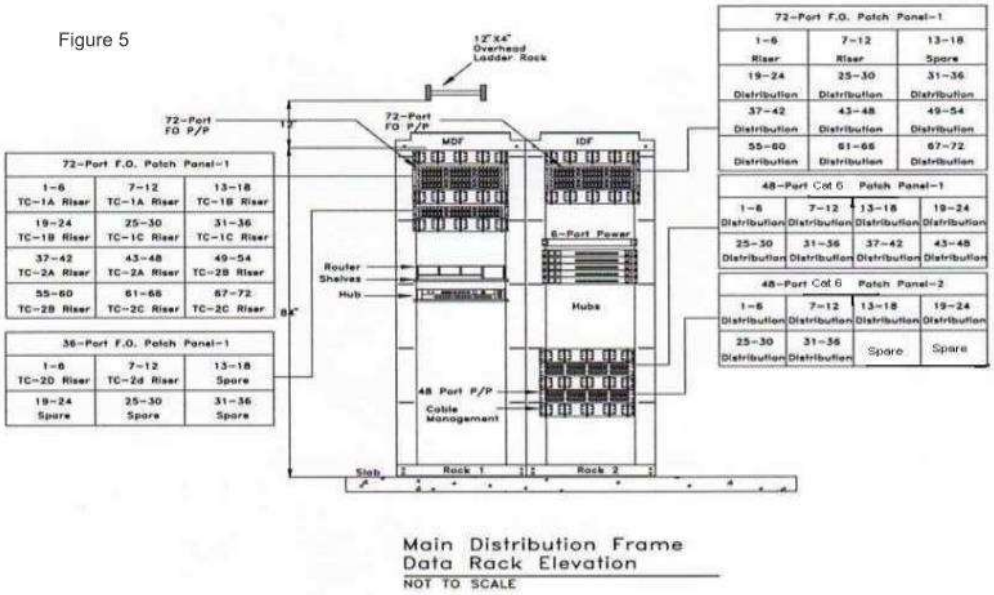


Main Distribution Frame Room Layout
NOT TO SCALE

FIGURE 4



Main Distribution Frame Voice Elevation
NOT TO SCALE



c. MDF/IDF Room Equipment Enclosures

- Any MDF/IDF Rooms located in rooms that are shared with space used for any other purpose should have wire mesh cages or sheetrock walls around the Communications equipment, or the equipment should be installed in a lockable cabinet.

d. Environment

- Environmental control equipment must function properly at all times. If the building system cannot ensure continuous operation on weekends and holidays, provision of stand-alone control units for the MDF/room and IDF room/closet is necessary.

- Within the MDF room and IDF room/closet, temperature should not vary by more than 5°F, and humidity must not vary by more than 10%. Measure temperature and humidity five feet above the finished floor in the center of the communications room/closet.

e. Local Exchange Carrier (LEC)

- Placement of Communications equipment may be influenced by vendors and service providers. For instance, the LEC (local phone company) may decide to terminate the Central Office (CO) service directly into the equipment space provided or request termination space other than that offered by the customer. If they request termination at a point other than that requested by the customer, the LEC should provide reasonable explanation.

- The LEC, CATV, and most service providers will require a conduit entrance in to the building to provide their service. The minimum requirements are two (2) four- inch conduits for the LEC and one (1) four-inch conduit for each other service provider, unless they specify otherwise in writing.

- It is critical that the high speed Data line, TLS – Canoga Perkins and Fiber Optics be located in the MDF room. This will ensure security and simplify troubleshooting.

- The LEC may also need space for distribution systems terminations (either horizontal or vertical) and patch cable terminations.

f. Other Equipment Vendors

- As with the local phone company (LEC), it is vital to consult with all Communications equipment manufacturers for their specific space and operational requirements, such as the telephone system and Data LAN/WAN equipment provider.

g. Relay Racks

- Each MDF will contain a minimum of one 19”W X 7’H Relay Rack onto which the fiber optic/copper patch panels and Data electronics are mounted.
- The relay racks should have a minimum of 42 rack units of mounting space on standard 19” wide rails.
- In some cases the relay racks are wall-mounted and in others they are free-standing two- or four-post racks. It must be determined which type of rack is required, based on field conditions, equipment manufacturer's requirements, and space allocated.
- All racks are to be grounded and bolted to each other as well as to the slab or wall.
- The rack should have vertical and horizontal cable management to accommodate routing of patch cords.
- There should be a minimum distance of 48” to be maintained from three sides of the rack.
- The relay rack specifications and associated components should meet the requirements of the equipment that will be installed in it.
- It should be at a minimum 84” tall with 6” rails, with 19” equipment mounting space and vertical and horizontal wire management.
- Manufactured by Hubbell of Eaton/B-Line, Panduit or approved equivalent

h. Wall-mounted Relay Racks

- The rack is to be securely fastened to the wall behind it and attached to the ladder rack above.
- The rack should be sized to accommodate the equipment to be installed in it, with vertical and horizontal jumper management.
- Manufactured by Hubbell of Eaton/B-Line, Panduit or approved equivalent

i. Communications Cabinets

- All communications cabinets are to be grounded to the grounding and bounding system and bolted to each other and to the slab.
- Each communications cabinet is to be installed with its side to an adjacent wall. Three feet of clearance around the cabinet is recommended and the cabinets must have front and rear.

j. Data Equipment Cabinets

- Data equipment cabinets should conform to the State Data Center Standard as follows:

Cabinet size	30”Wx44.30’Dx79.’H
Rack units	42 rack units for equipment mounting
Mounting rails	Two pair 19" adjustable depth universal mounting
Mesh steel doors	Single front and split rear with locking handles
Vertical cable management	Trough, rings or VeLCro tie downs or combination of, mountable left or right side
PDU mounting	Space to mount two horizontal PDU closest to equipment mountable top or bottom, together or separate
PDU Metering	Managed or Metered PDU’s to display Amperage, Voltage
Side panels	Removable, solid, both sides
Top	Solid with cabling access opening capabilities
Bottom if required	Solid with cabling access opening capabilities

- Cabinet should have grounding, bounding and anti-tip capabilities that can be added when required.

- Approved cabinet Manufacturer: Eaton Wrightline RS Series or approved equal

k. Cable Trays

- Between the relay rack and the wall-mounted frame, a 12” cable tray (center-rail systems are not permitted), with a 4" load depth and 6" rung spacing is to be installed suspended from a ceiling support structure, mounted to the relay rack and the wall.

- Do not attach any cable tray to a suspended ceiling grid.

- An open wire basket cable tray system is acceptable for cable support.

- Approved manufacturer: Cooper B-Line part # FT4X12X10 or approved equal

l. MDF Room Electrical Requirements

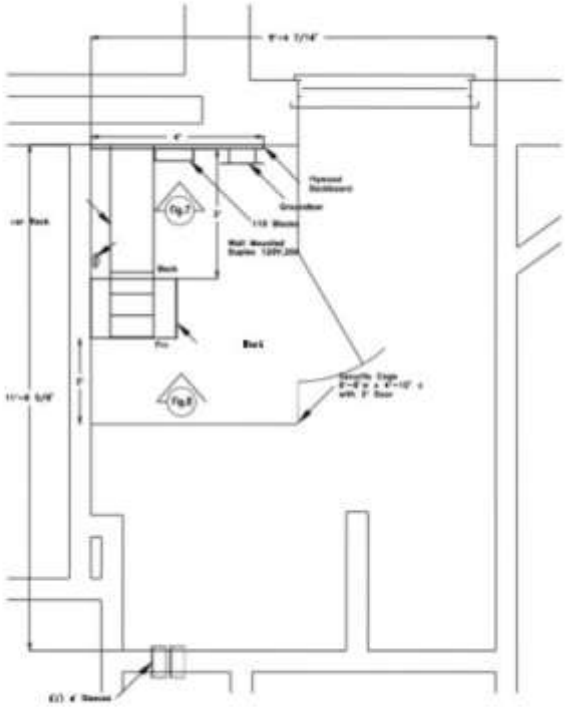
- Each room shall have a minimum of one duplex dedicated 20 Amp isolated ground circuit and one shared 20 Amp circuit.

- Larger equipment loads may require additional circuits.

8. IDF Room Requirements

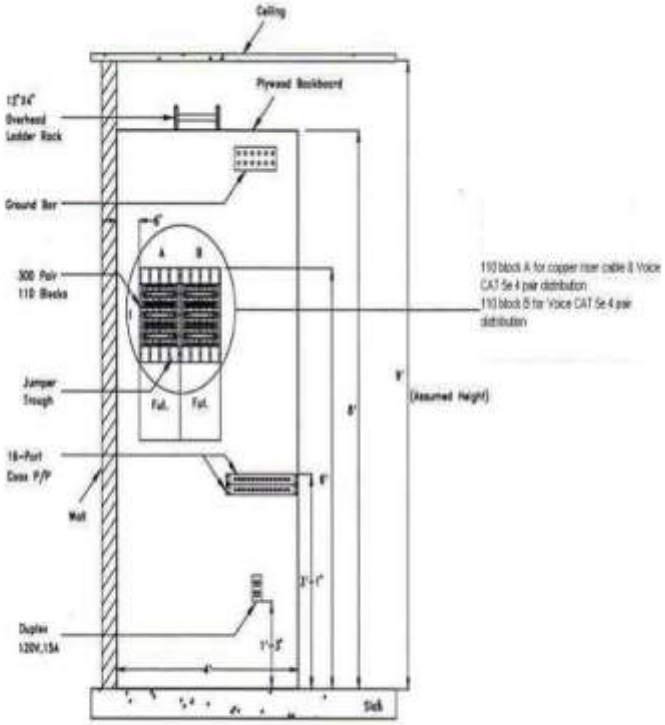
a. Each IDF Rooms within a building supports all connections in single, contiguous area (zones). Cross-zone wiring is not to be installed from user workstations. Connections between zones are made through backbone wiring systems, which link the IDF Rooms to the MDF. A typical Intermediate Distribution Frame (IDF) Room is composed of a wall-mounted plywood backboard and relay racks designed for mounting termination equipment and electronics.

FIGURE 6



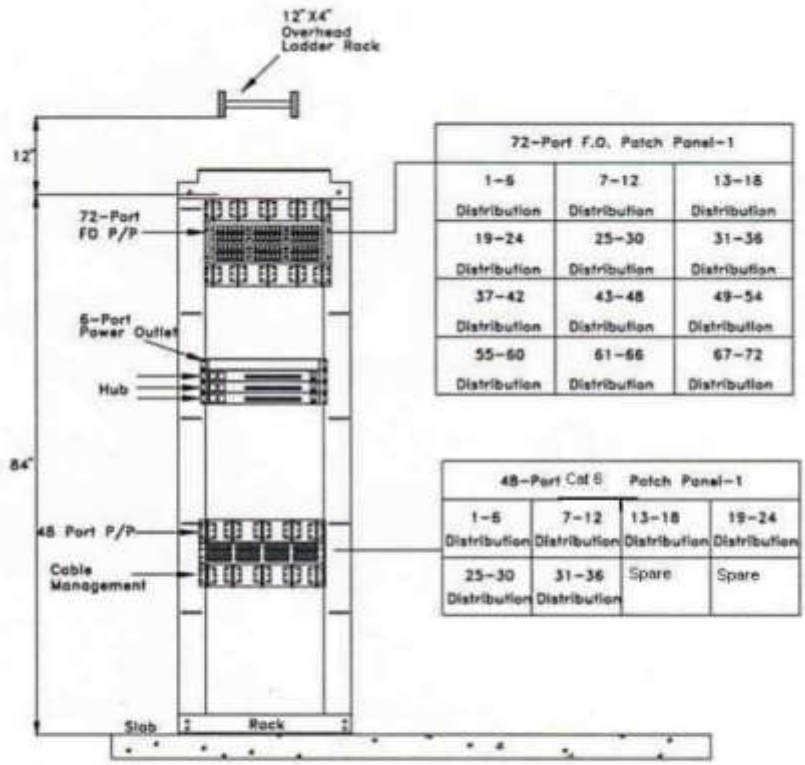
Sample IDF – TELECOMMUNICATIONS CLOSET LAYOUT
NOT TO SCALE

FIGURE 7



Sample IDF – Telecommunications Closet Elevation
NOT TO SCALE

FIGURE 8



Sample IDF –Telecommunications Closet
Data Rack Elevation
NOT TO SCALE

b. Number of IDF Communications/Data rooms/closets within a building

- Each floor should have at least one IDF Communications/Data room/closet.
- Wiring workstations to IDF Communications/Data rooms/closets on different floors is not a preferred practice but can be done if no alternative exists.
- If possible, IDF Telecommunication Closets should be positioned toward the center of the building (usually the core area) and stacked vertically, when possible, in multi-story buildings.

c. Plywood Backboard

- Each IDF Room will contain a minimum of one 4’ X 8’ sheet of plywood flush- mounted on the wall.
- Securely fasten the plywood to wall-framing members to ensure that it can support attached equipment.
- The plywood is to be 3/4”, A/C grade and fire retardant.
- All plywood backboards are to be mounted smooth side out and painted with white fire retardant paint at time of installation and prior to installation of equipment onto the plywood.

d. IDF Room Equipment Enclosures

- Any IDF Rooms located in rooms that are share space used for any other purpose should have wire mesh cages or sheetrock walls around the Communications equipment.

e. Relay Racks

- Each MDF will contain a minimum of one 19”W X 7’H Relay Rack onto which the fiber optic/copper patch panels and Data electronics are mounted.
- The relay racks should have a minimum of 42 rack units of mounting space on standard 19” wide rails.
- In some cases the relay racks are wall-mounted and in others they are free-standing two- or four-post racks. It must be determined which type of rack is required, based on field conditions, equipment manufacturer's requirements, and space allocated.
- All racks are to be grounded and bolted to each other as well as to the slab or wall.
- The rack should have vertical and horizontal cable management to accommodate routing of patch cords.
- The relay rack specifications and associated components should meet the requirements of the equipment that will be installed in it.
- It should be at a minimum 84” tall with 6” rails, with 19” equipment mounting space and vertical and horizontal wire management.
- Manufactured by Hubbell of Eaton/B-Line, Panduit or approved equivalent

f. Wall-Mounted Relay Racks

- The rack is to be securely fastened to the wall behind the rack and attached to the ladder rack above.
- The rack should be sized to accommodate the equipment to be installed in it, with vertical and horizontal jumper management.
- Manufactured by Hubbell of Eaton/B-Line, Panduit or approved equivalent

g. Communications Cabinets

- All communications cabinets are to be grounded to the grounding and bounding system, bolted to each other and to the slab.
- Each communications cabinet is to be installed with its side to an adjacent wall.
- Three feet of clearance around the cabinet is recommended, and the cabinets must have front and rear access.

h. Cable Trays

- Between the relay rack and the wall-mounted frame, a 12” cable tray (no center rail systems), with a 4" load depth and 6" rung spacing is to be installed suspended from a ceiling support structure, mounted to the relay rack and the wall.

- Do not attach cable trays to the suspended ceiling grid.
- An open wire basket cable tray system is acceptable for cable support.
- Manufactured by Hubbell of Eaton/B-Line, Panduit or approved equivalent

i. IDF Room Electrical Requirements

- Each Communications/Data room/closet shall have one 110V, 15 Amp electrical convenience outlet and one 110V, 20 Amp dedicated–circuit, isolated-ground electrical outlet for the electronic equipment.
- This is a minimum requirement based on the typical current draw of the networking equipment to be placed.
- The ground for the equipment outlet should be isolated where possible to avoid line transients.
- The 110V 20 Amp dedicated-circuit, isolated-ground electrical outlets should be mounted in convenient location to facilitate the use of the shortest equipment power cords.
- The recommended location is at the top of the rack or on the ladder tray.
- All electrical isolated ground outlets serving Communications and Data equipment must be attached to non-switched circuits to prevent inadvertent equipment shutdown.
- It is also recommended that they be on a UPS and/or generator if available.

M. MDF & IDF PRODUCT SPECIFICATIONS

1. Category 6 Patch Panels: In new construction projects, the default cabling infrastructure shall be Category 6 unless specified otherwise.

a. Category 6 Patch Panel Requirements

- Category 6 patch panels shall be standard 8-position, RJ-45 style, un-keyed, in 48-port configurations.
- Panel frames shall be 14-gage steel with rolled edges top and bottom for proper stiffness.
- Panel design shall incorporate plastic push-fasteners to permit hands-free positioning onto standard EIA-310-D 19” mounting rails.
- Panels shall accommodate a minimum of 24 ports for each rack mount unit (1 RMU = 1.75 in.).
- Panels shall be designed for 4-pair, 100 ohm balanced unshielded twisted pair (UTP) cable.
- Panels shall terminate 26-22 AWG solid conductors, with maximum insulation diameter of 0.050 in.
- Panels shall have attached wiring instruction labels to permit either T568A or T568B wiring configurations.
- Panels shall have individual port identification numbers on the front and rear of the panel.
- Panel adapter modules shall be 110-style termination with tin lead solder plated IDC contacts.

- Printed circuit boards shall be fully enclosed front and rear for physical protection.
- Panel contacts shall withstand a minimum of 2000 mating cycles with an FCC 8-position RJ-45 plug, without degradation of electrical or mechanical performance.
- Panel contacts shall be constructed of Beryllium copper for maximum spring force and durability.
- Contact plating shall be a minimum of 50 micro-inches of hard gold in the contact area over 50 micro-inch of nickel.
- Panel termination method shall follow the industry standard 110 IDC punch-down, using a standard 110 impact termination tool.
- Panels shall be compatible with a 4-pair multi-punch impact termination tool designed specifically for the purpose. Bending or other damage to the panel using a multi-pair punch tool shall not occur.
- IDC contact termination towers shall have tapered pair-splitting features to aid wire insertion and minimize pair un-twist.
- IDC contacts shall be Phosphor Bronze with 100 micro-inch tin lead 60/40 plating over nickel.
- Panels shall not require special cords or special installation requirements.
- Panel ports shall accept optional hinged dust covers and port identification icon buttons.
- Space above the adapter ports shall be available for additional labeling per ANSI/TIA/EIA-606-A.
- Category 6 panels shall be backward compatible with existing Category 3, 5, and 5e cabling systems for fit, form, and function.
- Panels shall accept a clip-on rear cable management support bar to provide cable strain relief.

b. Category 6 Patch Panel Performance Requirements

- All transmission performance parameters shall be independently verified by a UL or ETL third party testing organization.
- Category 6 panels shall meet or exceed Category 6 transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA-568-C.2 Transmission Performance Specifications for 4-Pair 100 ohm Category 6 Cabling.
- The manufacturer shall provide Category 6 component compliance certificates from third party testing organizations upon request.
- Panels shall be UL LISTED 1863 and CSA certified.
- Panels shall support 4PPOE IEEE 802.3bt Power specification to 1.5 times the rated current limits with no degradation of performance or materials.
- Panel contacts shall withstand a minimum of 2000 mating cycles with an FCC 8-position RJ-45 plug, without degradation of electrical or mechanical performance.

- Panels shall be third party verified, error free Gigabit Ethernet performance to IEEE 802.3 standard.

- Category 6 panels shall meet the current draft 10 Gb/s performance requirements of IEEE 802.3an and TSB-155, for a maximum 55-meter channel length. Conditions of requirement No. 10 above apply.

c. Acceptable Manufacturers:

- Hubbell Premise Wiring: The Hubbell products listed in the table below comply with all requirements specified in this document

HUBBELL CATALOG NUMBER	Description
P6E48U	NEXTSPEED® Category 6 Patch Panel, 48-Ports
PCBLMGT	Rear Cable Management Bar

- Or approved equal of: Ortronics, Panduit, Systimax.

d. Category 6 Patch Panel Installation Requirements

- Horizontal and backbone cabling of the proper category shall be fully deployed into the TR, TE, or ER according to applicable codes and standards.

- Cable slack, service loops, bend radii, and pathway fill ratio shall comply with applicable codes and standards.

- Racks, cabinets, enclosures, and metallic cable pathways shall be bonded to an approved ground according to ANSI-J-STD-607-A.

- Cable ends for termination shall be clean and free from crush marks, cuts, or kinks left from pulling operations.

- Properly mount patch panels into the designated rack, cabinet, or bracket locations with the #12-24 screws provided.

- Terminate cables into the patch panel according to manufacturer’s instructions.

- To maximize transmission performance, maintain wiring pair twists as close as possible to the point of termination.

- The length of wiring pair un-twist in each termination shall be less than 0.5 inches (13 mm).

- Horizontal or backbone cables extending from the panel terminations shall maintain a minimum bend radius of at least 4 times the cable diameter.

- Cable terminations shall have no tensile or bending strain on panel IDC contacts in each installed location.

- Panels shall be properly labeled on front and back with the cable number and port connections for each port.

2. Fiber Enclosures, Adapter Plates, Connectors

a. Fiber Adapter Enclosure Requirements

- Enclosure design shall be a modular, rack-mounted, powder coated formed cold rolled steel enclosure with a removable front cover, rear panel, top panel, and slide-out inner tray.

- Each basic unit delivered shall consist of: (1) enclosure assembly, (2) mounting brackets, (6) cable ties, (5) snap-in cable clips (4) #12-24 mounting screws, (1) adhesive grid label, (4) adhesive cable clips, (2) Velcro cable ties, (3) label holders, and (1) splice tray stud, wing nut, and spacer.

- Material shall be as follows:

  (1) Enclosure, panels and tray: 16-gauge cold rolled steel (CRS)
  (2) Mounting brackets: 14 gage CRS
  (3) Front cover: Acrylic (Plexiglas)

- Basic dimensions of the enclosures shall be approximately 17” wide by 12” deep.

- Enclosures shall be available in heights of 3.5” (2 RMU), 5.25” (3 RMU), and 7” (4 RMU) versions.

- Finish shall be black durable powder coat on all surfaces.

- Front door shall be Lexan plastic, hinged at the bottom, with a cap-plugged hole to accept an optional lock. Front door shall also be removable in the fully open position by sliding left off the mounting pins.

- Front door shall be secured in the closed position with magnetic quick-release latches.

- Top cover shall be removable in the forward direction, without fasteners, to provide access to the connector field. Top panel shall also have knockouts for backbone cable entry.

- Rear panel shall be removable without fasteners.

- Enclosure shall be equipped with panel-mounting brackets assembled for 19” rack mounting, compliant to ANSI/EIA-310-D.

- Panel mounting brackets shall be configurable to either 19” or 23” racks.

- Enclosure chassis shall have two mounting bracket locations for either flush mount or center mount on the rack.

- Rear of enclosure shall have two knockouts, top and bottom, for backbone cable entry and internal routing.

- Front of enclosure chassis shall have side cutouts for patch cord entry into, and exit from the enclosure.

- Inner tray shall slide out in the forward direction by releasing the lever-action quick-release latches. Tabs in the chassis shall engage with slots in the inner tray in the outward position to prevent tray from falling out.

- Inner tray shall have rear-located knockouts to match rear chassis knockouts.

- Inner tray panel mounting posts shall accept modular adapter panels, in high- or low-density versions. Adapter panels shall be available in singlemode.

- Splice tray mounting boss shall also accept a stud for mounting blown fiber adapter brackets.
- Inner tray shall have clips for cable ties, and holes to accept snap-in cable clips, front and rear, for complete cable management of patch cords and distribution cable strands.
- Inner tray shall have rear cable tie-down features to accept various diameter backbone cables entering the enclosure.

b. Fiber Adapter Panels Requirements

- Fiber adapter panels shall be a modular, quick-fastening steel plate, powder coated to match the enclosure finish.
- Fiber adapter panels shall have pre-installed LC fiber adapters, available in low- or high-density multi-mode or single-mode applications.
- Each individually bagged unit delivered shall consist of: (1) fully assembled adapter panel, with push-pull fasteners pre-installed.
- Adapter panels shall be constructed of 16-gauge cold rolled steel.
- Finish shall be black durable powder coat on all surfaces.
- Basic dimensions of the FSP panels shall be 5.10” length by 1.10” wide.
- Panels shall have two pre-installed, push-pull type quick-release fasteners for quick snap-in installation. Push-pull fasteners shall have an industry standard center distance of 4.65”.
- Panels shall be suitable for mounting either vertically or horizontally.
- Panels shall be available in with LC adapters with precision ceramic alignment sleeves.
- All fiber adapters installed in FSP panels shall have dust caps installed.
- Panels shall be available in low-density and high-density adapter patterns.

c. Fiber Connector Requirements

- Please note OM4 minimum standard

  (1) Internal Building Installation

    (a) Each IDF will connect back to the MDF with 12 strands of SM fiber.

  (2) External Building/Campus Installation

    (a) Buildings less than 1640ft/500m shall use a mix of Single Mode fiber.
    (b) Installation distances GREATER than 1640ft/500m require use of Single Mode fiber exclusively.

- Connector basic design shall be a factory pre-polished LC optical fiber connector with a zirconium ceramic ferrule. Integral with the connector body is a wedge-activated fiber clamping mechanism to secure the inserted fiber into a mechanical splice with the factory installed cleaved fiber stub. Index-matching gel is supplied factory-injected into the cleaved fiber stub splice to optimize transmission performance. Connector attachment is achieved without tools, by inserting a field-cleaved optical fiber and then extracting the disposable

clamp wedges from the connector body.

- Each basic connector unit delivered shall consist of: (1) connector body with disposable clamp wedge, (1) strain relief boot, and (1) plastic dust cap.

- Connector termination method shall utilize an industry standard multi-layer strip tool and bare fiber cleave tool as the only field tools required.

- LC connectors shall have features to enable field verification using a Visual Fault Locator (VFL) during termination.

- Connector materials shall be designed with thermal stability to comply with environmental requirements of ANSI/TIA/EIA-568-B.3 and TeLCordia GR-1081-CORE.

- Singlemode pre-polished fiber connector materials shall be as follows:

  (1) Ferrule: zirconium ceramic
  (2) LC inner body: thermally stable injection molded thermoplastic
  (3) Dust Cap: nylon or PVC
  (4) Strain relief boot: UL94-V0 molded PVC

- Pre-polished LC connectors shall require no field polishing.

- Colors for specific applications, as designated below:

- Pre-polished OM4 LC connectors shall require no adhesives for termination.

- LC connector internal fiber clamping mechanism shall firmly secure both the inserted glass fiber and the 900 micron buffer layer of the inserted fiber for maximum strain relief.

- All standard mating and interface dimensions for LC connectors shall comply with ANSI/TIA/EIA-604-10 (FOCIS 10).

- Ferrule outside diameter for LC singlemode connectors shall be 1.2483mm to 1.2497mm.

- LC ferrule tip shall have a PC spherical radius of approximately 7.0 mm radius for singlemode versions.

- Delivered connectors shall be individually bagged with the dust cap installed to protect from contamination.

- Delivered connectors shall have the disposable clamp activation wedge element pre-installed onto the connector body.

- Connector design and termination technique shall be independent of cable type or manufacturer, and shall be compatible for either 900 micron buffer or 250 micron buffer distribution cables.

- LC connector strain relief boot shall be a TeLCordia style slotted design for maximum flexural strain relief.

- Strain relief boot shall be yellow for singlemode.

- LC connectors shall be available individually bagged in packs of 12.

- Pre-polished LC fiber connectors, when properly installed onto qualified cable, shall meet the 10 Gb/s Ethernet performance requirements of IEEE802.3.

- Pre-polished LC fiber connectors, properly installed onto qualified cable, shall exceed the mechanical and environmental performance requirements of ANSI/TIA/EIA-568-C.3, Annex 'A'.

- Pre-polished LC fiber connectors, properly installed onto qualified cable, shall exceed the mechanical and environmental performance requirements of TeLCordia GR-1081-CORE.

- Qualification test data shall be available from the manufacturer upon request.

d. Acceptable Manufacturers:

- Hubbell Premise Wiring: The Hubbell products listed in the table below comply with all requirements specified in this document.

HUBBELL CATALOG NUMBER	Description
FCR2U6SP	Fiber Enclosure - 2U Rack Mount Fiber Enclosure, Accepts 6 Adapter Panels
FCR2U9SP	Fiber Enclosure - 2U Rack Mount Fiber Enclosure, Accepts 9 Adapter Panels
FCR3U12SP	Fiber Enclosure - 3U Rack Mount Fiber Enclosure, Accepts 12 Adapter Panels
FCR4U15SP	Fiber Enclosure - 4U Rack Mount Fiber Enclosure, Accepts 15 Adapter Panels
FSPLCDS6	Fiber Adapter Panel - 6 LC Duplex, Blue for SM – Zirconia Ceramic Sleeves
FSPLCQS3	Fiber Adapter Panel - 6 LC Quad Blue for SM – Zirconia Ceramic Sleeves
FCLC900KSM12	Fiber Connector - LC, SM, 9/125 UPC – Blue Box of 12

- Or approved equal of: Ortronics, Panduit, Systimax.

e. Fiber Installation Requirements

- For FCR-series enclosures, remove top and rear covers, and front door.

- Punch out the desired knockouts for cable entry.

- Using proper method, pull cables into cabinet through the desired knockout entry location.

- Strip the outer sheath and sub sheaths of the fiber cable to provide at least (2) meters service loop of the individual buffered fiber strands.

- Anchor the outer cable sheath into the rear channel of the inner tray using the cable ties provided. Note: in FCR-series enclosures, leave enough slack in the main cable to allow free motion of the inner tray fully outward. Remove cable entry knockouts as required.

- Installed copper and fiber cabling shall be properly strain relieved. Cable service coil, bend radius, and pathway fill ratio shall comply with applicable codes and standards.

- Use the plastic adhesive-backed clips provided to form the fiber strands into a large service coil on the surface of the inner tray. For FCR-series enclosures, be sure the inner tray has full mobility in and out, with no cable kinks or snags.
- Close inner tray and front cover, and lock the quick-release fasteners.
- Install LC fiber adapter panels by firmly using push fasteners to lock in place.
- Leave dust caps installed in the fiber adapter plates until connector termination is performed.
- Follow manufacturer's termination instructions for pre-polished connectors as specified
- Uncoil the 900-micron buffered strands of cable from the service loop and set-up for termination.
- Un-package the connector, and leave dust cap installed. Firmly press downward on the connector wedge tab to fully seat clamp wedges.
- Slide the strain relief boot onto the fiber strand before stripping.
- Using a fiber strip tool, strip buffered fiber completely to approx. 1.0" of exposed glass fiber.
- CAUTION: Do not nick or Scrape the glass fiber with the strip tool.
- Wipe the glass fiber firmly with an alcohol wipe. Always use 99.9% pure reagent grade alcohol for fiber cleaning.
- Mark the 900 micron buffer layer from the strip-off point per instructions.
- Insert the fiber into the cleave tool and cleave the fiber to the specified length from the end of the 900 micron buffer layer. Always keep the cleave tool clean.
- CAUTION: Always dispose of glass fiber waste in an approved container.
- Gently insert the cleaved fiber into the connector body. Rotate connector slightly during insertion to fully seat the fiber into the internal splice.
- Hold the seated fiber in place using slight force to form a bow in the fiber.
- CAUTION: Do not allow the installed fiber to slip backward.
- While holding the fiber seated, squeeze the wedge holder device to activate the clamp, and then slip the wedge holder off the connector body. Dispose the wedge holder.
- Remove the connector dust cap and inspect the ferrule tip. A 400X microscope is recommended. View of the polished fiber should be a smooth round circle with no scratches, pits, cracks or chips. Use a lint-free wipe to clean off any contamination.
- CAUTION: Do not view ends of live fibers, with or without a microscope.
- Plug the connector into the proper adapter panel and proceed with the next connector. Leave dust cap installed if the connector is not mated.

3. Racks, Horizontal & Vertical Managers

   a. Equipment Racks Requirements

- Racks shall be a structural aluminum construction, having two 6-inch deep rails.
- Racks shall feature universal side mounting hole pattern for vertical cable managers.
- Racks shall feature a weight load capacity of 1,000 lbs. when properly secured to the floor.
- Each basic rack delivered shall consist of: (2) vertical rails, (2) base angles, (1) assembly hardware kit, (2) top angles, and (20) #12-24 dog point machine screws for panel mounting.
- Racks shall be available in either for 19-inch standard rack configurations.
- Tapped holes in the front and rear vertical rails for mounting of panels shall be #12-24 thread size. Powder coat shall not interfere with thread fit.
- Standard rack heights of 8 ft (96 in)
- Racks with heights of 8 ft shall have a capacity of 51 rack mount units
- Rack base angles shall be pre-drilled for floor mounting, and for assembly to vertical rails.

b. Horizontal Managers Requirements

- Horizontal Managers shall be 19”W, 3.5”H
- Horizontal managers shall be 16ga. Cold rolled steel construction with (6) pass thru holes, and (7) Front mounted 3.5” steel rod D-Rings.
- Horizontal managers shall have hinged Aluminum front cover to conceal patch cords.

c. Vertical Managers Requirements

- Vertical cable managers shall be 14”D, 10”W
- Vertical cable managers shall feature a steel rod construction for increased air flow.
- Vertical cable managers shall feature a solid aluminum door that is designed to open left or right and swing out of way for cable management.
- Vertical cable managers shall feature power strip mounting brackets on rear of manager.
- Vertical cable manager shall accept and include (16) 3" black cable management spools.

d. Acceptable Manufacturers:

- Hubbell Premise Wiring: The Hubbell products listed in the table below comply with all requirements specified in this document
- Cooper B-Line: The Cooper B-Line products listed in the table below comply with all requirements specified in this document

HUBBELL CATALOG NUMBER	Description
HPW84RR19D	84”H, 6”D Equipment Rack
HM24C	2U Horizontal Manager w/ 3.5” Front rings and cover
VM1013	Vertical Cable Manager, 14”D, 10”W, with door & cable spools

B-Line CATALOG NUMBER	Description
SB55608419U6	84”H, 6”D Equipment Rack
SB87019S2FB	2U Horizontal Manager w/ 3.5” Front rings and cover
SB860810S084	Vertical Cable Manager, 14”D, 10”W, with door & cable spools

- Or approved equal of: Ortronics, Systimax

N. INFORMATION OUTLETS – DATA & VOICE

1. A work area has at least one standard Information Outlet consisting of Data RJ45 jack. All of the RJ45 jacks shall be Category 6 unless otherwise specified and wired according to the 568B standard.

   - DATA & VOICE Cabling Requirement LCenarios

     - DATA PC & VOIP Telephony INFORMATION OUTLET

       - 1x DATA RJ45 CAT 6 Jack per Information Outlet

2. Information Outlet Locations

   a. The location of the information outlets is dependent on the environment in which the outlets will be installed. An office environment certainly is different than a laboratory, training room, or manufacturing area. If the outlets are to be wall- mounted, the bottom of the outlet is to be located 15” above of the finished floor under normal conditions. However, there are many exceptions to this rule. If there is existing equipment that does not allow for this, such as a credenza or countertop, the outlet must be placed at a height appropriate to the situation.

   b. Locate the outlet where it is closest to the equipment and people it will serve. Keep in mind that the cord from the outlet to the device can be a trip hazard or may span across doors. In an office environment, each desk or workstation should have an information outlet. If a particular area has a series of fax machines or modems, then additional outlets should be installed. The number of jacks in an outlet is standard, so to maintain the standard, additional information outlets of the same configuration should be installed; do not install non-standard outlets.

   c. Computer laboratories or training rooms require a large amount of connectivity in odd locations. Power poles are one solution as is the use of surface-mounted raceway or floor-mounted boxes. Each situation is different and must be considered individually. Again, standards are to be maintained in outlet configurations.

   d. When locating an outlet, consideration should be given to the route the cable must take to the information outlet. If the outlet is to be installed on a masonry wall and surface-mount raceway is used for cable routing, the location of the outlet may be more dependent on the path available down or across the wall than where the equipment is located. Each location must be looked at individually to determine if the route to the desired outlet location is possible.

   e. Wall-mounted outlets should not be located on heating units, equipment or ductwork. They are always to be located on either a gypsum, sheetrock, or masonry wall.

   f. A description of the information outlet configurations follows:

      (1) Standard Office Information Outlets consist of: as detailed on the drawings attached to the contract, the contractor will install and terminate four-pair UTP Category 6 for Data cable onto individual RJ45 female jacks.

(2) Wireless Access Point consist of: as detailed on the drawings attached to the contract, the contractor will install and terminate four-pair UTP Category 6 for Data cable onto individual RJ45 female jacks.

3. Category 6 Jacks: In new construction projects, the default cabling infrastructure shall be Category 6 unless specified otherwise.

   a. Category 6 Jack Requirements

   - Jacks shall be standard 8-position, RJ-45 style, un-keyed, FCC compliant.
   - Jacks shall be designed for 4-pair, 100 ohm balanced unshielded twisted pair (UTP) cable.
   - Each jack shall be single unit construction, with snap – fit to industry standard keystone opening (.760” x .580”).
   - Jack housings shall fully encase and protect printed circuit boards and IDC fields.
   - Modular jack contacts shall accept a minimum of 2000 mating cycles without degradation of electrical or mechanical performance.
   - Jack contacts shall be constructed of Beryllium copper for maximum spring force and durability.
   - Contact plating shall be a minimum of 50 micro-inches of hard gold in the contact area over 50 micro-inch of nickel.
   - Jack termination method shall follow the industry standard 110 IDC punch-down
   - Jacks shall be compatible with a 4-pair single punch impact tool designed specifically for the purpose.
   - IDC contact termination towers shall have tapered pair-splitting features to aid wire insertion and minimize pair un-twist.
   - Jacks shall terminate 26-22 AWG solid or stranded conductors.
   - Jacks shall terminate insulated conductors with outside diameters up to .050”.
   - Jacks shall not require special cords, specialty tools or special installation requirements.
   - Jacks shall include a translucent stuffer cap for wire retention and to permit visual inspection.
   - Stuffer cap shall have retention snaps to assure conductor strain relief.
   - Jacks shall accept FCC compliant 6 position plugs.
   - Jacks shall accept optional hinged dust covers.
   - Jacks shall be compatible with ANSI/TIA/EIA-606-A color code labeling.
   - Jacks shall accept snap-on icons for specific identification.
   - Jacks shall be available in various colors to meet specific customer applications.
   - Jacks shall have attached wiring instruction labels to permit either T568A or T568B wiring

configurations.

- Category 6 jacks shall be backward compatible with existing Category 3, 5, and 5e cabling systems for fit, form, and function.

b. Category 6 Jack Performance Requirements

- All transmission performance parameters shall be independently verified by a UL or ETL third party testing organization.
- Category 6 jacks shall exceed Category 6 transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA-568-B.2-1, Transmission Performance Specifications for 4-Pair 100 ohm Category 6 Cabling.
- Category 6 jacks shall exceed 10 Gb/s transmission requirements for connecting hardware, under the constraints of ANSI/TIA-TSB-155 (current draft).
- The manufacturer shall provide Category 6 component compliance certificates from third party testing organization upon request.
- Jacks shall be UL LISTED 1863 and CSA certified.
- Jacks shall exceed IEEE 802.3 DTE Power specification to 4 times the rated current limits with no degradation of performance or materials.
- Jacks shall be third party verified, error free Gigabit Ethernet performance to IEEE 802.3 standard.
- Jacks shall exceed 4 Gb/s data transmission capacity within the bandwidth of 1 – 250 MHz when configured in a 4-connector channel.
- Jacks shall exceed the 4-connector channel performance requirements of Category 6, per the ANSI/TIA/EIA-568-B.2-1 standard.
- Jacks shall exceed the 4-connector Category channel performance requirements for 10 Gb/s transmission over Category 6, according to TIA/TSB-155 (current draft).
- The 4-connector channel test configuration shall utilize Category 6 patch panels and Category 6 patch cords, from the same manufacturer, with qualified Category 6 cable.

c. Acceptable Manufacturers:

- Hubbell Premise Wiring: The Hubbell products listed in the table below comply with all requirements specified in this document

HUBBELL CATALOG NUMBER	Description
HXJ6xx	NEXTSPEED® Category 6 Jack

xx = Jack color. Replace xx with “W” for White, “BK” for Black, “B” for Blue, “GY” for Gray, “GN” for Green, “OW” for Office White, “OR” for Orange, “R” for Red, “Y” for Yellow. Refer to project drawing for color applications.

- Or approved equal of: Ortronics, Panduit, Systimax.

d. Category 6 Jack Installation

- Horizontal cabling of the proper category shall be fully deployed from the TR or TE to each wall plate location according to applicable codes and standards.
- Cable slack, service coil, bend radii, and pathway fill ratio shall comply with applicable codes and standards.
- Metallic horizontal cable pathways shall be bonded to an approved ground according to ANSI-J-STD-607-A.
- Cable ends for termination shall be clean and free from crush marks, cuts, or kinks left from pulling operations.
- Terminate jacks according to manufacturer's instructions.
- To maximize transmission performance, maintain wiring pair twists as close as possible to the point of termination.
- The length of wiring pair un-twist in each termination shall be less than 0.5 inches (13 mm).
- Cable ends for termination shall be clean and free from crush marks, cuts, or kinks left from pulling operations.
- Properly mount patch panels into the designated rack, cabinet, or bracket locations with the #12-24 screws provided.
- Terminate cables into the patch panel according to manufacturer's instructions.
- To maximize transmission performance, maintain wiring pair twists as close as possible to the point of termination.
- The length of wiring pair un-twist in each termination shall be less than 0.5 inches (13 mm).
- Jacks shall be properly mounted in plates, frames, or housings with stuffer cap fully installed over IDC contacts.
- Horizontal cables extending from mounted jacks shall maintain a minimum bend radius of at least 4 times the cable diameter.
- Cable terminations shall have no tensile or bending strain on IDC contacts after assembly of faceplate or housing to the wall outlet.
- Jacks shall be tested as part of the installed horizontal cabling system, with faceplates assembled complete and properly mounted.
- Each link or channel in the horizontal cabling system shall be identified and tested individually, using an industry standard level III tester with correct settings.
- Each jack shall be tested as part of the horizontal channel or link for the parameters listed below.

4. Face Plates

   a. Face Plate Requirements

      - Faceplates shall be constructed of high impact, UL94 V-0 rated thermoplastic.

- Faceplates shall be 2.75" W x 4.5" H (69.8 mm x 114.3 mm) for single gang and 4.5” X 4.5” (114.3 X 114.3 mm) for double gang.

- Port size in each faceplate shall be industry standard vertical keystone opening size (.760” x .580”).

- Faceplates shall accept Hubbell XJ-series UTP jacks and Snap-Fit fiber optic, audio, and video modules for multimedia applications.

- Faceplates shall provide for ANSI/TIA/EIA-606-A compliant workstation outlet labeling.

- Faceplates shall be provided with clear plastic and color-matched label field covers.

- Color-matched blank Snap-Fit modules shall be available separately to fill unused ports and openings as required.

- Two #6-32 pan head Phillips/slotted mounting screws shall be included with each single gang faceplate.
- Four #6-32 pan head Phillips/slotted mounting screws shall be included with each double gang faceplate.

- Jacks and Snap-Fit modules shall snap firmly into rear of faceplate and position flush to outer plate surface.

- Faceplates shall be compatible with standard NEMA openings and boxes.

- Faceplates shall be compatible with raceway fittings, surface mount boxes, service fittings, flush mount boxes and drywall rings.

b. Acceptable Manufacturers:

- Hubbell Premise Wiring: The Hubbell products listed in the table below comply with all requirements specified in this document

HUBBELL CATALOG NUMBER	Description
IFP11xx	1-Gang, 1-Port IFP Face Plate
IFP12xx	1-Gang, 2-Port IFP Face Plate
IFP13xx	1-Gang, 3-Port IFP Face Plate
IFP14xx	1-Gang, 4-Port IFP Face Plate
IFP16xx	1-Gang, 6-Port IFP Face Plate
IFP26xx	2-Gang, 6-Port IFP Face Plate
IFP29xx	2-Gang, 9-Port IFP Face Plate
IFP212xx	2-Gang, 12-Port IFP Face Plate

xx = Face Plate color. Replace xx with “W” for White, “BK” for Black, “GY” for Gray, “OW” for Office White, to project drawing for color applications.

- Or approved equal of: Ortronics, Panduit, Systimax.

O. CABLE ROUTING SYSTEMS

1. Each cable routing system has advantages and disadvantages. Particular systems are favored for a variety of reasons, including architectural considerations, appearances, cost, local ordinances, and material concerns.

2. Various means of distributing cable from Communications/Data rooms/closets to the user work areas are identified in the following:

3. Ceiling Distribution System

   a. A distribution system within an accessible area above a false ceiling. This could either be a plenum area (where there is no enclosed system for cable routing) or an overhead conduit system (which has defined areas of access and routes).

4. "J" Hooks

   a. Where not installed in conduits, cable trays, or other supporting devices, the horizontal wiring plan is to be installed onto "J" hooks or an acceptable equivalent from the information outlet to the termination point within the IDF or MDF/IDF room. The "J" hooks are to be installed a maximum of five feet apart and fastened to the ceiling or the top of the walls near the ceiling. The cables are to be tie-wrapped to the "J" hooks, without crimping the sheath. The cable contractor is to furnish and install the "J" hooks. Cooper B-Line BCM 21, 32, and 64 are acceptable.

5. Sleeves and Conduits

   a. The use of conduits and sleeves within a building is common for the transport of communications cable. Conduits and sleeves are to be sized and routes are to be planned within and between buildings in order to route the cable plant from the MDF to IDF and IDF to Information Outlet, and to accommodate any additional cabling required. The sizing of the conduits and sleeves is to be based on the number of cables, the location and environment surrounding the sleeve or conduit, and acceptable conduit fill levels, which are typically 40%. All conduits are to be installed with the appropriate sweep to maintain the required bend radius for copper and fiber optic cable. All sleeves and conduits are to be installed with bushings and suspended according to building industry standards.

   b. The following are guidelines to use in determining where sleeves and conduits are to be installed but does not limit nor identify all areas or situations where sleeves and conduits will be required.

      - All masonry walls that have cables passing through them are to have sleeves installed.

      - Gymnasiums and athletic areas are to have conduits installed to house cables passing through the area.

      - Each MDF and IDF Room is to have sleeves installed to contain the large number of cables exiting the room. Conduits are to be installed in areas where cables extend from one building to another via covered or enclosed bridges and corridors.

   c. Cable routing is to follow a "streets and avenues" path in corridors where possible. However, there are a number of reasons for exceptions. In some cases, the corridors do not allow cables to be run because of architectural constraints or inaccessible ceilings. Also, in order to maintain the 90-meter standard for Category 6 cabling, some cables need to be run separately and diagonally to isolated information outlets. Throughout all runs, the contractor is to maintain EIA/TIA standards regarding the proximity of communications cabling to high voltage cabling, motors, transformers, fluoreLCent lighting, ballasts, etc.

P. CABLING-GENERAL

1. All cable shall meet the requirements of the NEC, except where other authorities or codes impose a more stringent requirement or practice. Codes, such as the NEC, do not normally include transmission performance requirements. This section specifies the essential media transmission characteristics. It is

advisable to consult standards associated with the planned service or equipment to determine any specific media limitations.

2. Contractor is to take all necessary precautions to assure that the maximum tensile load and minimum bend radius of all cables (fiber and copper) are not exceeded. When terminating Category 5e & 6 cable, care should be taken to maintain pair twists up to the termination point and not more than 0.5" of the cable pairs shall be untwisted. It is preferred that the cable sheath is also not removed more than 0.5" from the termination point. Tie wraps are to be hand-tightened on cables and are not to crimp the sheath. Contractor is responsible for protecting all connectorized cables from damage by other contractors at the information outlet before and after installation of the outlet faceplates.

3. All riser and station cable installed is to be plenum-rated cable. The fluoropolymer resin that insulates Category 6+ plenum cables is engineered as a fire safety innovation. The NEC requires that all cable installed in plenum spaces and not encased in conduit must have certain fire resistance and low smoke producing characteristics. Not only are such cables highly resistant to fire but they also produce very little smoke.

4. All new Voice cabling will be terminated onto Category 6 RJ45 Patch Panels. The fiber optic cabling will be terminated onto fiber distribution panels with LC connectors.

5. Cables shall be terminated on the appropriate unassigned (vacant) portions of the wall-mounted Main and Intermediate Distribution Frames or Patch Panels and run as uninterrupted conductor sections to the Information Outlets. All cable terminations shall be made uniformly in sequence, commencing with termination of the first cable pair on the first connection points in the upper left-hand corner of each block.

6. Minimum separation distances between pathways and power wiring of 480 V or less are shown in Table 1, below.

Table 1 Separation of Communications Pathways from <= 480V Power Lines

	Minimum Separation Distances		
Condition	< 2 kVA	2-5 kVA	> 5 kVA
Unshielded power lines or electrical equipment in proximity to open or nonmetal pathways.	127 mm (5 in)	305 mm (12 in)	610 mm (24 in)
Unshielded power lines or electrical equipment in proximity to a grounded metal conduit pathway	64 mm (2.5 in)	152 mm (6 in)	305 mm (12 in)
Power lines enclosed in a grounded metal conduit (or equivalent- shielding) in proximity to a grounded metal conduit pathway.	76 mm (3 in)	152 mm (6 in)	

All cabling shall be at least:

- 12” from high voltage lighting and fluorescent fixtures
- 72” from transformers and motors

Q. HORIZONTAL CABLING – CATEGORY 6 UTP DATA
All riser and station cable installed is to be plenum-rated cable.

1. Category 6 100 OHM balanced UTP Cable Requirements: In new construction projects, the default cabling infrastructure shall be Category 6 unless specified otherwise.

   a. Cable construction shall be four twisted pairs of 23 AWG insulated solid conductors, with a ripcord, surrounded by a tight outer jacket.

   b. All 4 pairs will have a cross-hair (X) physical separator between the pairs.

c. Conductor diameters shall be 0.0224” □ .0003” solid copper.

d. Conductor insulation diameter shall be 0.039” □ .0005” fluoro copolymer.

e. Outer jacket diameter shall be 0.235” □ .008” low smoke PVC, with a nominal wall thickness of 0.015”.

f. Ripcord shall be directly underneath the outer jacket.

g. Cable shall be marked every 2 ft including

- Cable Manufacturer
- Cable Description
- Month and Year of manufacture.
- Job number.

h. UL, ETL, or CSA agency certification or verification markings shall be marked on the cable jacket according to the certifying agency’s requirements.

i. Color coding of the pairs shall be as follows:

- Pair 1: White/Blue; Blue
- Pair 2: White/Orange; Orange
- Pair 3: White/Green; Green
- Pair 4: White/Brown; Brown

j. Cable shall be supplied in 1000 ft spools or 1000 ft Reelex boxes.

2. Category 6 100 OHM balanced UTP Cable Performance Requirements

a. All transmission performance parameters shall be independently verified by a UL or ETL third party testing organization.

b. Cable shall exceed Category 6 transmission requirements specified in ANSI/TIA/EIA-568-B.2-1, and shall be tested through 550 MHz.

c. Worst-case cable performance shall be +8.0 dB headroom over current TIA/EIA and ISO standards limits for NEXT and PSNEXT loss, and ELFEXT and PSELFEXT loss.

d. Insertion loss shall be 3.0% lower than standard Hubbell Category 6+ plenum and riser cables described in Section 27 15 13.

e. Worst case electrical performance characteristics shall be as follows:

- Characteristic Impedance: 100 + 15 (1.0-100 MHz) 100 + 20 (101-250 MHz)
- Maximum Conductor Resistance: 9.38 /100 Meters @ 20°C
- Maximum Resistance Unbalance: 3%
- Maximum Mutual Capacitance: 5.6 nF/100 Meters @ 1 kHz
- Maximum Capacitance Unbalance: 330 pF/100 Meters
- Maximum Delay Skew: 25 ns/100 Meters

f. The manufacturer shall provide Category 6 component compliance certificates from third party testing organization upon request.

g. Cable shall be UL and C(UL) listed.

h. Cable shall exceed IEEE 802.3af DTE Power specification to 4 times the rated current limits with no degradation of performance or materials.

i. Cable shall be third party verified, error free Gigabit Ethernet performance to IEEE 802.3ab.

j. Cable shall exceed the requirements of TIA/TSB-155: 10 Gb/s Ethernet Operation over 55 Meters Channel Length.

k. Cable shall meet or exceed the 4-connector channel performance requirements of Category 6, per the ANSI/TIA/EIA-568-B.2-1 standard.

l. The 4-connector channel test configuration shall utilize Category 6 jacks and patch panels, with Category 6 patch cords, from the same manufacturer, with pre-qualified Category 6+ cable.

2a. Minimum Cable Performance:

a. All measurements are at 250MHz

- Insertions Loss: 32.7dB
- NEXT: 41.4dB
- ACR:8.6dB
- ELFEXT: 23dB
- Return Loss: 17.5dB

3. Acceptable Manufacturers:

a. Hubbell Premise Wiring: The Hubbell products listed in the table below comply with all requirements specified.

HUBBELL CATALOG NUMBER	Description
C6SPxx	NEXTSPEED Category 6 550 MHz – Plenum Spool
C6RPxx	NEXTSPEED Category 6 550 MHz – Plenum REELEX

xx = Cable color. Replace xx with “W” for White, “GY” for Gray, “B” for Blue, “Y” for Yellow. Refer to project drawing for color applications.

b. Or approved equal of: Berk-Tek, Systemax, Panduit

4. Category 6+ 100 OHM balanced UTP Cable Installation Requirements

a. Pull cable into conduits, or place into raceway or cable tray as specified. Do not exceed 25 Lb. pull force per cable. Use appropriate lubricants as required to reduce pulling friction.

b. All exposed wiring shall be installed in surface raceway.

c. All wiring above ceilings or below access floors shall be installed in cable tray or open-top cable hangers.

d. Cable slack and service loops shall be stored properly above the ceiling or under the access floor. A “figure-eight” service loop is recommended for Category 6 cabling to reduce EMI coupling.

e. Pathway fill ratio in conduit, tray, raceway, etc. shall not exceed 40% of pathway cross-sectional area.

f. Installed cable bend radius shall be greater than 4X cable diameter. Avoid kinking or twisting the cable during installation.

g. Do not over-tighten cable ties, and do not use staples or clamps to anchor cables. Velcro straps are recommended.

h. Recommended spacing of cable supports above the ceiling shall be 48”.

i. Maintain the following clearances from EMI sources:

- Power cable: 6 in.
- Florescent lights: 12 in.
- Transformers and electrical service enclosures: 36 in.

j. Communications cabling that must cross power cables or conduit shall cross at a 90-degree angle, and shall not make physical contact.

k. Length of each horizontal cable run from the TR to the wall outlet shall not exceed 90 meters.

l. Leave sufficient slack for 90 degree sweeps at all vertical drops.

m. Do not install cable in wet areas, or in proximity to hot water pipes or boilers.

n. Cable ends for termination shall be clean and free from crush marks, cuts, or kinks left from pulling operations.

o. Installed cable jackets shall have no abrasions with exposed conductor insulation or bare copper ‘shiners”. The installer is responsible to replace damaged cables.

p. Horizontal cables extending from mounted jacks or panels shall maintain a minimum bend radius of at least 4 times the cable diameter.

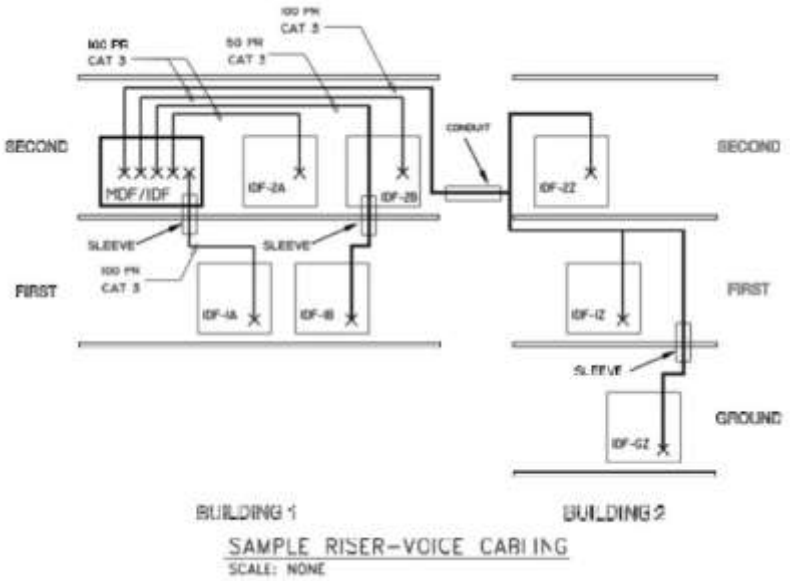
q. Firestop all cable penetrations through fire-rated barriers per local codes.

R. VERITCAL DISTRIBUTION SYSTEMS

1. Riser Connectivity and Cable General

a. The cabling system shall use a fiber/copper riser cable system between the IDF rooms and the MDF within the building.

b. Fiber Riser shall be 12-strand single mode fiber optic cable is to be installed between each IDF and the MDF Room. These cables are to be terminated onto fiber optic patch panels located in the relay racks in each of the IDF rooms and the MDF Room. The 12- strand single mode fiber cable is to be connectorized with LC connectors on both ends.



2. Fiber Backbone Distribution cable: indoor, armored

   a. Fiber Backbone Distribution cable Requirements

   - Optical Fiber Indoor Distribution Cable shall be constructed with 12 optical fibers, each coated with a 900 micron color-coded PVC tight buffer, surrounded by an aramid yarn strength member, Armored, and a single outer jacket with the appropriate flame rating.

   - Fiber cables shall be a non-metallic construction, OFNP (Plenum FT-6) flame rating.

   - Cable markings shall repeat every meter, and shall have at minimum the following information:

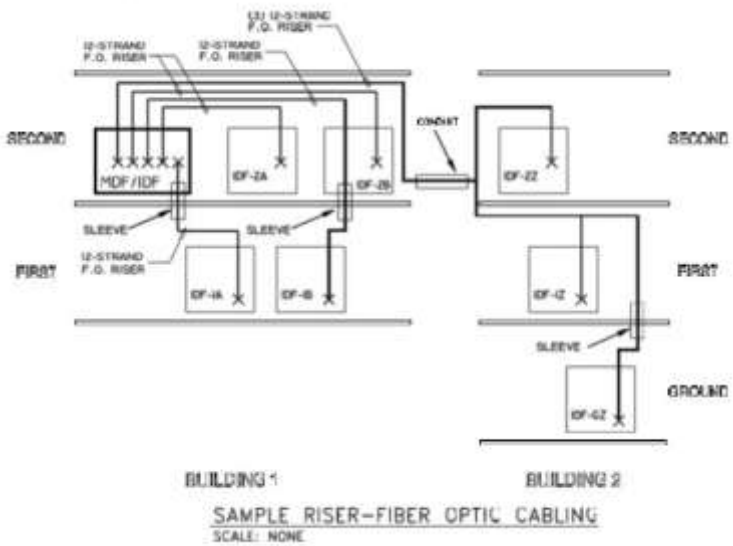
     a. Sequential length indicator marking (meters)
     b. Manufacturer's name and catalog number
     c. Lot number, traceable back to the fiber draw lot
     d. Date of Manufacture
     e. Fiber type: (Singlemode)
     f. Cable rating (OFNR, OFNP, etc.)
     g. Applicable TeLCordia, TIA, IEC, and ICEA standard references and appropriate UL/CSA agency listings

   - Cable jacket color shall be yellow for Singlemode 8.3/125 micron fiber.

   - Buffer position color codes shall conform to standard ICEA and TIA-598 conventions as follows:1-Blue, 2-Orange, 3-Green, 4-Brown, 5-Slate, 6-White, 7-Red, 9-Yellow, 10-Voilet, 12- Aqua.

   - Optical fiber in any cable construction shall be enhanced performance, bend-insensitive type.

   - Singlemode cables shall perform at minimum to the attenuation, bandwidth, and distance application parameters in the table below.



Fiber Gigabit and 10 Gigabit Ethernet Application Chart					
Fiber Type	**Wavelength (nm)**	**Max Attenuation (dB/km)**	**Bandwidth (MHz●Km)**	**1 GbE Distance (m) @ 850/1300nm**	**10 GbE Distance (m) @ 1300nm**
SM 8.3 µm (OS2)	1310/1550	0.5/0.5	>25000	5000/-	10,000/40,000

- Optical fiber cables as supplied shall meet or exceed the applicable IEC 60793-1 qualification test requirements for optical, geometry, mechanical, and environmental parameters as specified, and tested in accordance with TIA/EIA-455.

b. PERFORMANCE REQUIREMENTS

- For installed fiber cables, all fiber strands shall pass insertion loss and return loss in accordance with test methods ANSI/TIA/EIA-526-14 for multimode cables.

- Installed fiber cables shall exceed all currently ratified bandwidth-distance- application performance parameters for IEEE 802.3ae (10 GbE) and for IEEE 802.3ba (40/100 GbE)

- Plenum cables shall be rated UL NFPA-262/UL910/CSA FT-6

c. Acceptable Manufacturers:

- Hubbell Premise Wiring or pre-approved equal. The Hubbell products listed in the table below comply with all requirements specified in this document

HUBBELL CATALOG NUMBER	Description
HFCD15012PS	Fiber Optic Cable – 12 Strand SM 8.3 µm (OS2), Plenum, Armored, yellow

- Or approved equal of: Panduit, Berk-Tek

d. Fiber Backbone Distribution cable: indoor, armored Installation Requirements

- Prior to cable deployment, backbone pathways (conduit, tray, raceway, wire basket, etc.) for cable routing shall be permanently installed in compliance with contract documents, and applicable codes and standards.

- Racks, cabinets or enclosures into which cables are to be routed shall be permanently installed in compliance with contract documents, and applicable codes and standards.

- Optical fiber cables shall be deployed using the proper pulling grip or apparatus attached to the exposed cable strength member. Contact the cable manufacturer regarding permissible methods for cable pulling. Never pull directly on the fiber strands of an optical fiber cable.

- Cables shall not exceed minimum bend radius limits or maximum pulling loads during or after installation. Avoid crushing or abrasion of the cable jacket during installation.

- Installed cables shall be fully supported and strain relieved from pulling on terminated connections. Apply wire ties loosely and avoid crushing or clamping cables with excessive force.

- All non-armored fiber optic riser cables are to be installed in plenum inner-duct. Fibers in innerduct or armored plenum riser serving as riser cables are to be installed according to the attached riser drawing. Contractor to size the inner-duct for each cable run. Multiple fiber optic cables can occupy an individual inner-duct when non-armored finer is not used.

S. PATCH CABLES

1. Patch cables should meet the minimum performance requirements specified for each system. This requirement specifically prohibits the use of flat, non-twisted (also known as "silver satin") cords for Data or local area network applications. However, "silver satin" patch cables are acceptable for use in telephone systems.

2. The contractor shall provide two Category 6 Patch Cords for each end of each standard outlet for horizontal LAN connectivity. The cords are to be of varying lengths based on the patch panel, electronics equipment, and work area configurations. The quantity and lengths are to be documented and agreed upon, and the owner or Project Manager is to sign for them upon acceptance. These cords are to be stored in the MDF or IDF room for which they are designated.

3. The contractor is to provide dual LC to LC Patch Cords for connectivity for ports or equipment served by the fiber patch panel. The cords are to be of varying lengths based on the patch panel and electronics equipment configurations. These cords are to be stored in the MDF or IDF room for which they are designated.

4. Fiber Patch Cords

   a. Fiber Patch Cord Requirements

      - Provide factory-made, dual LC to LC fiber cables in 1-Meter lengths for every fiber cable installed.

      - LC Optical fiber patch cords shall be constructed with aramid-reinforced PVC loose-jacket duplex cable, with optical fibers having a 900-micron PVC buffer coating diameter. Optical fiber used in 10 GbE patch cords shall be laser optimized 50 or OS2 singlemode, per ANSI/TIA/EIA-492AAAC,with no substitutes.

      - 50 micron core optical fiber within the patch cord cable shall be graded index type in accordance with ANSI/TIA/EIA-492AAAC, with the following specifications:

a. Core diameter: 50 +/-3.0 microns, or 8.3 micron for singelmode
b. Cladding diameter: 125 +/- 2.0 microns
c. Core/cladding concentricity: less than 3.0 microns
d. Core non-circularity: 6% maximum
e. Proof test: 100 kpsi
f. Effective modal bandwidth: 5700 MHz•km
g. Coating diameter: 245 +/-15 microns
h. Buffer diameter: 900 microns nominal

- Connector terminations on each end of the fiber patch cord shall be heat-cured epoxy type with a machine polish, inspected 100% for polish quality and mated-pair insertion loss.

- Epoxy volume within each connector shall be sufficient to properly surround and strain relieve the fiber and buffer layer at the buffer/fiber transition inside the connector body.

- Optical fiber patch cords shall be supplied in a sealed plastic bag with dust caps installed on each end, with insertion loss test results included.

- Optical fiber patch cords shall be available in standard lengths of 1, 2, 3, and 5 meters.

- Optical fiber patch cords shall be manufactured with industry standard LC or LC connector terminations on each end.

- Factory mounted connectors on each end of the patch cords shall comply with the applicable ANSI/TIA/EIA-604 Inter-mateability standard.

- Buffered fiber strands within the cable jacket shall be surrounded by aramid (Kevlar) material serving as a strength member.

- The aramid (Kevlar) strength member shall be mechanically secured at each connector to provide tensile strain relief of the optical fiber.

- Additional strain relief of the buffered fiber shall result from crimping the rear of the connector during termination.

- Duplex fiber patch cords shall be a zip-cord cable construction with jacket cross-section dimensions of 3.0 mm X 6.0 mm for LC style.

- Duplex fiber patch cords shall have reverse-pair polarity according to ANSI/TIA/EIA-568-B.3 and TIA/EIA-TSB-125.

- Cable jacket shall be marked with the cable manufacturer, UL Optical Fiber Non-Metallic Riser rating (Type OFNR) designation, lot number, and fiber core/cladding diameter designation.

- Fiber A-B polarity shall be clearly marked on each end of duplex patch cords.

- Optical fiber patch cord jacket color shall be aqua blue, specifically for 50 micron laser optimized singlemode fiber cables.

- Fiber patch cord connector materials shall be as follows:

  a. LC Ferrules: zirconium ceramic
  b. LC housings: injection molded thermoplastic
  c. Dust Cap: nylon or PVC
  d. Strain relief boot: UL94-V0 molded PVC

e. Strain relief boot on all connectors shall be beige.
f. LC connector outer housing shall be beige.

b. Fiber Patch Cord Performance Requirements

- 50 micron laser optimized and singlemode patch cords shall have a maximum mated-pair insertion loss of 0.60 dB per end, with a minimum return loss of –20 dB.
- Fiber patch cords shall exceed 10 Gigabit Ethernet performance requirements of IEEE 802.3 standard.
- Fiber patch cords shall exceed the mechanical reliability requirements for tensile, flex, twist and impact as specified in ANSI/TIA/EIA-568-B.3, Annex 'A'.
- Fiber patch cords shall exceed the environmental reliability requirements for high/low temperature and humidity as specified in ANSI/TIA/EIA-568-B.3, Annex 'A'.

c. Acceptable Manufacturers:

- Hubbell Premise Wiring: The Hubbell products listed in the table below comply with all requirements specified in this document

HUBBELL CATALOG NUMBER	Description
DFPCLCLCFyySM	LC-LC Optical Fiber Patch cords, OS2-SM, yellow
(yy=length-1,2,3,5m)	

- Or approved equal of: Ortronics, Panduit, Systimax.

5. Category 6 Patch Cords: In new construction projects, the default cabling infrastructure shall be Category 6 unless specified otherwise.

a. Category 6 Patch Cord Requirements

- The contractor shall provide two Category 6 Patch Cords for each end of each standard outlet for horizontal LAN connectivity. The cords are to be of varying lengths based on the patch panel, electronics equipment, and work area configurations. The quantity and lengths are to be documented and agreed upon, and the owner or Project Manager is to sign for them upon acceptance. These cords are to be stored in the MDF or IDF room for which they are designated.

- Category 6 patch cords shall be constructed with a clear polycarbonate plug and boot having vertically staggered, trifurcated contacts, each having 50 micro-inches of gold plating.

- Plug dimensions and function shall comply with FCC 47, Part 68.5.

- Patch cords shall have a snag-less feature, integral to the strain relief boot on each end.

- Patch cords shall be constructed with category 6 patch cable, with 24 AWG 7/32 tinned copper stranded conductors, each insulated with polyethylene, and overall jacket with UL flame-retardant PVC.

- Patch cords shall be manufactured using a T568B wiring format, and shall function suitably for either T568A or T568B wiring schemes.

- Patch cords shall be available in the following colors: black, blue, gray, yellow, orange, red, green, white, and purple. Custom lengths and colors shall be available with a delivery lead-time quotation.

- Standard patch cord lengths shall range from1 ft. to 20 ft.

- Category 6 patch cords shall be backward compatible with existing Category 5 and 5e cabling systems for fit, form, and function.

b. Category 6 Patch Cords

- All transmission performance parameters shall be independently verified by a UL or ETL third party testing organization.

- Category 6 patch cords shall be channel performance balanced with Hubbell category 6 jacks, patch panels, and punch-down blocks.

- Category 6 patch cords shall meet or exceed Category 6 component transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA-568-B.2-1 standard.

- The manufacturer shall provide Category 6 component compliance certificates from third party testing organization upon request.

- Patch cords shall be cUL and UL LISTED 1863.

- Patch cords shall exceed IEEE 802.3 DTE Power specification to 4 times the rated current limits with no degradation of performance or materials.

- Patch cords shall be third party verified, error-free Gigabit Ethernet performance to IEEE 802.3 standard.

- Jacks shall exceed 4 Gb/s data transmission capacity within the bandwidth of 1 – 250 MHz when configured in a 4-connector channel.

- Category 6 patch cords shall meet or exceed the 4-connector channel transmission performance requirements of Category 6, per ANSI/TIA/EIA-568-C.2 standard.

- The 4-connector channel test configuration shall utilize Category 6 patch panels, blocks, and jacks.

c. Acceptable Manufacturers:

- Hubbell Premise Wiring: The Hubbell products listed in the table below comply with all requirements specified in this document

HUBBELL CATALOG NUMBER	Description
HC6xx01	Category 6 Patch Cord, 1FT
HC6xx03	Category 6 Patch Cord, 3FT
HC6xx05	Category 6 Patch Cord, 5FT
HC6xx07	Category 6 Patch Cord, 7FT
HC6xx010	Category 6 Patch Cord, 10FT
HC6xx15	Category 6 Patch Cord, 15FT
HC6xx20	Category 6 Patch Cord, 20FT
HC6xx25	Category 6 Patch Cord, 25FT

xx = Cable Color. Replace xx with “W” for White, “BK” for Black, “B” for Blue, “GY” for Gray, “GN” for Green, “P” for Purple, “OR” for Orange, “R” for Red, “Y” for Yellow. Refer to project drawing for color applications.

- Or approved equal of: Ortronics, Panduit, Systimax.

T. FIRE STOP – PENETRAION SEALANT

1. Provide fire-resistant silicone foam fill to restore fire ratings to all wall, floor, or ceiling penetrations. Foam must be UL classified and meet NEC and local code.

2. All penetrations through fire-rated floors and walls shall be sealed to prevent the passage of smoke, fire, toxic gas, or water. The fire rating of the penetration seal shall be at least that of the floor or wall into which it is installed, so that the original fire rating of the floor or wall is maintained as required by Article 300-21 of the National Electric Code.

3. No flammable material may be used to line the chase of the hole in which the fire stop material is to be installed.

4. When damming materials are to be left in place after the seal is complete, then all such materials shall be non-flammable.

5. The sealant shall be poured into the hole after each cable has been spread to allow a minimum of ½" of foam to flow between them. No cables may be touching each other, because contact between cables could allow voids to form in the fire stop.

6. If plastic cartridges are used for smaller installations, the chemical components of the foam shall be pre- measured within the cartridges to ensure the proper ratios.

7. The sealant shall remain resilient and pliable to allow for the removal and/or addition of cable without the necessity of drilling holes. It shall adhere to itself perfectly to allow any and all repairs to be made with the same material. It shall allow for vibration, expansion, and/or contraction of anything passing through the penetration without affecting the seal, or cracking, crumbling, and spalling.

8. When sealant is injected into a penetration, the foam shall expand to surround all the items within the penetration at that time and be fire resistant, maintaining the pass-minute rating. No heat shall be required to further expand the foam to block the passage of fire and smoke or water.

9. The foam sealant material shall have been subjected to fire exposure testing in accordance with standard time-temperature curve in the Standard, UL, ASTM E

10. 119, and NJPA 251. The foam fire-stop material shall also have been subjected to the hose stream test in accordance with UL 10B.

U. TESTING

1. General Test Procedures

   a. Before an application for final acceptance of the work will be considered, all tests stated within this section shall be satisfactorily completed. The communications work shall include miLCellaneous tasks, (e.g., removal of panel trims, junction, and pull box covers) deemed necessary to demonstrate compliance with the requirements of the Communications specifications, as well as cable and equipment manufacturers' recommended installation procedures.

   b. Upon completion of testing and problem resolution, all connections must be 100% error free: "Error free" is defined to mean the item meets all the manufacturers' specifications and recommendations as published in their latest manufacturing manuals for proper installation and testing. In addition, each item must conform with all other related industrial practices and standards, Building Trades, and Electrical and Communications Industry Standards and Practices.

c. Upon successful completion of each item of testing, the Contractor shall issue in writing a certificate of compliance, along with the test results, to the Project Manager. All failed CAT-6 cables and/or Fiber strands shall be clearly labeled and identified as defective, with the type of defect (i.e. open ring side, grounded tip, short, excessive loss, etc.) identified.

d. The Contractor will attempt to remedy any defective copper cable pair or Fiber cable strand and specify in the documentation the location of the problem as identified during the testing procedures. The Fiber trouble location and identification must be completed with an OTDR.

2. Copper Cable Test Procedures

a. Contractor must complete cable system performance verifications on all copper and fiber cable as specified below and provide the test results to the owner or project manager. Category 6 – 6a cable must meet or exceed all manufacturer's and EIA/TIA standards for performance and installation. Fiber cable must also meet or exceed all manufacturer's and EIA/TIA standards for performance and installation.

b. All copper and fiber optic testing documentation is to be submitted on a CD, as well as 8.5" x 11" hard copies.

c. At a minimum, in addition to any other required testing, the Contractor shall conduct and report on the following tests of copper cabling after the installation is complete:

- MDF-to-IDF tests of all new riser pairs installed under this contract, to determine continuity, shorts, crossed pairs, correct pinning, and grounds.

- IDF (patch panels)–to-information outlet tests of all new cable pairs installed under this contract, to determine continuity, shorts, crossed pairs, correct pinning, and grounds.

- The coaxial cable is to be tested from the MDF Room to the IDF Room and from the IDF Room to the coax outlet. Contractor is to test for continuity, shorts, and grounds.

- The horizontal Category 6 cabling, installed from the IDF Room to the Information Outlet at the workstation, is to be manufacturer certified and warranted for Category 6 compliance. All manufacturers' performance certificates and extended warranties are to be provided to the owner or project manager upon completion of the testing and manufacturer certification. Contractor is to present copies of certificates identifying the contractor as a current certified VAR for the selected cabling system and therefore, qualified to install a certified cable plant.

- All Category 6 cabling is to be tested end–to-end and documented for Category 6 compliance at all frequencies up to and including 250MHz for 6. Such testing is to comply with the procedures and standards outlined by the cable manufacturer and EIA/TIA TSB - 67 concerning testing of Category 6 cable plant.

- A certified Cat 6 testing system is to be used for such testing to insure that cable pairs are defect free. "Defect free" for the copper cable is defined as a copper pair not having any pair reversals, split pairs, shorts or opens. Test results shall be provided to the Owner or Project Manager within 2 days after testing or 5 days prior to the Owner connecting electronic equipment onto the cable network, whichever is sooner. The contractor must also provide testing summary reports of all category 6 cables including run numbers, and pass/fail results with respect to length, impedance, DC resistance, mutual capacitance, attenuation, NEXT loss, and active ACR. The contractor must also provide spreadsheet analysis of the linearly dependent parameters of length, DC resistance, mutual capacitance, and attenuation; the field measured values shall be compared to the specification's values on one spreadsheet.

- In the event that a CAT 6 cable fails to perform to the manufacturer's specifications, the Contractor will, at the owner's request, remove the cable and replace it with a new cable, replacing the defective cable at no additional expense to the owner.

- End-to-end testing is required for every RJ-45 connection. An owner's representative may accompany the Contractor's staff to witness the end-to-end testing. End-to-end testing is defined herein as testing all cabling links to the very last termination point. The Contractor is required to supply sufficient quantities of two-way radios and test equipment to ensure that the tests are completed accurately and expeditiously.

- The Owner, DTI, or Project manager may conduct performance tests of transport electronics connected to the cabling system. Successful equipment performance tests do not relieve the Contractor from the specified testing, repair, and documentation requirements.

- The Contractor shall provide to the Owner or Project Manager with copies of all copper-cable test results.

3. Fiber Optic Cable Test Procedures

   a. All fiber optic cable and associated equipment lateral, and vertical riser cabling must be thoroughly tested. The fiber cable will be accepted only after each strand is tested in accordance with the specifications defined herein. All strands are to be tested and found to be 100% acceptable.

   b. The Contractor shall test all cables, connectors, associated equipment, and hardware furnished by the Contractor upon receipt of same as defined herein.

   c. As a minimum, the Contractor shall test, as described below, all optical fiber cable strands installed within the scope of this proposal:

      - Fully test complete links only. Piecemeal testing is not acceptable.

      - Perform end-to-end, bi-directional attenuation (loss) test for each fiber strand at 1310 and 1550 for singelmode. Conduct tests in accordance with EIA/TIA-526-14, Method B and with test instrument manufacturer's published instructions.

        a. Demonstrate that measured link loss does not exceed the expected value based on the number of mated connector pairs, the connector's published loss per mated pair, and the cable's published loss based on distance.

        b. Strands whose measured attenuation falls outside the acceptable range shall be subject to further inspection and testing to determine the nature of the fault. At a minimum, an OTDR shall be used to: determine the true loss for each connector pair and the exact length of the fiber, and to identify the presence of any core damage.

        c. Riser end-to-end testing of individual optical fibers is considered to be from the MDF Room to the IDF Rooms distribution panels on each floor.

      - Faults related to connectors shall be corrected and the fiber re-tested as stated above until acceptable attenuation measurements are received.

      - Where defects are found to be inherent in the fiber itself, notify the Project Manager in writing. Upon obtaining approval by the Project Manager, replace any cable having fewer than the manufacturer's guaranteed number of serviceable fibers.

      - Remove all newly installed defective cables from pathways. Do not abandon cables in place.

- All test results and corrective procedures are to be documented and submitted as a spreadsheet, and digitally on a USB thumb drive to State/DTI within five (5) working days of test completion.

- Considering that the fiber cable plant is to be certified, each test report form shall provide at least the following information:

  a. Project name
  b. Contractor's name
  c. Date(s) of preparation and of testing
  d. Fiber type, strand count, connectors and patches
  e. Designated cable number (regardless of whether only one cable of each type is present) and individual fiber numbers
  f. Make, model, serial number, and date of last calibration of test equipment used
  g. Name of test crew foreman
  h. Test results: Calculated maximum link loss, length of run, OTDR, and also
  i. Power Meter-measured link loss for each fiber, pass/fail result, and comments.

- In addition to the tests specified above, the Contractor shall be present while the Owner or Project Manager conducts performance tests of the transport electronics connected to the cabling system; the contractor shall conduct on- the-spot cable tests and effect cable plant repairs as necessary. Successful equipment performance tests do not relieve the Contractor from the specified testing, repair, and documentation requirements.

- Recommended test equipment:

  a. Optical fiber power meter and Light Source: OS-100D Light Source, or equivalent.
  b. TDR: Tektronix TFP2 FiberMaster, Laser Precision TD-2000 or equivalent with 850nm and 1300nm emitter modules and hard copy printout, or equivalent.
  c. Optical fiber inspection scope: Cambridge Instruments 10x fiber scope, or equivalent.

- The Contractor shall provide copies of all fiber and copper cable test results to the Owner or Project Manager.

- All fiber optic cabling (workstation and riser) is to be installed in a manner that complies with and allows Owner to receive the manufacturer’s extended warranty. The contractor is to be certified and authorized to provide the extended warranty. A manufacturer's extended warranty is to be provided, through the contractor, upon completion of the testing and manufacturer’s certification. Contractor is to present copies of certificates identifying the contractor as a current certified VAR and therefore, qualified to certify and install the cable plant.

- The Owner and Project Manager reserves the right to observe any or all portions of the testing. Notification of testing is at least three days prior to start of testing.

4. Replacement

   a. Any fiber strand, connector, block, or module installed by the Contractor that fails to meet the loss budget, or that tests below the manufacturer's standards, shall be replaced at no additional cost to the owners or State/DTI. The replacement cable, connector, or part shall be tested after repairs have been made to verify compliance. Only equipment that meets the installation requirements stated herein shall meet the system’s acceptance requirements.

5. Source Manufacturing/Quality Control

a. Cables that are supplied by the Contractor, and test outside of the factory test data by a margin of 10 percent on loss, may be deemed non-usable and returned to the manufacturer for replacement.

6. Physical Inspection: Prior to conducting any transmission testing, the following visual inspections will be performed:

   a. Verify that all cable has been installed in full compliance with the proposal specifications.
   b. Check for physical damage to the Fiber Distribution Panels and termination hardware.
   c. Check that all cabling is properly jacketed, installation properly labeled at both ends of the cable, inner-duct and termination hardware is completed in all IDFs and the MDF Room.
   d. Verify that all cable bends are within the manufacturer's specified bend radius.
   e. Verify that all cabinets and racks (which require grounding) are properly grounded and comply with the National and Local Electrical Codes and State Standards for grounding.
   f. Verify that the cables are properly approved and structurally supported for termination.
   g. Verify that all Delaware Fire Code requirements have been met and satisfied.

7. DOCUMENTATION

   a. Proper labeling and documentation will allow a technician to quickly trace a particular cable link and will significantly reduce the time and costs of moves, additions, changes, and troubleshooting. Both labeling and documentation depend on the use of a system-wide coding LCheme that will identify and locate each component of the wiring system and allow all components to be linked in a logical fashion.

   b. There are three components of wiring system documentation:

      (1) Labeling Communications/Data room/closet termination areas aids in identifying the source and function of a circuit.

      (2) A labeling scheme simplifies the documentation process.

      (3) “As built” documents provide a permanent record of the communications infrastructure. These documents are a critical management resource. As a result, it is imperative that "as built" documentation be prepared as part of the communications infrastructure project. In addition, these documents must be kept current throughout the system's life cycle.

8. Termination Blocks

   a. Labels on the connecting hardware should be coded based on the function of the terminated wiring. Colored designation strips are typically provided with a termination block.

9. Cable and Information Outlet Identification: The Contractor shall furnish and install cable tags labeled with identifying cable numbers mutually agreed upon with contractor and the Owner or Project Manager.

   a. The Contractor shall clearly and consistently mark the appropriate designation strip labels on all termination hardware mutually agreed upon with the Owner or Project Manager. Contractor will submit a sample of all designation labels for approval before installation.

   b. The Contractor shall affix outlet identification labels, machine printed or typed, with identifying cable numbers as shown on the attached drawings.

   c. Subsequent to pulling and terminating cables, the Contractor shall place the appropriate cable tags within six (6) inches of each end of each copper cable and eighteen (18) inches of each optical fiber cable end.

d. If the cable tape becomes illegible or is removed at any time during the job, the

e. Contractor shall immediately replace it with a duplicate preprinted cable tag.

f. The Contractor shall provide the Owner or Project Manager with a listing of all cable identification numbers, keyed to cable types.

g. Contractor will label each information outlet with the following labeling scheme: If the 1st floor IDF closet "A" is the origination point of the cable feeding workstation "007" the following is the configuration of the label to be installed:

Floor- IDF Closet - Information Outlet Number
Example: 1A-007

h. Contractor will submit for approval a sample of all information outlet designation labels.

10. "As-Built" Documentation

a. Maintaining records and documents is the most important portion of the administration of a communications infrastructure. Maintenance and moves, additions, and changes can become very difficult if a current set of records and documents is not maintained. In fact, isolation and resolution of problems are often delayed because configuration information is either unavailable or outdated.

b. Subsequent to the installation and prior to acceptance, the Contractor shall prepare and issue As-Built drawings, in an AutoCAD format, that shall reflect the lengths of cables installed and the actual manner and conditions of installation, including all deletions from, additions to, or departures from the contract documents. These documents are to include the information outlet station numbers and cable routing where they vary from the original plan. A copy of these documents will be stored in the MDF, with a master copy located at the Owner or Project Manager.

11. Cable Management System

a. Wiring and equipment relationships must be maintained in a database or spreadsheet (depending on their complexity). The best approach is to use a third- party vendor's application for tracking cable management. These records contain comprehensive information about the users' communications configuration. The information will be very valuable in the support of long-term user-community communications requirements.

V. APPENDIX A – COMMUNICATIONS PLANNING CHECKLIST

1. Space allocation for Communications/Data Room/Closets

a. Based on a number of factors, including the:

- Type of equipment to be installed
- Size of the phone and data termination backboards
- Access to floor cores and conduits
- Cable tray requirements
- Location, size, and swing of the Communications/Data room/closet door(s)

b. Square footage is not as important as the actual floor dimensions and the placement of the equipment. It is possible to design around some obstacles and still have a functional facility. For instance, an oblong room is not as desirable as a square room having the same square footage.

c. The criteria for establishing the size of a Communications/Data room/closet and determining whether or not it is functionally acceptable are complex. Answering the following questions is the first step in determining the long-term feasibility of a communications room or closet:

- What will be the closet's primary function: phone, data, or combined services?
- Where is it located in proximity to serviced workstations, network rooms, and other Communications/Data rooms/closets?
- What type of equipment is going to be in the room/closet?
- Is it wall- and/or rack-mounted?
- How much equipment will be put in the room/closet? What are the dimensions of those devices?
- What are their environment requirements?
- Based on the type(s) of equipment going into the room/closet, what is the installation, maintenance, and operator work space required around the equipment?
- Can the equipment be attached securely to the structure?
- What cable types are being used? What are the cable separation requirements? Where are the cables terminated within the closet?
- Does equipment mounted in the closet require an open space? Is there any other device needing clear space?
- Is the room/closet securable? Do other entities need access to the space? What are their space requirements?
- What size is the door? Does it swing in or out? Can the door be modified?
- Is power available? Can it support the room/closet electrical requirements? Can it be modified?
- Does the room need air conditioning? Does it ventilate well? Can it be modified?
- Where are the floor cores and the ceiling access points for conduits?
- Are there expansion requirements? Can the expansion requirements be accommodated by the room/closet size? Can the closed be enlarged at a later date?

W. APPENDIX B – CABLE INSTALLATION CHECKLIST

1. Check Local Building Codes

   The requirements stipulated by Section 800 of the National Electrical Code for Communications cable installations produce an orderly installation. However, it is important to consult your building inspector to determine whether there are special local requirements. Strapping requirements depend upon the building's design, State and Local Standards, and codes. Terminations can be made in standard junction boxes.

2. Coordinate with Other Contractors

   Plan to install the cabling system in new buildings after the power wiring, air- handling ducts, and ceiling supports have been installed, but before the ceiling tiles are in place. This will prevent damage to the cable system during construction.

3. Plan the Job

   On a blueprint, mark all terminations and desired routings, if known, to accommodate future building modifications.

4. Label the Cables

   Label each cable reel and its free end according to the termination locations marked on your blueprint.

5. Pull Cable into Place

Deliver the cable from the bottom of each reel, making sure not to kink, crush, or pinch the cable. Pull groups of cables to a logical point and then fan out to the individual termination points. Arrange the cables neatly so they are easily identifiable for relocation. Separate the Communications cables from other cables by at least six inches and avoid sharp edges, tight bends, and locations that would subject the cable to abrasion, corrosion, or moisture. According to the National Electrical Code, low-voltage cables cannot share a tray with power cables. Running signal cables close to power cables may also cause hum pickup. If in doubt about cable locations, consult the standards or the Owner.

6. Remove Slack

   Remove slack in lines by pulling the cables back to the wiring room and by adjusting their ceiling location as needed.

7. Label and Cut

   Label each cable and then cut it off, making sure to leave enough cable to reach the termination panel.

8. Tie Cables Together

   Use cable ties to bundle and secure parallel runs together. Place the ties at intervals sufficient to prevent sagging and to maintain neatness. Distances between ties may vary from six inches to four feet, depending on the size of the cables.

9. Strap the Cable

   Use straps to fasten the tied cable bundles to hangers at 4-foot or other appropriate intervals. The distance between hangers will vary from 3 to 20 feet, depending upon the strapping surface, the type and number of cables in each bundle, State and Local Standards, and codes. Make sure to support the cables with hangers rather than pipes, conduit, or other structures in the building plenum. If space permits, use existing hangers; otherwise, install new ones. Do not use straps that are too small for the cable diameter because they can cut or pinch the cable insulation.

10. Inspect the Job

    Be sure that the cables are not resting on false ceilings or near electrical fixtures or sagging more than three inches from the point of the tie wrap.

X. APPENDIX C – QUALTY ASSURANCE

1. All materials used shall bear the Underwriters' Laboratory, Inc. label, provided a standard has been established for the material in question.

2. All products and materials shall be new and unused, clean, and free of defects, damage, and corrosion.

Y. APPENDIX D – CODES, REGULATIONS, AND STANDARDS

1. All installations and equipment shall be in compliance with, equal to or exceed the minimum requirements of OSHA, NEC, NEMA, IEEE, SAME, ANSI, UL, EIA, TIA recommendations and the rules, regulations and requirements of the Federal Communications Commission.

2. The installation shall comply fully with all applicable Local, County and State of

3. Delaware laws and ordinances, regulations, and codes.

4. Local electrical and building codes in Delaware may be more restrictive than national codes, recommendations or practice. Follow the most restrictive code or recommendations.

5. Should any change in plans or Specifications be required to comply with governmental regulations, the Contractor shall notify the Owner or Project Manager at the time of submitting the construction schedule.

Z. APPENDIX E – WARRANTY

1. Besides the manufacturer's extended warranty the Contractor shall submit a single Guarantee stating that all portions of the work are in accordance with Contract requirements and guaranteeing all work against faulty and improper material and workmanship, including work and materials of all subcontractors, manufacturers, suppliers, and sub trade specialists, for a period of twenty-five (25) years from date of final acceptance by the project manager, State/DTI, and Owner. Where guarantees or warranties for longer terms are provided, such longer terms shall apply. Within 24 hours after notification, the Contractor shall correct any deficiencies that occur during the guarantee period at no additional cost to Owner, all to the satisfaction of the Project Manager and or Owner.

2. When installed by a Certified Installer and used in a Structured Cable System, the manufacturer's extended warranty shall cover the installation for a period of 25 years against defects in material and workmanship. It shall also guarantee that it will support any current and future applications designed for Data transmission over the 100/500MHz link/channel, as defined in TIA/EIA 568A Communications Standard.

3. All move, add and change (MAC) activity shall be covered by the warranty provided it is performed by a Certified Installer.

AA. APPENDIX F – BID/QUOTE RESPONSE FORMAT

1. Proposal identification number or control number. This number will be used as a reference for this individual proposal and will facilitate coordinating multiple bids or quotes for the same location or job site.

2. Requesting State Agency and Contact name, phone number and address. This should be the name of the State agency requesting the quote or bid and that agency's contact person's phone number(s) and address.

3. Building or office location address. This address should be the actual location of the job site. This address should include the floor numbers, if more than one story, and building numbers or names, if more than one building is involved.

4. Total Cost of Bid/Proposal. This dollar amount should include the total material and labor cost. The material and labor cost should be stated separately and then totaled. Also state whether or not labor costs are based on prevailing wage standards or not.

   Example:

Material	$3,500.00
Labor Prevailing	$2,750.00
Total	**$6,250.00**

5. Scope of Work. This section should be a written description of the work to be performed. It should be function-specific.

   Example:

   - Install, terminate both ends, test, and label XX work area locations consisting of one Voice and two Data CAT6 cables and CAT6 568-B RJ45 jacks.

- Install one Voice cable from the Communications Closet to the Fir/Security Alarm Panel location.
- Provide and install a 100-pair plenum-rated riser cable from the boiler room to the main communications closet and terminate on 110 type wall mount hardware.
- Provide and install 7' relay racks and CAT6 patch panels.

6. Material

The material should be and itemized list with manufacturer's name and part numbers, including all piece parts and quantity of each. Total man hours to complete the job should be included as an item in the list.

Hubbell Cable	Blue	C6RPB	2,800 ft
Hubbel Cable	White	C6RPW	2,000 ft
Hubbell Jack Single		HXJ6xx	14 ea
Hubbell Jack Double		HXJ6xx	14 ea
Hubbell 110 block		30200007	1 ea
Hubbell Panel P6E48U		951044344	1 ea
~~CIRCA protector panel~~		~~1880ECAS1-100G~~	~~2 ea~~
~~1 pair fuse CIRCA~~		~~4B1E~~	~~200 ea~~
etc.			
etc.			
etc.			
Labor Man Hours			75 hr

7. Warranty

This should include the name of the manufacturer from which the State will receive the warranty and the type and length of the warranty or warranties provided with the cabling solution that is proposed. 25 years is required.

BB. APPENDIX H – CERTIFIED CONTRACTOR LIST

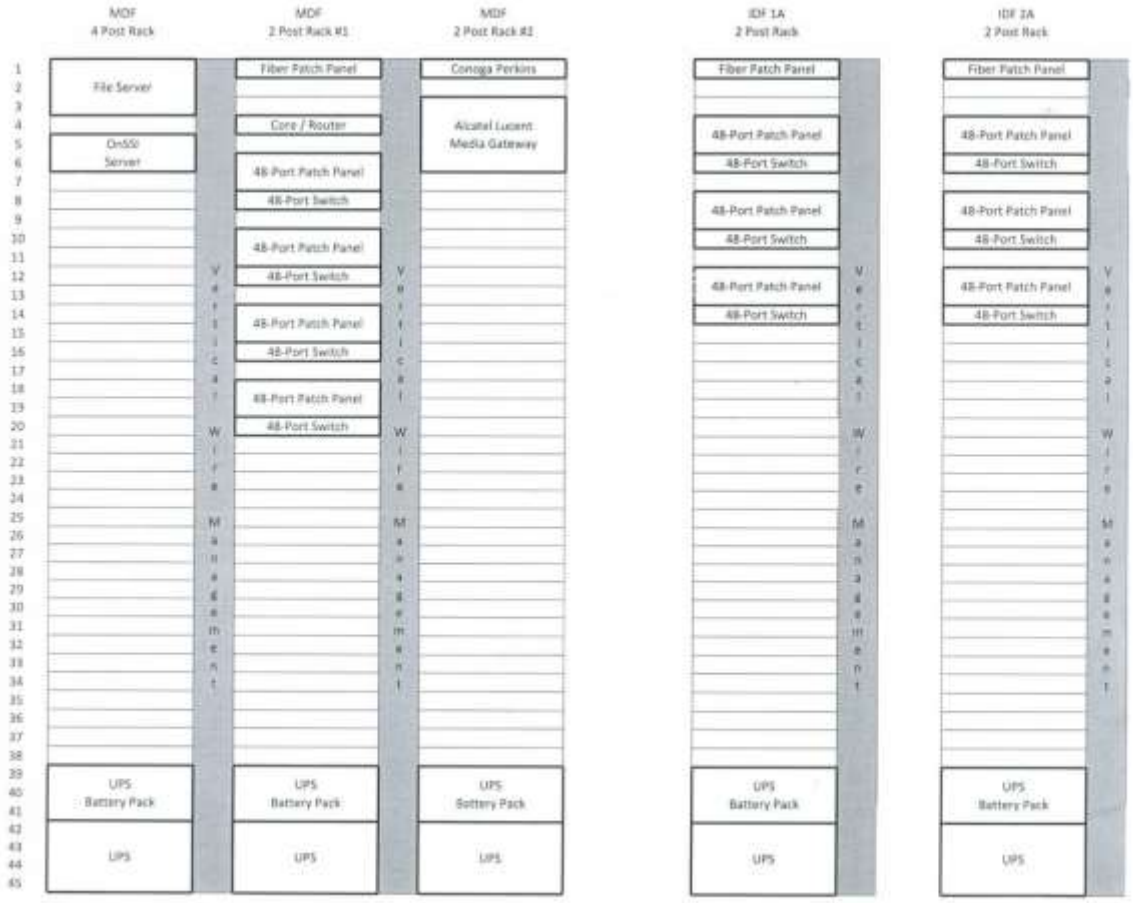
GSS16441-DATA_CBLV01 **Advantech Incorporated** 151 Garrison Oak Drive Dover, DE 19901 David Sweeney Phone: 302-674-8405 ext 123 Fax: 302-674-3698 Cell: 302-359-0189 Daves@advantechsecurity.net FSF ID#: 0000027017	GSS16441-DATA_CBLV02 **Arugie Enterprises Corp.** dba: ARG Communications 612 S Colonial Ave, Ste. A Wilmington, DE 19805 Joseph Ruggieri Phone: 302-225-2000 ext 301 Fax: 302-225-2010 Cell: 302-584-0010 joe@whyarg.com FSF ID#: 0000000456	GSS16441-DATA_CBLV03 **Assurance Medica, LLC** 590 Centruy Blvd., Suite B Wilmington, DE 19808 Chris Honeycutt Phone: 302-993-4486 Fax: 866-246-1153 Cell: 302-363-1500 choneycutt@assurancemedia.net FSF ID#: 0000020739

	GSS16441-DATA_CBLV05 **KCI Communications Infrastructure** 921 Mercantile Drive, Suite H Hannover, MD 21706 Josh Wilkerson Phone: 410-309-7902 ext 8614 josh.wilkerson@kci.com FSF ID#: 0000271910	GSS16441-DATA_CBLV06 **Skyline Technology Solutions, LLC** 6956-F Aviation Boulevard Glen Burnie, MD 21061 Jason Ross Phone: 410-590-2002 Fax: 410-787-2551 Cell: 443-398-7917 jross@skylinenet.net FSF ID#: 0000313842
GSS16441-DATA_CBLV07 **Tangent Cable Systems, Inc.** 3700 Washington Avenue Wilmington, DE 19808 Chad Myers Phone: 302-994-4104 Fax: 302-994-4105 Cell: 302-463-2396 cmyers@tangentcable.com FSF ID#: 0000027967	GSS16441-DATA_CBLV08 **Troy Ventures, LLC** dba: ThinkSecureNet, LLC and SecureNetMD, LLC 16557 Coastal Highway Lewes, DE 19958 Andrew Laroche Phone: 302-645-7770 ext 800 Cell: 860-305-4787 drew@securenetmd.com FSF ID#: 0000317474, 0000261617, 0000453212	GSS16441-DATA_CBLV09 **Under.Comm, Inc.** 198 Mullet Run Milford, DE 19963 Scott Hermansader Phone: 302-424-1554 Fax: 302-424-4478 Cell: 302-222-236 scott@undercomm.com FSF ID#: 0000030544

Awarded Categories:

Vendor	General Structured Cabling	DTI Dark Finer
Advantech Incorporated	X	
ARG Communications	X	
Assurance Media	X	X
KCI Communications	X	
Skyline Technology Solutions	X	
Tangent Cable Systems	X	
Troy Ventures	X	
Under/Comm	X	

2.2 DISTRICT STANDARD RACK LAYOUTS



END OF SECTION 26 07 40

SECTION 26 07 71
INTERCOM/TELECOMMUNICATION AND CLOCK SYSTEM

PART 1 – GENERAL

1.1 General

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division l Specifications Sections, apply to work of this section. Electrical Contractor shall provide device boxes, conduit stubs, and pull strings for all wall-mounted speakers.

B. This section is a Division 26 Communications System, and is part of each Division-26 Section making reference to the telecommunications system specified herein.

C. The contractor shall furnish and install all equipment including, but not limited to, outlet boxes, conduit (with pull strings), wiring, cable, speakers, telephones and clocks as shown on the plans, and all other equipment necessary to provide a complete and operating system for the Appoquinimink School District.

1.2 Scope of Work

A. Provide a telephone type communications system for all instructional and administrative areas. Provide for system integration of the following basic school communications systems including the Cafetorium and local classroom sound systems.

1. Telephone System
2. Voice Mail System
3. Intercom/Public Address System

B. Volp Telephone System: System provides for the interconnection to public telephone lines and intercommunications throughout the school. Each classroom or office provided with a telephone can communicate with any other internal telephone by touch-tone access. Integrate with the public telephone lines to provide inward and outward telephone calls on a controlled basis. Features and functions of the telephone system includes:

1. Private two-way telephone handset to handset communications.
2. Direct dial communications.
3. Dial access to intercom system for public address.
4. Administrative control console with display and busy lamp field.
5. Multi-line telephones.
6. Software programmable features, functions, and restrictions.

C. Voice Mail System: Provide system that utilizes recorded voice messages that are accessible from any touch tone telephone. System shall be fully integrated to digital telephone system. System shall provide the following features and functions.

1. Ability to light and extinguish message lights automatically.
2. Automated Attendant
3. Voice Mail

D. Intercom/Public Address System: Provide speaker and amplifier system for paging and public address throughout the school. Provide program channels for cassette tape players and AM/FM radio. System provides the following features and functions.

1. Audio program to classrooms.
2. Emergency paging.
3. All call paging.

4. Zone paging.
5. Hands-free intercom speaker communication.
6. Distribution of master clock class change tones.

1.3 Reference Standards

A. National Fire Protection Association:

1. NFPA 70-90: National Electrical Code.

B. Underwriters Laboratories, Inc.:

1. UL 486A-91: Wire connectors and soldering lugs for use with copper conductors.
2. UL 1449-85: Transient voltage surge suppressors.
3. Comply with UL 1863.

C. Electronics Industries Association:

1. EIA 568-91: Commercial Building Telecommunications Wiring Standard.
2. EIA-160: Sound Systems.
3. EIA-299A: Loudspeakers, Dynamic Magnetic Structures and Impedance.
4. EIA-310A: Racks, Panels and Associated Equipment.
5. SE-101-A: Amplifier for Sound Equipment.
6. SE-103: Speakers for Sound Equipment.

D. Federal Communications Commission:

1. FCC Regulations, Part 15 Title 47.

1.4 Submittals

A. Shop Drawings: Submit in accordance with Section 01300, including the following:

1. Product and cable specification data sheets.
2. Main Distribution Frame (MDF) and equipment assembly details.
   a. Indicate size and space requirements.
   b. Indicate positions of major components.
3. Complete wiring diagrams indicating:
   a. Devices.
   b. Components.
   c. Interconnecting wiring.
   d. Block diagrams
4. Data base programming sheet indicating all features of telephones, speakers, etc.
5. Floor plans indicating device and component locations, conduit, raceway and cable routes.
6. Grounding details and requirements.
7. Power connections, including source and branch circuit data.

B. Operation and Maintenance Manuals: Submit in accordance with Section 01300, including the following:

1. Component Operating Manual including technical data sheets.
   a. Control settings.
   b. Amplifier loads.
2. Information for reordering replacement parts.
   a. Provide a replacement parts list.
   b. Provide a list of recommended parts, tools, and instruments for testing and maintenance purposes.
3. Wiring diagrams/details:

a. System functional block diagrams.
b. System schematic diagrams.
c. System wiring list.
d. Identify terminals to facilitate installation, operating and maintenance.
e. Indicate terminals to facilitate installation, operating and maintenance.
f. Indicating and distinguish between field and factory wiring.

4. System Operating Instructions: Provide a clear and concise description of operation which gives, in detail, the information required to properly operate the equipment and system.
5. Update to include any information necessitated by construction. Complete "as installed" wiring and schematic diagrams shall be included which show all items of equipment and their interconnecting wiring.
6. Component Service Manual: Include information for testing, repair, troubleshooting, assembly, disassembly, and required/recommended maintenance intervals.

C. Project Record Documents:

1. Submit in accordance with Section 01300 for the complete system. Record drawings shall include and indicate all components of the installed systems, including the routing of conduit, raceways and cable.

2. Drawings shall be coordinated and referenced to the O & M manuals and related wiring diagrams. Floor plan drawings shall be 1/16" = 1'-0" or greater to provide for clear a and legible documents.

D. Test Reports: Submit field test reports specified in Part 3.

1.5 Training

A. Provide all training and utilize specified manuals and record documentation. All training shall be provided at the project site and coordinated with the Owner. All training sessions will be video taped by the vendor for Owner's future reference.

B. Training shall include a minimum of two four-hour sessions encompassing all instructions required for system operation. Provide operators manuals and user guides with training. Provide follow up training for 8 hours minimum after initial training.

C. Training shall utilize the equipment provided at the project site. Coordinate use, time and availability of equipment with the Owner.

D. Demonstrate adjustment, operation and maintenance of the system including each component and control.

E. Voice Mail / Homework Hotline: Basic training shall be provided for this system. Additional training for system programming and database management shall be in addition to this contract and will be purchased on an "as needed" basis.

1.6 Warranty and Maintenance

A. Provide a one (1) year warranty of the installed system against defects in material and workmanship. All labor and materials shall be provided at no expense to the Owner during normal working hours. The warranty period shall begin on the date of system acceptance.

B. Make available a service contract offering continuing factory authorized service of this system after the initial warranty period.

1.7 Quality Assurance

A. Maintenance Qualifications:

1. Experienced in manufacturing equipment of the types and capacities specified for this project.
2. Equipment has a record of successful in-service performance.

B. Contractor Qualifications:

1. Established communications and electronics contractor for at least five (5) years.
2. Authorized distributor for the equipment supplied with full manufacturer's warranty privileges.
3. Maintains a fully equipped service organization capable of providing full maintenance and service of the installed system within 24 hours.
4. Maintains the necessary spare parts in the proper proportion as recommended by the manufacturer to maintain and service the equipment being installed.

C. Manufacturer's Instructions: Comply with all installation instructions and methods recommended or required by the manufacturer.

D. Reference Standards: Comply with all reference standards indicated in this section as applicable. System shall be UL Listed under UL813.

1.8 System Requirements and Operation

Digital Telephone System

A. The contractor shall provide a complete and satisfactory digital telephone system. All equipment and installation material requirements shall be furnished and installed including the interfaces to intercom and voice mail systems. System being provided is a Remote Campus ECS. The ECC Building will be connected to the Elementary School via fiber.

l. Contractor shall provide a microprocessor, stored program control telephone system.
2. The system shall employ state-of-the-art digital technology and be in current production.
3. All talking circuits shall be balanced transmission circuits.
4. System proposed must allow full integration with voice mail.
5. All systems must be adequately surge protected based upon stated manufacturer's requirements.

B. Central Switching Exchange: The installation shall include a comprehensive programmable telephone communications system consisting of a digital central switching exchange. The system shall have expansion capability to support up to 448 ports. The following is a outline of the system minimum requirements.

1. All programmable functions shall be located in battery backed RAM to prevent loss in the event of system failure.

2. The central switch shall utilize standard dual tone multiple frequency (DTMF) decoding in conformance with standard telephone practices.

3. The system shall provide direct dialing, full duplex private telephone communication between all stations equipped with administrative or staff telephones.

4. The system must provide the flexibility of interfacing with all of the following telephone industry standard trunking providing compatibility with existing and future services.

a. Loop Start 02LS2: The system must be compatible with existing central office lines.
b. Ground Start O2GS2: The system must be compatible with central office GS Lines.
c. DID O2RV2: The system must provide Direct Inward Dialing capabilities where direct individual station access over non-dedicated trunks is required.

d. OPX OL13C: The system must have capabilities of remote extensions not on the local premise to access all system features.
e. E+M Tie Lines TL31M/TL32M: The system shall be compatible with standard PBX signaling for direct connection to an existing or future remote PBX.
f. T1 SF/D4 Framing or ESF/D5 Framing: The system shall provide high volume phone traffic capabilities with direct interface without the need for additional interface equipment. Systems requiring additional T1 interfacing equipment such as channel banks are not acceptable.
g. CENTREX: The system shall have the capability of interfacing with other outside providers such as Centrex, Watts and Data services.
h. ISDN PRI – The system shall have the capability to interface with outside providers via ISDN primary rate interface.

5. Incoming trunk groups shall provide the capability of directing calls to multiple points such as Operator/Attendant, Administrator, Staff or Emergency Lines. The system shall also offer routing, transferring and conferencing of outside trunks to any of the Administrative or Staff telephones. Outside call that are directly go to an Administrative telephone can be automatically transferred to the attendants station if unanswered within a predetermined amount of time.

6. The system must provide automatic circular hunting for the first available outgoing trunk when placing calls from within the system.

7. The system shall have capabilities for discriminating ringing to enable the receiving party to distinguish between internal and outside calls.

8. The system shall provide Direct Inward System Access (DISA). It shall be possible to access central switch functions (i.e. paging, monitoring, remote activation of time schedules and relays ,etc.) from any offsite touch tone telephone via an incoming telco line. Only authorized individuals may use this feature by dialing the dedicated trunk number and then dialing the system function.

9. The system shall allow for Station Message Detail Recording (SMDR) providing a complete printed record of all calls being placed within the system or when any of the system C.O. lines are accessed.

10. System shall have the capability of connecting in a master/slave configuration with the other building in the complex. System shall house the ISDN PRI cards that will be shared by all systems.

11. Provide the following system features:

    a. Add On Conference: Allows a station user and/or operator console to add a third, fourth, and fifth internal party to an existing two party conversation.

    b. Alpha-Numeric Display For Attendant Position: A visual device on a console switch, by use of digits and/or alphabetical designation, indicates the trunk circuit to which the attendant is connected, or on internal calls, the station number and alpha/name identification class of service of the station line in voice connection with the attendant.

    c. Area/Office Code Restriction: The ability of the switching system to selectively identify 6-digit area and Office Codes, and either allow or deny passage of long distance calls to those specific 6-digit codes. This type of restriction is usually provided on a trunk group basis, and on an "allowed" rather than "denied" basis.

    d. Call Forwarding: Allows a station user to program at any time any internal station number (or the attendant), and when activated by the status user, all incoming calls to this station will be automatically rerouted to that preprogrammed number.

e. Call Forwarding - Busy Line: Automatically reroutes incoming Direct Inward Dialing (DID) calls, attendant processed calls, incoming CCS calls, or direct terminating Tie Line Calls, directly to attendant or predetermined secondary station when the called station is busy.

f. Call Forwarding - No Answer: Similar in function to the "busy line" version of Call Forwarding, automatic rerouting of a call, DID, or alternate facility to the attendant or a preprogrammed secondary station occurs when a given station does not answer within a prescribed time interval.

g. Call Transfer: Capability for any mutli-line administrative or single line staff telephone to transfer a "call" to any other multi-line administrative or single line staff telephone.

h. Class Of Service: A numerical index that is assigned to each extension and determines a variety of allowed or denied types of calls on both an incoming and an outgoing basis.

i. Direct Inward Dialing (DID): A basic facility allowing incoming calls from the public telephone network to reach specific lines without attendant intervention or assistance.

j. Direct Outward Dialing: The extension user can make external calls without attendant assistance.

k. Directed Call Pickup: A station user is able to answer calls ringing on any other station by dialing a unique code of that particular station to be answered.

l. Direct Paging Access: Facilities for telephones which have been software programmed with this capability, to instantaneously distribute page announcements simultaneously to all locations equipped with loudspeakers, by dialing a predetermined code number.

m. Direct Station Selector: Ability to one-touch transfer calls to intended party while also providing busy status indication of same extension.

n. Do Not Disturb: A feature allowing incoming calls to an extension to be routed to the call forward destination, other features operate as if the extension is busy.

o. End-To-End Signaling: Attendant and stations are able to continue to send DTMF signaling over an established external communications path.

p. Fixed Night Service: An arrangement used to route incoming calls, normally answered at the attendant position, to pre-selected stations with the system when the attendant is not on duty.

q. Flexible Night Service: Permits the attendant to "set-up" night connections in accordance with day-to-day requirements, with full flexibility in the assignment of incoming trunks to various stations. Such night service arrangements must be established by the attendant on each occasion they are activated.

r. Flexible Numbering Plan: Station dial plan is user definable to meet the requirements of the owner.

s. Hold: The capability to maintain a connection to a busy line, even when the station originating the connection is not off hook to the line or is engaged by another line.

t. Last Number Re-Dial: Memory contained either within the system common equipment or within the station instrument enables the station user to dial a special access digit or button to activate a speed calling treatment of the last number which was dialed from that station instrument.

u. Message Waiting Indication/Activation: A station user may initiate message waiting lamp indication at another station with button or feature code.

v. Programmable Feature Keys: Multiple buttons which can be programmed on a per station basis to access system features with one button access.

w. Remote Maintenance: A remote terminal can access the system for maintenance through a modem part or built-in system modem.

x. Speed Calling Station: Allows station users to assign abbreviated codes to certain frequently called numbers for use system-wide.

y. Speed Call System: Allows attendant to assign abbreviated codes to certain frequently called numbers for use system-wide.

z. Voice Mail Integration: Capability of integration to future voice mail system including direct access to intended party's mailbox without entering any digits, message waiting light indication, and access to immediate operator assistance.

aa. Call Transfer To Voice Mail: Calls may be transferred directly to any voice mail box from any phone.

C. Administrative Attendant Console(s): Provide units with the following features.(Quantity as per plans)

1. Ability to distinguish call type and status via a 32 character liquid crystal display.
2. Ability to transfer calls via a single button to stations.
3. Ability to monitor status of all stations in system via a direct station selection (DSS) console.

D. Multi-Line Digital Telephone(s): Provide units with the following features.(Quantity as per plans)

1. Twenty-Four (24) programmable direct station select “speed dial” keys (buttons) for automatic dialing. These buttons can be initially programmed for C.O. line access, All Call Page, Zone Page, Manual Class Change Signaling and direct station selection of frequently dialed extensions.
2. Feature buttons for a minimum of 8 features.
3. LCD display to show feature use, trunk use, and incoming caller identification.
4. Full handsfree speaker phone.
5. Message waiting indication.

E. Digital Classroom Telephone(s): Provide units with the following features.(Quantity as per plans)

1. Flash key.
2. Message waiting light.
3. Ringer Volume Control
4. Wall or desk mount as indicated on plans.

F. Digital Door Bell (s): (Quantity as per plans).

<u>VOICE MAIL SYSTEM</u>: Provide system that utilizes recorded voice messages that are accessible from any touch tone telephone, 24 hours a day, 7 days a week. System shall be an option card in the Digital Telephone system. Voice Mail shall provide the following features and functions.

A. Digital Integrated with the telephone system including customized call forwarding with personalized greeting or transfer capability. Messages left in a users mailbox will light the users telephone lamp automatically. After accessing messages the system will extinguish the user’s lamp automatically.

B. Full or Part Time Automated Attendant.

C. Voice Mail

D. Audio Bulletin Board with Information Mailboxes

E. Outbound Dialing to Phones, cellular services and digital pagers

F. Distribution and School-Wide Announcements

G. Ability to capture and announce Caller ID information within each message

H. A Directory Lookup feature for non users

I. A Windows based System Administrator Editor

J. Number of Ports: The system shall have four (8) ports

INTERCOM/PUBLIC ADDRESS SYSTEM

A. Central Switching Exchange (CSE)

l. The installation shall include a comprehensive programmable microprocessor based communications system consisting of a central switching exchange capable of handling up to 360 remote stations.

2. All programmable functions shall be located in battery backed ram to prevent loss in a power failure condition.

3. The central switch shall utilize standard dual tone multi-frequency type decoding (DTMF) for conformance with standard telephone practices.

4. The central switch shall provide an RS-232 port for connection of on or off site programming and or diagnostics. It shall be possible for the user with a personal computer. (IBM XT or compatible) to access and change all system parameters as necessary and to save complete system architecture on its storage medium. It shall also be possible to run diagnostic software to isolate and correct faults in the system.

5. Provide a one (l) watt amplifier circuit for each remote station to allow absolute flexibility for simultaneous paging, program distribution and time tone schedules. Equipment requiring a single power amp for these functions shall size such an amp as to deliver a minimum of one (l) watt per station. Additional power will be required for hallway speakers, outside horns and common areas.

6. Provide facilities for a printer output to create a log of system activity.

7. The system shall be provided with four (4) multifunction ports for administrative phones and or any loop start trunk port of a key or PBX telephone system. All communication between administrative phones or between administrative phones or between administrative phones and loudspeaker locations shall be non-blocking.

8. Provide capabilities of zoning incoming calls from any staff station location to any of four (4) multifunction ports.

9. Provide four (4) telephonic links between DTMF telephone locations.

10. Provide eight (8) unrestricted talk paths for private communication between administrative phones, administrative phones and staff stations, and program of time tone distribution.

11. Provide one (l) direct dialing, two-way voice amplified intercom link with automatic gain control for every twenty-four stations allowing multiple open voice conversations.

12. Tone Generator: The system shall provide nine (9) built in software definable tones for emergency and routine signaling.

13. Program Clock: The system shall provide an integral program clock for time tone distribution and other time related functions. It shall be possible to synchronize the program clock from an external master clock.

14. Clock Schedules: The system shall provide eight (8) separate time-tone schedules with a minimum of 1024 events. Individual events of each schedule shall be capable of sounding one of nine users defined tone types to any of the three hundred and sixty (360) speaker stations. These schedules can be run individually or simultaneously.

15. Programmable Relays: The system shall provide eight (8) internal system relays which can be activated manually from any administrative phone or automatically activated or cycled via an integral Master Time Control Center for controlling facility wide utility functions.

NOTE: Systems that do not provide manual control of these relays from any administrative telephone will not be accepted.

16. Audio Program Distribution: The system shall provide facilities for the distribution of three (3) simultaneous audio programs. Program distribution shall be defined from an administrative or staff telephone location. Audio routing shall be accomplished via electronic cross-point switching. Systems which can not distribute program from multiple locations via telephones with the proper access level and require manual activation of mechanical switches at the central control rack only will not be accepted.

    a. Administrative phones may distribute program by room, by any of the 24 audio groups or facility wide.

17. Programmable Paging Zones: The system shall provide twenty-four (24) paging zones with two (2) priority levels of all call capability. Paging into any one zone shall not interrupt any program (s) previously distributed. If the areas receiving programs are part of the page zones the program shall be interrupted during the page and returned automatically when the page is completed. These zones are completely separate from the eight (8) zones provided for time signal reception. Any of the three hundred sixty (360) speaker station locations may be programmed to any or all of the systems twenty-four (24) audio zones. Systems providing less than 24 audio zones will not be accepted.

18. Programmable Extension Numbers: The system shall support two (2), three (3) or four (4) digit programmable architectural room numbers for administrative and staff station locations.

19. Pre-Announce Tones: The system shall provide selective pre-announce tones for discriminating between pages and intercom calls. A single chime shall be used for pages and a dual chime for intercom calls.

20. Call-In Confirmation Tone: The system shall provide a call confirmation tone (single beep) at the intercom speaker location when a call is placed. This tone verifies that the call has been placed into the system queue. A second confirmation tone (three beeps) shall be activated if the call is upgraded to an emergency call. Equipment which does not notify the caller that the system has accepted and placed the upgraded call will not be accepted.

21. LCD Display: An operators display shall be provided. This 4 x 20 alpha-numeric LCD display shall continually show time, day, date and current operating time schedule (s) unless it is in the programming mode. In addition, it shall show up to three (3) incoming calls and the priority of each call-in queue (the fourth line shows how many additional calls are pending in the queue). Programming menus, time schedules and complete system architecture can also be displayed when in the programming mode. Menu prompts and feedback tones shall be used to help the user program the

system. The operators display shall be capable of operating with any administrative phone on the system.

B. Standby Power: The system shall be equipped with an Uninterruptible Power Supply (UPS) system to maintain the system in full operation during power outages. All features and functions shall be maintained while on the UPS including interconnect telephone operation. The UPS system shall operate the system for a minimum of 30 minutes during normal usage of the Voice Communication and Sound System. The UPS system shall be mounted on a shelf one (l) foot off the floor.

C. Diagnostics: The central switching exchange shall provide an RS-232C serial data port for connection to a computer for on-site or via a modem to a remote computer for off-site diagnostic functions by distributor or manufacturer personnel. It shall be possible to determine circuit and software faults via these diagnostic and facilities remote software change. The system shall maintain statistics of operation of the main system functions for use by the individual administering the system.

l. Minimum diagnostic functions shall include:

Check active list of activity within the system.

DTMF test, to check the DTMF registers.

I/O diagnostics enable checking of each line, and each device connected in the circuit.

Capability of checking each link, and ability to remotely block a link from the system if found detective.

D. UL Listing: The system shall be UL8l3 listed meeting the 1990 National Electrical Code (NFPA70).

E. Program Distribution Panel: The system shall provide facilities for the distribution of three (3) simultaneous audio programs. Program distribution shall be defined from an administrative telephone location. Audio routing shall be accomplished via electronic cross-point switching. Systems which cannot distribute program from multiple locations via telephones with the proper access level and require manual activation of mechanical switches at the central control rack only will be considered to be in direct conflict with the intent of this specification.

l. Administrative phones may distribute program by room, by any of the 24 audio groups, or facility wide.

2. Program sources for distribution shall be:

Source #l: Provide a rack mounted, quartz synthesized AM/FM Digital Tuner operating on 120 VAC. The AM section shall be tunable over a range of 530 to 16l0Hz. The FM section shall be tunable over a range of 87.5 to 108MHz. The tuner shall have seek and scan, 20 preset stations, digital readout and shall include a roof mounted antenna.

Source #2: Provide a rack mounted Compact Disc Player operating on 120 VAC. Controls shall include play, stop, pause, search, and skip. The CD player shall have a frequency response of 20-20,000Hz + ldB. Dynamic range shall be 92dB with a total harmonic distortion of 0.007% at lkHz. A digital display indicating number of tracks, total running time of disc, which track is currently running and its elapsed time shall be incorporated in the player. Auto cueing and random play shall also be standard features.

NOTE: Automobile type combination units are not considered equal in quality.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

A. All bids shall be based on the equipment as specified herein.

B. The telecommunication system supplier shall be licensed (Alarm and Communications License furnished by the State Board of Electricity) and be an established professional communications system subcontractor with a minimum of five years of continuous service.

Approved system suppliers for this project are:

l. Simplex Building Systems

2.2 EQUIPMENT

A. Alcatel Lucent Omni PCX Enterprise Communications System

1. Simplex 5195 ADIX System

B. Intercom/Public Address System

1. Simplex 5120 Integrated Communication System

2.3 PBX TELEPHONE SYSTEM

A. Office Phones #8038
Classroom Phones #8018

1. Simplex Grinnell to coordinate with District for which rooms are to be equipped with administrative and classroom handsets.

B. Telephone Trunk Ports: Provide ports for the direct connection of 50 central office lines capable of operating with either loop start or ground start trunks for existing and future compatibility with utility services.

C. Digital Telephone Ports: Provide as required to support quantities indicated. Construct system with 20% spare capacity.

D. Single Line Telephone Ports: Provide as required to support quantities indicated. Construct system with 20% spare capacity.

MAIN DISTRIBUTION FRAME (MDF)

A. Provide special cabinet, floor to ceiling, with hinged doors for access to 66 type blocks. Back of cabinet shall have 5/8" plywood to mount 66 blocks. Size as required.

B. All wire from telephones shall be terminated on 110 type blocks in the MDF cabinet. All circuits in the CSE shall be brought out on 25 pair cables and terminated in the MDF cabinet on 66 type blocks. The 66 type blocks shall then be connected via jumper wires to the 110 type blocks. All circuits shall be identified by room and/or circuit number on the 110 block.

WALL PLATES AND JACKS

A. See Specification Section 260741.

POWER SUPPLY AND TRANSIENT/SURGE PROTECTION

A. AC Voltage Supply

1. Separately fused, 110 volt AC circuit fused with a circuit breaker of 20 amps.

2. Protect the AC supply with a Tripp Lite Model ISOBAR (IB) 2.0 AC outlet strip or equivalent.

B. Grounding: The cabinet housing the CSE and associated sound equipment shall be grounded to the building ground via a #6 AWG insulated copper wire.

C. Provide the following standby power equipment:

1. TrippLite Model (BX-750) or (BC-1200) battery backup system. Size as required for 60 minutes of operation.

2.4 INTERCOM/PUBLIC ADDRESS SYSTEM

A. Equipment Rack: Install all sound system components in an equipment rack. Simplex 5100-9810. Unit shall be 61” high with locking rear door. Provide blank panels as necessary to cover excess space. Install the equipment rack (s) on a roller truck with locking wheels to ease servicing and conservation of space.

B. Central Processor: Provide and install a CPU capable of supporting all speakers indicated on plans. System shall be capable of supporting up to 360 individual speaker zones. Simplex Model 5120 System.

C. AM/FM Tuner: Simplex 5100-9177 AM/FM Digital Tuner with antenna mounted above ceiling at exterior wall.

D. Compact Disc Player: Simplex 5120-9184 Compact Disc Player.

PERIPHERAL SYSTEM DEVICES

A. Backboards: Provide 4’x8’ plywood backboards for mounting of system cross connect field mount as shown on the plans. Provide modular termination backboards with 110 type terminal blocks as required to terminate all cables. Provide distribution and cross connect backboards equal to AT&T 110 Series for all cross connect wiring.

B. Paging Speakers:

1. Ceiling Tile Installation (Round)
   a. Simplex 5120-9416 8" Speaker, 5 oz. Magnet, 25/70v Transformer
   b. Simplex 5120-9420 Round White Steel Baffle
   c. Simplex 5120-9491 Back Box w/ Tile Bridge

2. Wall Mount Installation (Square)
   a. Simplex 5120-9416 8" Speaker, 5 oz. Magnet, 25/70v Transformer
   b. Simplex 5120-9430 Square White Steel Baffle
   c. Simplex 5120-9492 Square Back Box

3. Surface Ceiling Installation (Square)
   a. Simplex 5120-9416 8" Speaker, 5 oz Magnet, 25/70v Transformer
   b. Simplex 5120-9430 Square White Steel Baffle
   c. Simplex 5120-9493 Square Back Box

C. Horn Loudspeakers:

1. Flush Wall Mount Installation (Square)
   a. Simplex 5120-9411 8" Loudspeakers
   b. Simplex 5120-9494 Flush Enclosure w/Baffle

c. Provide Weatherproof Where Indicated.

D. Cabling:

1. Two-way intercom speakers: 2 conductor, 22 AWG, solid, plenum, Green and non-shielded.
2. Commons area speakers: 2 conductor, 18 AWG, stranded, plenum, Green and non-shielded.

E. Backboards

PART 3 - EXECUTION

3.1 Conduit and Raceway Installations

A. Provide conduit and raceway systems as specified in Section 260110 f as indicated below.

1. Accessible suspended ceilings: Provide conduit from each outlet to plenum space above ceiling.
2. Non-Accessible ceilings: Provide conduit run from each outlet to cable tray.
3. Exposed structure: Provide conduit run from each outlet to cable tray.

B. Minimum conduit size:

1. Telephones: 3/4" conduit.
2. Speakers: 1/2" conduit.

C. Label all conduits at cable tray.

D. Outlet Boxes: 2-1/8 inches deep, 2 gang with single gang device ring as required for wall construction. Use deep masonry boxes at masonry construction.

3.2 WIRING INSTALLATION

A. Methods:

1. Install wiring in conduit and raceways except as indicated.

2. Wiring above accessible suspended ceilings may be installed without conduit.

3. Install wiring in cable tray at all locations where cable tray is provided. Route wiring and cable directly to nearest available cable tray.

4. Conceal wiring installations where possible.

B. Installation:

1. Cable Support: Securely fasten to the permanent building structure where not installed in raceway. Support at regular intervals appropriate to the cable and wire size. Cable and wiring shall not lay loose on ceiling tiles or grids. Install parallel to building lines and follow building structure. Use cable support equipment/hardware recommended by the manufacturer.

2. Cable Pulling: Do not exceed manufacturer's recommended pulling tensions. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between indicated termination, tap, or junction points. Remove and discard cable where damaged during installation and replace it with new cable.

3. Wiring in Enclosures: Bundle, lace, and trim the conductors to terminal points with no excess. Provide and use lacing bars and distribution spools.

4. Identify and tag all cables with permanent type markers to denote location served.

5. Provide cabling and make connection to the telephone company's telephone lines where the service enters the building.

6. Provide a minimum #6 AWG insulated copper ground wire from the main equipment rack to the building main ground bus. Size and provide grounding as recommended by the manufacturer.

C. Terminations:

1. Splice, Taps and Terminations: Use numbered terminal strips in junction, pull and outlet boxes, terminal cabinets, and equipment enclosures. Tighten connections to comply with tightening torques specified in UL Standard 486A.

2. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors.

3. Rack and terminal cabinet wiring shall be neatly routed or bundled in plastic wiring duct and routed along rack sides. All splices and connections shall be by plug, solder or screw terminal strips, etc. Splices shall not hang in racks or terminal cabinets.

3.3 EQUIPMENT INSTALLATIONS

A. Surge Suppressors: Where AC power-operated devices are not protected against voltage transients by integral surge suppressors conforming to UL Standard 1449, install surge suppressors at the device power line terminals.

B. Install and wire equipment in accordance with accepted engineering and installation practices. Only the highest degree of workmanship will be accepted.

C. Label all front panel controls used in the normal operation of the system using plastic laminate engraved labels, or approved equal. Firmly affix to the panel or device. Dymo or Kroy tap adhesive backed lettering is not acceptable. Refer to Section 260055.

D. Label each major system component as to function and area served.

E. Mount system components in cabinets or racks as recommended by manufacturer, except as otherwise indicated.

F. Arrange equipment to facilitate access for maintenance and working space.

G. Identify system components, wiring, cabling, and terminals according to Section 260055 "Electrical Identification".

3.4 FIELD SERVICES AND TESTING

A. Measure the impedance of each amplifier's connected loudspeaker load after all speakers are installed and all transformer "taps" properly set. All room or area volume controls shall be set at "full on" for these measurements. Where more than one zone is connected to the same amplifier, each zone shall be measured individually and then combined. These measurements shall be made with proper test equipment using a 1000 Hz sine wave signal. The results of these measurements shall be recorded for inclusion in the operation manuals.

B. Where the measurement of any amplifier's loudspeaker load is less than 1.25 times the amplifiers nominal output impedance, make required corrections.

C. The gain controls of all electronic equipment shall be set as required and then capped or locked into position. Controls which are used for normal system operation are excluded from this requirement. All control settings shall be recorded for inclusion in operation manuals.

3.5 FINAL CHECKOUT AND ACCEPTANCE

A. System shall be complete and fully operational before requesting final acceptance and scheduling system demonstration/training.

B. Final Acceptance of the system will be given upon completion of all of the specified requirements, including testing, training and demonstration, and submittal of all required documentation.

3.6 EXTRA DEVICES

A. In addition to the equipment shown on the project drawings, include the quantities of the components shown below. These devices may be installed at the discretion of the Owner, Architect or Engineer. If necessary, these devices, along with the required panel additions, wiring, labor, etc., shall be furnished and installed at no additional cost to the Owner. If, at the end of the project, they are not required to be installed, they shall be given to the Owner for their use.

Qty	Description
3	Classroom Telephones
3	Classroom/Office Speakers
1	Administrative Telephone

3.7 EXECUTION

A. All work under this section shall be performed by persons having specific familiarity with telephone, data, and sound system installation. Upon request, the contractor shall submit resumes, references or other corroborating documentation, to the engineer to confirm the contractor's capabilities and experience.

B. GROUNDING: Except where specifically indicated otherwise, all exposed non-current carrying metallic parts of the communications system shall be grounded. This may be accomplished via a driven ground rod, cold water pipe or building power ground. If the building power ground is used, a separate ground conductor shall be used from the equipment to the grounding grid. All grounding shall be done with #6 solid copper wire or larger. The contractor shall use every effort to insure system stability and safety.

END OF SECTION 260771

SECTION 26 07 72
CAFETORIUM SOUND REINFORCEMENT SYSTEM

PART 1 – GENERAL

1.1 SUMMARY

A. Scope: Extent of work is indicated on the drawings and by the requirements of this section. The Sound reinforcement system shall be capable of being operated in either of two modes as follows:

1. Unattended Mode

a. This mode shall be utilized for day-to-day operations. In the unattended mode, it will only be necessary for school personnel to power up the system, wireless mic and control volume.

2. Production Mode

a. This mode shall be utilized for large productions. In the production mode, it will be necessary to utilize the mixing console.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Provide products and materials conforming to the following:

1. Electronic Industries Association (EIA): Comply with the following EIA standards:

RS-160 Sound Systems
RS-299-A Loudspeakers, Dynamic Magnetic Structures and Impedance
RS-310-C Racks, Panels & Associated Equipment
SE-101-A Amplifiers for Sound Equipment
SE-103 Speakers for Sound Equipment

2. National Fire Protection Association (NFPA): Provide work complying with applicable requirements of NFPA 70 "National Electrical Code" including, but not limited to the following:

Article 250 Grounding
Article 300 Part A. Wiring Method
Article 310 Conductors for General Wiring
Article 725 Remote Control, Signaling Circuits
Article 800 Communication Systems

3. Comply with requirements of Underwriters Laboratories, Inc. (UL) 50. "Cabinets and Boxes."

B. Certification: Provide certificate of compliance with the referenced standards from the equipment manufacturer.

1.3 CONTRACTOR QUALIFICATIONS

A. The installation (electrical) contractor shall hire the services of a sound system contractor to supply the equipment, design, supervise and complete final checkout and certification procedures.

B. The sound system contractor shall be a factory authorized sales and service distributor of the specified equipment, and must provide with his submittals manufacturer documentation stating that they are in fact authorized distributors of the specified equipment.

C. Provide installation supervision by personnel, who are factory authorized service representatives of the specified equipment manufacturer and who currently provide maintenance service for equipment of the type specified.

PART 2 – GENERAL CONDITIONS

2.1 APPROVED EQUIPMENT

A. This specification is based upon equipment produced by various manufacturers. The authorized manufacturer's representative for all products is Simplex-Grinnell.

2.2 GENERAL

A. The intent of this specification is to provide a complete and satisfactory operating system for the pickup, amplification, distribution and reproduction of voice, symphonic, and other audio program material. All equipment and installation material required to fulfill the above shall be furnished whether or not specifically enumerated herein or on the drawings. All necessary hookup and installation shall be by a factory approved representative. The installation supervisor shall also instruct the personnel designated by the owner as to correct operation of the system. A minimum of 8 hours time for this training shall be included in the bid.

B. The contractor shall provide three complete sets of the following data, upon completion: installation wiring plans and diagrams, schematic drawings, complete instruction manuals, and service instructions.

C. The system shall be guaranteed for a period of one year from the date of acceptance or first beneficial use, whichever is first, against defective materials, design and installation. Any defects shall be repaired/replaced at no expense to the owner during normal business hours.

D. The work specified shall be performed by fully competent workmen, in a thorough manner. All materials furnished by the contractor shall be new, and all work shall be completed to the satisfaction of the Architect, Engineer and Owner.

E. At the time of submittal, the contractor shall submit a complete and accurate listing of all major items of equipment to be used in assembling the system, including all items of equipment listed under this specification, as well as contractor's block diagrams indicating the proposed interconnection of all equipment to be furnished. All modifications of standard equipment necessary to meet specifications shall be explained fully and must be accompanied by schematic diagrams.

F. All equipment, except portable equipment, shall be held firmly in place. This shall include loudspeakers, amplifiers, cables, etc. (The exception to this rigid-mounting clause is, of course, when it is required to use resilient shock mounting to de-couple the array from the structure it is being mounted to.) Fastenings and supports shall be adequate to support their loads with a safety factor of at least five (5). All switches, connectors, outlets, cables, etc., shall be clearly, logically and permanently marked during installation.

G. The contractor must take such precautions as are necessary to guard against electromagnetic and electrostatic hum, to supply adequate ventilation and to install the equipment so as to provide minimum safety to the person who operates it.

H. Care shall be exercised in wiring so as to avoid damage to the cables and to the equipment. All joints and connections shall be made with rosin-core solder or with mechanical connectors approved by the Engineer. All wiring shall be executed in strict adherence to standard broadcast practices.

I. The contractor shall submit to the engineer a "certificate of completion" to assure that the system has passed all the tests required in subsequent part of this specification and is in proper operating condition. Final tests shall be made in the presence of the engineer, who shall be notified of the test date a minimum of five (5) days prior to that date.

J. All wiring shall be type CMP, communications plenum cable, and install concealed in attic spaces and walls. Wiring shall be run in bridle rings spaced a maximum of 6 feet apart. Where wiring must be run down walls exposed, it shall be installed in EMT conduit for unfinished areas, and Wiremold raceway for finished areas.

PART 3 – EQUALIZATION

3.1 GENERAL REQUIREMENTS

A. Provide all required testing apparatus specified herein to complete successfully the equalization and tests. Provide factory trained personnel to perform the tests and adjust the equalizers required. The purpose of the equalization is to adjust the acoustic amplitude response of the sound system to a specified uniformity measured throughout the entire audience area. This adjustment is made to realize maximum acoustic gain and optimum tonal balance from the sound system throughout the audience area and stage monitored area.

3.2 INSTRUMENTATION

A. Prior to initial testing, the contractor must submit to the engineer a list of test equipment to be supplied by the contractor and the date calibrated. Provide the following minimal standard laboratory test equipment. Any substitutions or additions to the following list must be approved by the engineer.

1. An impedance bridge
2. Audio oscillator
3. Random-noise generator
4. Precision sound-level meter
5. 1/3-octave real-time audio frequency analyzer
6. Oscilloscope

Kits, home-built and other non-professional test equipment shall be unacceptable.

3.3 INSPECTION OF SOUND SYSTEM PRIOR TO EQUALIZATION

A. Prior to undertaking equalization of the sound system, perform the following inspections on the sound system, and submit to the engineer the written results of each inspection for inclusion in the permanent records of the sound system.

1. Measure and record the impedance of each loudspeaker line before connecting it to the output of its respective amplifier. The load impedance shall be equal to or greater than the rated impedance. Record the total impedance.

2. Measure and record the acoustic distribution of the loudspeaker in the sound system throughout the entire seating area. Record the location of all positions in the seating area where any 1/3-octave band, 350-5000 HZ, deviates more than +3dB from the desired house curve.

3. Measure and record with an oscilloscope, the output of each power amplifier. The input source to each amplifier being measured shall be a sinewy oscillator with less than 0.5% THE adjusted to 10dB less than full power output of the amplifier. Inspect the output sinewy appearing on the oscilloscope for complete freedom from hum and noise, parasitic oscillation and RH interference.

4. Adjust alignment delay for minimal comb filtering and lobing.

3.4 HOUSE-CURVE EQUALIZATION

A. Use pink noise as a source signal, and place a calibrated measuring microphone in the seating area at twice the critical distance (2Dc). (Critical distance is defined as that distance from the sound source at which the

direct sound from the source and the reverberation sound are in a ratio of one to one.) The acoustic amplitude response that appears on the screen of the real-time spectrum analyzer shall be recorded. Point-to-point measurement, averaging estimates and any other non-real-time dynamic measurements shall be unacceptable. After the unequalled acoustic amplitude response is recorded, the master equalizer set shall be used to bring the observed acoustic amplitude with +3dB uniformity and to conform to the predetermined high-frequency roll off dictated by the combination effect of humidity, air absorption, and the random incidence of the measuring microphone. The equalized house curve shall be recorded in graphic form and provided to owner.

3.5 DOCUMENTATION OF TESTS, MEASUREMENTS AND ADJUSTMENTS PERFORMED

A. The contractor shall provide the following documentation to owner:

1. List of personnel and certified test equipment used

2. Impedance of all loudspeakers

3. The variation of acoustic distribution throughout the seating area above and below a reference level at each 1/3-octave center frequency from 350-5000Hz.

4. The recorded inspection results observed for hum, noise, parasitic oscillation, and RH interference from the output of each power amplifier.

5. The equalized house curve made with the measuring microphone.

6. All filter settings.

PART 4 – EQUIPMENT

4.1 MIXING CONSOLE

A. The mixer shall have 16 input channels with internal power supply, with all connectors easily accessible.

B. The input channels shall have 3-pin XLR-type microphone inputs and ¼ inch balanced line inputs with a MIC/LINE switch to select the desired input. Each input channel shall have a gain control with a peak LED and a direct output and insert connector. The input channels shall have 3-band EQ with semi-parametric mids from 250 - 5 kHz with +/-15 dB of boost/cut. The input channels shall have 4 aux sends, 2-fixed pre-fader and 2-fixed post-fader. The input channels shall have 60-mm faders, mute and routing switches.

C. The mixer's output section shall have XLR- type 3-pin active balanced, low-impedance outputs for left, right, and mono and these outputs are controlled by 60-mm faders. There will be insert jacks on the master outputs. There shall be a headphone amplifier with level control and three-conductor ¼ inch phone jack mounted on the front panel. There shall be four master aux sends with level controls, after-fade listen and mute switches. There shall be two stereo aux returns with level and balance controls and routing switches. There shall be separate tape record output and playback controls with ¼ inch connectors.

D. The mixer shall have independent PC boards for each channel and use high-quality electrical components. There shall be an integral power supply with excellent current capacity and very low noise.

E. Dimensions shall be 5.8” H x 17.4” W x 17.4” D. Net weight shall be 19 lbs.

F. The mixing console (sound board) shall be manufactured by Soundcraft, Model FX16ii and be provided with rack mounting kit in sound rack.

4.2 MAIN SPEAKER SYSTEM

A. The loudspeaker shall be a multiple driver, full-range system with matched active equalization as follows:

1. The transducer complement shall consist of eight (8) full-range drivers of 11.4 cm diameter, mounted symmetrically in vertical pairs on a faceted, removable baffle assembly. Each driver shall have a rated impedance of 1£2 and shall be wired in series, resulting in a composite nominal impedance of 8 ohms.

2. The loudspeaker system sensitivity shall be 99dB-SPL in the 300Hz- 3kHz range and 92dB-SPL in the 50Hz- 16kHz range with both measurements referenced to a 1 Watt (2.83V) pink noise input at 1 meter. The nominal horizontal beam width shall be 120 degrees, and the nominal vertical beam width shall be 100 degrees. The power handling capacity of the loudspeaker shall be 240 Watts continuous pink noise, band limited from 50Hz to 16kHz.

3. The loudspeaker shall be provided with a ducted vent system, tuned at 55Hz. The input connectors of the 802 Series II loudspeaker shall consist of two (2) parallel-wired 1/4 inch (6.3 mm) phone jacks and two parallel-wired male XLR connectors.

4. The loudspeaker enclosure of the 802 Series II loudspeaker shall be composed of mica-reinforced polyethylene copolymer structural foam. Outer dimensions of the 802 Series II loudspeaker shall be 13" H x 20" W x 12" D, its weight shall be 31 lb.

5. The loudspeaker shall be the Bose 802 Series II loudspeaker system. For each speaker location, provide (2) speakers, one mounted on top of the other, stage left and stage right and also Gym side, Stage left and Stage right.

6. The loudspeaker system shall be supplied with a separate systems controller, to be connected before the inputs of the system power amplifiers. The fixed, 2-channel systems controller shall provide active electronic equalization and crossover functions. It shall include an operating mode switch, input sensitivity switch, low-frequency output level control, and mono sum switch.

7. The systems controller shall use screw-type terminal strips for balanced input and output wiring connections. Mount inside the auditorium sound system equipment rack.

8. The electronic controller shall be the Bose 802C Series II systems controller.

4.3 AMPLIFIERS

A. The power amplifiers shall be a dual-channel type capable of bridged mono operation. It shall deliver continuous power of 325 watts per side into 4 ohms or 200 watts per side into 8 ohms in a dual-channel mode, or 650 watts into 8 ohms in a bridged mono mode over the range of 20 to 20,000 Hz at no more than 1% distortion. The power amplifier shall be a Biamp Model CPA650, 650-Watt Power Amplifier.

B. Frequency response shall be 20 to 20,000 Hz (+0, -1 dB) with a noise level at least 98 dB below rated output. The unit shall be capable of balanced or unbalanced input operation without the need of additional components.

C. The amplifier shall provide passive cooling via extensive heat sink assemblies and shall not require fan cooling for normal operation. The amplifier shall be equipped with output short circuit and overload protection, along with automatic reset thermal protection.

D. Precision 31-position detented level controls shall be provided for each channel with the option for rear or front mounting without the need for additional hardware or circuitry. The controls shall be factory mounted on the rear panel. Each channel shall be provided with a peak level indicator on the front panel. Dual-channel or bridged mono operation shall be selected from a rear panel mounted switch. A power on indicator shall be located on the front panel next to the power switch.

E. Balanced or unbalanced input connections shall be via a screw terminal strip. Output 5-way binding posts shall accept a variety of speaker connection methods. Speaker protection fuse holders shall be provided on the rear panel shall be factory equipped with fuses rated for 8-ohm operation. The fuses shall be easily exchanged with a readily available type to meet the speaker protection requirements of the application.

4.4 MAIN SIGNAL CHAIN

A. A signal chain consisting of, but not limited to the following, shall drive the main speakers:

(1) Biamp AutoOne automatic mixer (for unattended mode)
(1) Sabine FBX-1020 Plus Feedback Controller
(1) Biamp MEQ3011/3 Octave Equalizer
(1) Architectural Acoustics CEX 5 Processor
(1) Bose 802c Active Equalizers
(2) Biamp CPA650 Power Amplifiers

4.5 FOLDBACK SYSTEM

A. The foldback system shall be initially connected directly to the main signal chain. The signal shall be mixed through an aux send of the main console. Two female receptacles shall be provided on stage for the "on stage" monitor loudspeaker. The system shall be comprised of, but not limited to, the following equipment:

(1) Peavey Architectural Acoustics 115TF Speaker
(1) Biamp CPA650 Amplifier
(1) Sabine FBX-1020 Plus Feedback Controller
(1) Biamp MEQ3011/3 Octave Equalizer
(2) Monitor Speaker Jacks

4.6 WIRELESS MICROPHONES

A. A Shure wireless microphone system shall be provided, configured as follows:

(4) ULXS124/85 Combo Wireless System with Rack Mount Receivers
(1) UA845 Antenna/power distribution system (lot) ½ wave remote antennas and mounting hardware

4.7 MISCELLANEOUS EQUIPMENT

A. Provide the following miscellaneous equipment to form a complete and functional sound reinforcement system.

(1) Lowell L277-61 Floor Mounted Equipment Racks with casters.
Provide (3) 7" drawers for storage. Provide locking front and rear doors. Front door to be louvered type. Side panels to be louvered. Provide TP27-3 fan panel in top of each rack. Bolt racks together to form one unit.
(lot) Lowell RPC series power sequencers
(4) Single Gang Device Plates with (1) n1/4" phone plug jack for foldback speakers.
(As Required) Security Covers for all processing equipment
(As Required) Microphone and Monitor Speaker input/output XLR connector plates
(As Required) Equipment Rack Kits

PART 5 – WIRING

5.1 INSTALLER'S RESPONSIBILITIES

A. The installer shall coordinate the installation of the sound system equipment with the manufacturer's authorized representative.

B. All conductors and wiring shall be installed according to the manufacturer's recommendations.

C. It shall be the Installer's responsibility to coordinate with the supplier, regarding the correct wiring procedures before installing any conduits or conductors.

5.2 INSTALLATION OF SYSTEM COMPONENTS

A. System components shall be installed in accordance with the latest revisions of the appropriate NFPA pamphlets, the requirements contained herein, National Electrical Code, local and state regulations, and other applicable authorities having jurisdiction (AHJ).

B. All wiring shall be type CMP for plenum installations. All sound system cable shall be installed above the acoustic ceiling or contained in building walls. Where a device is mounted on a masonry wall, install conduit stub within wall from device backbox to top of wall. All wiring shall be concealed and all backboxes recessed, where possible. Where wiring cannot be concealed, install cables in EMT conduit. Where device backbox cannot be recessed in walls, provide the manufacturer's matching surface backbox.

C. Where wiring is run above acoustic ceiling or in attic space, install cables in bridle rings connected to building steel supports. Install bridle rings every 6 feet. Cables shall not be ty-rapped to any pipes.

D. Wire and cable shall be U.L. listed and be plenum rated, type CMP.

E. Raceway containing conductors identified as "Sound System" conductors shall not contain any other conductors and no AC current carrying conductors shall be allowed in the same raceway with the DC fire alarm detection and signaling conductors.

F. It shall be the responsibility of the contractor to coordinate the exact location of all installed equipment with all applicable trades.

G. Speaker circuit cables shall be run in separate bridle rings and conduit from microphone cables. Intercom wiring shall be run in its own dedicated bridle rings. These wiring runs shall be separated by at least 3 feet from each other.

PART 6 – GUARANTEE AND FINAL TEST

6.1 GENERAL

A. The contractor shall leave the sound system in proper working order, and without additional expense to the owner, shall replace any defective materials or equipment provided by him under this contract within one (1) year (365 days) from the date of final acceptance by the awarding authority. Warranty work shall be completed during normal business hours, a maximum of 24 hours after notification of the service request.

6.2 FINAL TEST

Before the installation shall be considered complete and acceptable by the awarding authority, a test on the system shall be performed as follows:

A. The contractor's job foreman, in the presence of a representative of the owner, and the fire marshal's office shall operate every building fire alarm device to ensure proper operation and correct annunciation at each remote annunciator and control panel.

B. When the testing has been completed to the satisfaction of both the contractor's job foremen and the representatives of the manufacturer and owner, a “Certificate of Installation" shall be completed and signed by the necessary personnel, stating that the system is installed in accordance with this specification.

6.3 AS BUILT DRAWINGS, TESTING AND MAINTENANCE INSTRUCTIONS

A. As Built Drawings

A complete set of reproducible "as-built" drawings showing installed wiring, specific interconnections between all equipment, and internal wiring of the equipment shall be delivered to the owner upon completion of system.

B. Operating and Instruction Manuals

Three (3) complete sets of operating and instruction manuals, each placed in a 3-ring binder, shall be delivered to the owner upon completion. Each manual shall contain a copy of the as-built sound system drawings. The instruction period for the owner or its representatives shall be 16 hours, performed during normal business hours.

END OF SECTION 26 07 72

SECTION 26 08 51
HEATING TERMINALS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of heating terminal work is indicated by drawings, schedules and specifications.

B. Types of electrical heating terminals in this section include the following:

1. Self-regulating cable
2. Constant wattage cable
3. Monitoring controller and sensor

C. The heating terminal work shall be designed and installed to provide freeze protection for all exterior and interior piping including, but not limited to, supply, return, fill, drain and equalizing lines on chillers and cooling towers, fire protection systems where indicated or subjected to freezing and rain water conductors where indicated.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data on heating terminals, including dimensions, capacities, ratings, performance characteristics, gauges and finishes of materials, installation and wiring instructions.

B. Shop Drawings: Submit assembly type shop drawings showing unit dimensions, construction details, and field electrical connection details.

PART 2 – PRODUCTS

2.1 ELECTRIC HEAT TRACING CABLE

A. The heat tracing cable shall be either self-regulating or constant wattage type. Cable installation shall be designed to maintain 40 deg. F in a -20 deg. F ambient temperature with a 25 MPH wind factor and a 20% safety factor. System shall be designed to operate at the voltage indicated on the plans.

B. Heat loss design shall be calculated on a nominal 1-1/2" fiberglass insulation thickness. Pipe sizes and lengths shall be taken from the Mechanical, Plumbing and Fire Protection drawings.

C. Heat trace system shall be complete with, but shall not be limited to, controller, sensors, trace cable, wiring, connectors, junction boxes, mounting brackets, supports and fastenings as required in the quantities and lengths to suit the required installations.

D. Monitoring Controller: Furnish a microprocessor base controller with the following characteristics:

1.	Supply Voltage:	120/277 Vac, +/- 10%, 50/60 Hz, internal power less than five watts.
2.	Environmental Temp.:	-40°F to 125°F maximum operating temperature range; 0% - 95% R.H. @ 40°C non-condensing
3.	Microprocessor:	Non-volatile memory; no data loss on power outage.
4.	Load Current:	30 AMPs maximum

5. Control: Double pole solid state switching
6. Temp. Sensor Input: 100 ohm platinum RTD, 3 wire, 20 ohm maximum, lead wire compensation, a = .00385 ohms/ohm/deg. C.
7. Outputs: Unit alarm output configurable as "open on alarm" or "close on alarm". AC alarm triac: isolated solid-state triac, SPST, 0.5 AMP max. @ 12 to 277 volts AC.
8. Indicators: LED: Program Mode, Actual Temperature, Control Temperature, Heater Current, Power ON, Heater ON, Alarm Conditions/Programming Parameters. Digital Display: Actual Temperature, Control Temperature, Heater Current, Programming Parameter Values, Alarm Values.
9. Setpoints:

<u>Temperature:</u>	
Units:	Deg. F or Deg. C
Control Range:	-40 deg. F to 999 deg. F or OFF
Low – temp. alarm:	-40 deg. F to 999 deg. F or OFF
High – temp. alarm:	-40 deg. F to 999 deg. F or OFF
<u>Ground Fault:</u>	
Alarm Range:	20 to 100 mA
Trip Range:	20 to 100 mA or OFF
<u>Current:</u>	
Low Alarm Range:	0.0 to 30.0 AMPs or OFF
High Alarm Range:	1.0 to 30.0 AMPs or OFF
Power Limit:	1.0 to 30.0 AMPs or OFF
Auto Cycle Time:	0.5 to 24.0 hours or OFF

10. <u>Alarm Conditions</u>

Low Temperature	Low Current	Memory Failure
High Temperature	High Current	Ground Fault Trip
Ground Fault	Sensor failure	SCR Failure

11. Heat Trace System Diagnostic Test. System cycles heating cable regularly (settable period from 0.5 to 24.0 hours) and confirms proper system operation.
12. Stored parameters (measured): Minimum process temperature, maximum process temperature, maximum ground-fault current, maximum heating cable current.
13. Enclosure: NEMA 4X.
14. Additional Features: Soft start, On/Off or proportional control, power limiting, password protection.
15. Manufacturer: Controller shall be similar to Raychem Corporation's Digitrace 910/920

E. Heat Trace Sensor: Furnish a 3-wire, platinum resistance temperature detector (RTD) with the following parameters:

1) Type: 100 ohm platinum.
2) Accuracy: 100 ohm +/- 0.25 ohm @ 0 deg. C.
3) Alpha: 0.00385 ohm/ohm/deg. C.
4) Temperature Measurement Range: RTD – 300: 300 deg. F. (150 deg. C.)
5) Exposure Temperature Limits: RTD – 300: 300 deg. F. (150 deg. C.)
6) Manufacturer: Sensor shall be similar to Raychem Corporation's RTD – 300 or approved equal.

F. Communications: RS-485 interface to be provided for MODBYS Communications to BAS System.

G. Power Wiring: Provide required circuit breakers and wiring to local panel for required quantity of heat trace circuits.

2.2 MANUFACTURERS

A. Subject to compliance with requirements, furnish a heat trace cable system of one of the following:

1. Raychem Corporation
2. Delta – Therm Corporation
3. Thermon Manufacturing Company
4. Approved substitute

PART 3 – EXECUTION

3.1 INSTALLATION OF HEATING TERMINALS

A. Install heat trace cable system and controls as required, in accordance with equipment manufacturer's written instructions, and with recognized industry practices, to ensure that the heat trace system equipment fulfills project requirements. Comply with applicable installation requirements of the NEC and NECA's "Standard of Installation".

B. Install electric heat trace cable system after the piping tests are complete and before the piping insulation is applied. The Electrical Contractor shall consult, cooperate and coordinate with both the Mechanical Contractor and the Insulation Contractor in completing the required work.

C. Install heat trace labels every 15’.

D. Megger test before and after insulation is complete. Tests to be documented. Tests to be witnessed by the Construction Manager and Insulation Contractor.

3.2 GROUNDING

A. Provide equipment grounding connections, sufficiently tight to assure a permanent and effective ground, for heating terminals and controls as indicated in contract documents.

3.3 TESTING

A. Upon completion of installation of heating terminals and controls and after building circuitry has been energized; test heating terminals and all control functions to demonstrate capability and compliance with requirements. Where possible, field correct malfunctioning units, then retest to demonstrate compliance.

END OF SECTION 26 08 51

SECTION 26 09 30
DIMMING CONTROLS

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.

1.2 SUMMARY

A. The Electrical Contractors, as part of the work of this section, shall coordinate, receive, mount, connect, and place into operation all equipment. The electrical contractor shall furnish all conduit, wire, connectors, hardware, and other incidental items necessary for the complete and properly functioning lighting control and dimming system as described herein and shown on the plans.

B. This section includes the following:

1. General specification for a dimming and control system.
2. Specifications for four different control systems
3. specifications for three different dimmer systems
4. Installation and Checkout of equipment on job site.

1.3 MANUFACTURERS REQUIREMENTS

A. The equipment herein specified is manufactured by Leviton Lighting Controls Division, Tualatin Oregon (503)-404-5500 and shall serve to indicate the quality of equipment required. Base bid shall be for equipment by Leviton Lighting Controls Division. If alternate equipment is proposed, it shall be shown as an add or deduct from the base bid price and shall be subject to approval.

B. Other manufacturers who wish to bid must submit a complete bill of materials and company information listing qualifications and experience to the Architect ten days prior to bid date for permission to bid. All manufactures must comply with the specifications herein in every detail.

1.4 EQUIVALENT MANUFACTURERS

Strand
Lehigh
ETC

1.5 MANUFACTURERS SERVICES

A. Shop Drawings: Shop Drawings shall be submitted for approval within 30 days after receipt of contract. No fabrication of equipment is to proceed prior to approval of these drawings. Submittal package shall contain:

1. A complete bill of material
2. Sets of catalog cuts for standard equipment
3. Sets of shop drawings detailing all mechanical and electrical equipment including one line diagrams, wire counts, internal wiring, and physical dimensions of each item. Marked up catalog cuts are unacceptable.

B. Jobsite Checkout: Upon completion of all contractors wiring, and after all fixtures are installed and lamped, the contractor shall request the services of a factory representative to completely check out the system prior to energizing the system. At the time of checkout and testing, the owner's representative shall be

thoroughly instructed in the proper operation of the system for a full day.

C. Documentation: Two complete sets of as built drawings shall ship with the equipment when it leaves the factory, along with operations and maintenance manuals for the dimmer system.

D. Ballasts: It shall be the responsibility of the installing contractor to ensure that any fluorescent dimming ballasts supplied are compatible with the dimming equipment being furnished on this project.

E. Installation Instructions: Installing contractor shall follow manufacturer's installation instructions

F. Operation and Maintenance Instructions. Within two weeks after system turn-on is completed, the manufacturer shall provide three sets operations and maintenance manuals along with a copy of written warranty.

1.6 QUALITY INSURANCE

A. Source Limitations: Obtain dimming controls from a single source with total responsibility for compatibility of lighting control system components specified in this Section.

B. Performance Testing Requirements

1. All equipment shall be 100% tested as a complete system. Sample testing is not acceptable.

C. Code Requirements

1. All system components shall be UL listed and so labeled when delivered to job site.

2. Building Codes: All specified dimmers and scene controllers shall comply with the National Electrical Code. All units shall also comply with applicable, local building codes.

D. Installer Qualifications: Installer shall be one who is experienced in performing the work of this section, and who has specialized in installation of work similar to that required for this project.

E. Source Limitations: To assure compatibility, obtain dimming systems and controls from a single source with complete responsibility over all lighting systems and controls, including accessory products.

F. Manufacturer Requirements

1. Experience: The manufacturer will be one who has been continuously engaged in the manufacture of architectural lighting controls and dimmers for no less than ten years.

2. Testing: Manufacturer shall assemble all dimmers into dimmer cabinets and complete all internal wiring at the factory, prior to shipment. Testing shall be done as a complete, powered system: all dimmers shall be simultaneously connected to load banks, and all control stations shall be connected to the dimmer cabinet(s). Testing shall include exercising all functions such as take control, transferring, mastering, fading, or other special control provisions for each control and control station included in the system.

1.7 DELIVERY, STORAGE & HANDLING

A. General: Comply with Division 1 Product Requirements Sections.

B. Ordering: Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

C. Delivery: Materials must be delivered, in a timely manner to other trades.

D. Storage and Protection: Store materials away from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

1.8 WARRANTY

A. Manufacturer's Warranty: All equipment shall be warranted free of defects in materials and workmanship.

B. Warranty Period: 26 months from date of shipment or two years from date of turn-on, whichever occurs first.

C. Owner Rights: Manufacturer's warranty is in addition to, not a limitation of, other rights the Owner may have under contract documents.

PART 2 – PRODUCTS

2.1 DIMMING SYSTEM

A. General Description:

1. The dimmer rack shall contain 48 dimmer module slots for housing up to 96 dimmers.

2. The rack shall offer an option for a redundant control module that provides seamless backup in case of the main control module's failure or removal from the rack.

3. Each dimmer module shall monitor the temperature parameters for each dimmer.

B. Dimmer Rack Mechanical

1. The rack is built from extruded aluminum structural members with removable side panels of code gauge steel, measuring 86" high x 17" wide x 24" deep.

2. All exterior surfaces shall be finished in textured black powder coat finish.

3. Side, rear, top and bottom panels shall be easily removed without dismantling the rack.

4. Since the racks require no rear or side access, racks shall be able to be mounted back-to-back or side-to-side.

5. The front of the rack shall be completely open, allowing clear installer access to all line, load and control terminations.

6. Dedicated wire guides shall be mounted internally to aid in installation of load circuit wiring. Each load termination shall accept up to a #2 AWG wire.

7. The cooling fan and its control unit shall be mounted in removable modular housings for easy cleaning and maintenance.

8. Each dimmer shall receive fresh air through the door-mounted electrostatic filter.

9. Each rack shall have a locking door.

10. All dimmers shall be housed in removable modules made of die cast aluminum.

11. Each module shall contain one or two circuit breakers, a solid-state power switching device (SSR), a dimmer control PCB assembly, and two filter chokes.

12. All electrical contacts shall feature self-aligning floating connectors to insure precise alignment of all connections.

13. Modules shall be keyed so that a module of higher ampacity cannot be inserted into a slot that is wired for a lower ampacity dimmer.

14. All dimmer modules shall be inserted and removed without the use of any tools.

15. The rack shall be designed to operate on voltages ranging from 90-135VAC (120V nominal) at 50/60 Hz.

16. Rack shall be for use with four-wire three-phase or single-phase power. Simple rack-to-rack bussing eliminates the need to run separate line feeds to each rack.

17. The rack shall be UL listed and C-UL listed (for Canadian applications) with a short-circuit current rating of 100,000 RMS amps symmetrical providing listed dimmer modules are installed and the racks are not modified.

18. Optional current-limiting fault-current fuses (Amp-Traps) shall be available for other 100, 000 short-circuit current applications.

19. In systems that require a ground wire per load circuit, an optional ground bus shall be installed inside the rack.

20. All bussing, and all line and load terminal shall be copper.

C. Control Module

1. Each rack shall contain an electronic backplane with all control wiring connections on removable screw terminals for easy control wiring.

2. The backplane shall also retain all rack configurations, analog scenes, and backup scenes or looks in non-volatile memory, so that when any new control module is inserted, it automatically comes on-line, fully functional within ten seconds without requiring any programming by the user.

3. Each rack shall require a single control module that connects to the rack's electronic backplane.

4. Control modules shall be inserted and removed without the use of any tools.

5. Multiple control module outputs shall automatically pile-on to each other in a "highest takes precedence" fashion.

6. Each control module shall have three LED's to indicate the presence of voltage on each power phase.

7. The control module shall also contain LED's for overtemp, active control sources, panic and diagnostics.

8. The rack configuration and all backup scenes shall be able to be accessed through Hand-Held Terminal plugged into the front of the module, or remotely.

9. The 120V control module shall be UL Listed and C-UL Listed.

10. Each control module has an opto-isolated DMX512 input, a twelve-scene analog input and a 99-scene backup input. The module combines all inputs in a "highest takes precedence" manner. Analog scenes include snapshot capability.

11. Each dimmer shall be able to be programmed for the following operating parameters:

    a) Minimum and maximum level
    b) Non-dim operation
    c) Softpatch

12. Feedback information shall appear through the LED's of each dimmer module.

13. Feedback information to the control module for each dimmer shall include overtemp warning.

14. In addition to feedback from each dimmer, the rack shall monitor and provide feedback for the active voltage per phase.

15. Each rack comes with hardware-selectable Panic operation.

16. Terminals for dry contact closures shall be provided to initiate a Panic scene which shall drive all selected dimmers without affecting any other control setting.

D. Dimmer Module

1. The dimmer module shall be designed for superior reliability in the most demanding of operating conditions.

2. Each dimmer module shall monitors it's temperature and report this information to the control module.

3. Each dimmer module shall have a dedicated optically isolated control signal line from the control module.

4. The failure of one module shall not affect the operation of any other dimmer module.

5. Mechanical:

    a. All dimmers shall be housed in removable modules made of die-cast aluminum.

    b. Each module shall contain one or two circuit breakers, a solid-state power switching device (SSR), a dimmer control PCB assembly, and two filter chokes.

    c. The face of the module shall have a handle, the circuit breaker switches, air vents, and labeled LEDs for local feedback.

    d. The left side of the module shall have a wide section of spring steel to insure a proper fit for each module in the rack.

    e. All electrical contacts shall feature self-aligning floating connectors to insure precise alignment of all connections.

    f. Modules shall be keyed so that a module of higher ampacity cannot be inserted into a slot that is wired for a lower ampacity dimmer.

    g. All dimmer modules shall be inserted and removed without the use of any tools.

6. Electrical:

    a. The dimmer module shall be designed to operate on voltages ranging from 90-135VAC (120V nominal) at 50/60 +/-1Hz.

b. The load lugs in the rack shall be capable of accepting up to #2 AWG wire.

c. The dimmer module electronics' firing signal shall be optically isolated to 4,000 Volts from the power semiconductors.

d. The control signal from the control console shall be optically isolated from the control module electronics.

e. The dimmer module shall be capable of withstanding the following adverse conditions without any interruption of operation:

1) A complete dropout of line voltage for up to 10 milliseconds
2) A line surge or sag of 25% of nominal operating voltage for at least 500 milliseconds
3) Transient voltages up to 21/2 times the nominal line voltage

f. The module shall also maintain proper output voltage regulation with +/- 1 Volt for line voltage changes of up to 10% per second, and for line frequency changes of up to 1 Hertz per second.

g. Each dimmer shall be able to be programmed for the following operating parameters:

1) Soft patch
2) Minimum and maximum level
3) Non-dim operation

h. When a dimmer is set as a non-dim, it shall pass a full sine wave unregulated from the input voltage.

i. Each dimmer shall track overtemp and level conditions, and provides feedback to the LEDs on the face of the dimmer module.

j. Real-time feedback information to the control module for each dimmer shall include:

1) Over-temperature warning
2) Over-temperature shutdown.

k. Modules shall be available in standard (500microsecond) rise times. (350 microseconds for dual 5kW, 230V) measured from 10% to 90% at 90 degrees conduction angle under full load. Oscillographic evidence of rise time data shall be provided before approval of any alternated manufacturer is allowed.

l. Airflow modules shall be required in unused slots in order to maintain proper rack ventilation.

m. 120V units shall be UL listed and C-UL listed (for Canadian applications).

n.

Dimensions:	H	W	D
Dual & Single Modules	11/2" 3.8cm	121/2" 31.8cm	61/2" 16.5cm

o. i Series e Dimmer Modules Rise Time and Maximum Heat Loss Per Channel

Catalog#	Description (in Microseconds)	Rise Time	Current Rating Watts	Max Heat Loss Per Channel BTU/hr	Ton/AC	
4-0011E	i500 1.8KW 120V Dual Dimmer Module	500	2 x 15A	70	239	.020
4-0012E	i500 2.4KW 120V Dual Dimmer Module	500	2 x 20A	93	317	.027
4-0014E	i500 6.0KW 120V Single Dimmer Module	500	50A	264	900	.076
4-0061E	i500 2.5KW 230V Dual Dimmer Module	500	2 x 15A	119	406	.034
4-0052E	i350 5.0KW 230V Dual Dimmer Module	350	2 x 25A	96	327	.028
4-0064E	i500 5.0KW 230V Single Dimmer Module	500	25A	224	764	.064
4-0031	i Series 15Amp 120V Constant Module		2 x 20A			

Provide the following:

Qty.	Catalog No.	Description
1	4-0112E	i96e Rack: 120V Standard Dual 1.8/2.4 kW
1	4-0112E	i96e Rack to contain 400A/3P enclosed circuit breaker/60A/2P furnished and installed by E.C.
1	4-0311E	Control Module 120V
48	4-0012E	i500e 2.4KW Dual Dimmer Module
23	4-0099	Filler Modules
1	40001-00	i96e Rack Ground Bus Kit

2.2 DIMMING SYSTEM OVERVIEW

A. The Dimension 8000 system shall be a lighting control system designed specifically for the control of architectural lighting. Large networks of wall stations can be assembled using Multiple Protocol Converters (“input/output nodes”), which are capable of utilizing several data transmission methods depending on the application. The network shall offer Lumanet III and Ethernet protocols as a minimum.

B. Multiple Protocol Converters (“input/output nodes) may be self-contained within the dimmer system or may be external devices that shall interface to the dimmer system though DMX-512. Multiple DMX I/O nodes may be provided for system redundancy where specified.

C. The system architecture shall be based on a peer-to-peer network, where the failure of any single component or node shall not cause loss of other system functions. Systems that require a central processor for system operation are not acceptable.

D. Systems shall be grouped in up to 128 station nodes to form a “subnetwork”. Multiple Protocol Converters (“input/output nodes”) can be used to join subnetworks together. Networks can contain both daisy chained and/or starred wiring configurations.

E. Each subnetwork shall use 2 or 3 pair RS-485 cable with maximum overall length of 5000 ft.

F. Each subnetwork shall use LUMANET III as the primary protocol.

G. Each node on a subnetwork shall have a unique logical identifier (“ID”) numbered from 0 to 255.

H. Each subnetwork shall control a maximum of 2048 dimmer channels.

I. Wall stations may have up to 255 unique lighting control programs (“Personalities”).

J. Station nodes may be linked to other station nodes on the same or different subnetwork. Linkages may be changed at any time by any other station or I/O node capable of transmitting the necessary LUMANET III commands.

K. Combine and Separate of adjoining rooms shall be accomplished by linking stations and/or through use of station personalities.

L. Ethernet protocol shall be ColorNet 2.0 (or later revision), TCP/IP based protocol. Protocol shall conform to and be fully compatible with all 10/100 BaseT TCP/IP routers and networks.

2.3 WALL STATIONS (Station Nodes)

A. Each Wall Station shall contain its own microprocessor, a LUMANET III connection, re-programmable flash memory for storage of operating program, and additional non-volatile memory for storage of lighting control programming data.

B. All station nodes shall be capable of having both the internal operating program updated and the lighting control program modified though the LUMANET network, utilizing an appropriate input/output node. Mechanical removal of the station from the installation location shall not be necessary. Systems that require removal of stations for updating the operating system or programming data are not acceptable.

C. All stations shall be capable of storing up to 255 unique sets of lighting control programming (Personalities).

D. Any station shall be capable of becoming a slave to any other identical station.

E. All buttons shall be captured mechanically to prevent inadvertent removal of button caps.

F. Presets may include any assigned dimmers even though those dimmers are assigned to other presets on the same or other Stations.

G. All stations shall have the ability to assign one of eight function security levels to any of the functions. The lowest security level shall be zero (any access). Seven shall be the highest security level. The station shall also have eight overall security modes. The function security level shall be required to be a lower number than the station security mode before the function can execute. A station security mode of eight will allow all function access. A station security mode of zero will not allow any function access. Station security mode may be set by keyswitch, remote device, or by local password (LCD station only). Systems that allow only one security level, or do not allow security levels for various functions within a station are not acceptable.

H. LCD Wall Station:

1. Station shall have a faceplate made of DuPont Corian™. A defined selection of standard colors is available. Additional DuPont Corian™ colors are available as custom.

2. Exposed station dimensions shall be 4-1/2”Hx8-7/16”Wx1/2”D. Station shall mount in standard 4-gang back box (min dimension 2-13/16”Hx8-1/8”Wx3”D).

3. Station shall contain a long life (50,000 hours min.) backlit LCD display. Electro Luminescent Displays are not acceptable. LCD shall be 20 characters by 4 lines. LCD shall display text as programmed. Text shall be unique to network selected station Personality (menu). LCD may also be used for local programming prompts.

4. The station shall contain 15 momentary push buttons. Buttons shall be selectively backlit by LED’s. Buttons shall operate in momentary or toggle modes. Pressing a button shall cause a pre-programmed lighting control command to be transmitted on the subnetwork.

5. Station shall allow local manual adjustment of assigned dimmer levels for each preset, utilizing the LCD display and pushbuttons. This feature shall be capable of being electronically locked out.

6. The Station shall allow the presets to optionally capture and store the current levels of assigned dimmers (SNAPSHOT), even though the dimmer levels originated from another station, control console, or other external source. Systems with LCD Stations that do not support snapshot function to its presets from multiple sources are not acceptable.

7. The LCD station shall be capable of storing up to 7 passwords. A station security mode from 1 to 7 shall be assigned to each password

8. The LCD station shall prompt for a password whenever a function is selected that has a security level that is higher or the same of the station security mode

9. The LCD Station shall have the option to automatically return to a preprogrammed personality (menu) and/or security mode in a preprogrammed time after station is idle

10. The LCD Station shall have selectable backlight level for active/idle conditions. The selections shall be: High/High, High/Low, and High/Off.

I. Pushbutton Wall Station:

1. Station shall have a faceplate made of DuPont Corian™. A defined selection of standard colors is available. Additional DuPont Corian™ colors are available as custom.

2. Exposed station dimensions shall be 4-1/2”Hx3”Wx1/2”D. Station shall mount in standard 1-gang back box (min dimension 2-3/4”Hx1-3/4”Wx2”D).

3. Station shall contain from 1 to 15 momentary push buttons. Buttons shall be selectively backlit by LED’s. Buttons shall operate in momentary or toggle modes. Pressing a button shall cause a pre-programmed lighting control command to be transmitted on the subnetwork.

J. Provide the Following:

Stage Manager Panel
Quantity 1 000-KLCDO-00B LCD Station
Panic Switch
Quantity 4 000-KB010-00W
Entry Stations (2-Button)
Quantity 3 000-KB022-00W

Manufacturer to Program Eight Preset Names on LCD Control
Preset 1 House
Preset 2 Hse/Stge
Preset 3 Assembly
Preset 4 Study
Preset 5 Band
Preset 6 Choir
Preset 7 A/V
Preset 8 Drama

K. Distribution Equipment

1. Pipe Battens

a. All stage battens shall be 1-1/2” nominal diameter schedule 40 pipe with lengths as described above. All joints shall be sleeve spliced with 18” long sleeves with 9” extending into each pipe held by two (2) 3/8” hex bolts and lock nuts on each side of joint.

b. All battens are to be hung level and plumb, and are to be supported by 3/8" all-thread and associated accessories, in conjunction with standard practices and manufacturer's written instructions. This is to include any assemblies or additional supports as may be needed to provide adequate support.

c. **All** electrics shall be a double pipe batten with connector strip supports for the second pipe batten.

d. Front of house shall be a single pipe batten with connector strip and terminal box mounted above. Electrical Contractor shall steel flex connect from terminal box to above ceiling junction box and transition to conduit to dimmer board. Electrical Contractor shall be responsible to paint all hardware and flex conduit to match surrounding area.

2. Connector Strips

a. Each section shall consist of a 4" x 4" (102mm x 102mm) 18 gauge steel wireway or extruded aluminum with removable cover sections for access, labeled with circuit numbers.

b. Each strip shall have a terminal compartment which shall be factory installed on the right of left end as required and shall contain molded barrier type terminals for feed connection.

c. The strip shall be provided with heavy steel mounting straps on approximately 5' (1.52m) centers, to grip up to 2" (51mm) pipe.

d. Type S or SO, 18" (457mm) cable pigtails shall be secured by strain reliefs and shall be furnished with three pole grounded female receptacles. Flush receptacles are available in lieu of pigtails. Internal wiring shall be rated at 125 C.

e. External finish shall be black powder coat epoxy. The entire unit shall be UL and CSA approved and labeled.

Provide the following:

Qty.	Catalog No.	Description

Connector Strip with locking Connectors
First, Second and Third Electrics

3	157-000 30'	Long connector strip with **nine (9)** 20 AMP twist locking connectors mounted on 18" pigtails and wired on **six (6)** circuits. Provided complete with terminal box, mounting straps, circuit labels and wire mesh.

Front of House:

1	157-000	25' long connector strip with nine (6) 20A twist lock connectors mounted on 18" pigtails and wired on nine (6) circuits. Provided complete with terminal box, mounting strips, circuit labels.

Connector Strip Accessories

Qty.	Catalog No.	Description
4	152-045	Wire mesh grip, large with loop 12/28 & 10/24 and larger cables

Note: #12 AWG and #10AWG multi-conductor cable drops to be specified per project requirements. Specify quantity, gauge, length of drops, and number of conductors required per drop. Include one ground conductor in each drop.

3. Gridiron Boxes

   a. Each unit shall be a surface mounted code gauge steel box located as shown on the drawings. The unit shall be provided with terminal strips for feed connections. Knockouts, cables clamps and "Kellums" cable grips shall be provided. Access shall be by means of a removable cover.

   b. Finish shall be black baked enamel and the entire unit shall be UL listed and CSA approved in Canada.

Provide the following:

Qty.	Catalog No.	Description
4	175-003	Gridiron Box, 14-21 circuits

K. Fixtures:

1. Border Lights: Electrical Contractor shall furnish and install border lights for 1st and 2nd electrics as indicated on plans and as mentioned above as part of base bid. Wiring to be installed and terminated at connector strip.

   a. Housing shall consist of die cast aluminum end plates, extruded aluminum rails secured to a code gauge steel housing with compartment dividers. All painted surfaces shall be baked high temperature black. Rated 600 volts, 660 watts continuous operation. Rated lamp seal temperatures shall not be exceeded.

   b. Unit shall be provided with leads at each end of the unit consisting of three(four) 3-wire, 600V, 200oC, UL listed conductors, 18" long in a silicone braided sleeve. Male and female connectors shall be provided as specified by catalog number.

   c. For mounting, unit shall be provided with a heavy steel trunion securely fastened to each of the cast steel end plates and equipped with painted malleable iron C-clamps, adjustable for up to 2" ID pipe ("U" bolts not acceptable). Each unit shall be provided with a tilt adjust knob. Optional castered carriage sets with trunions shall be provided for CVC lighting applications.

   Provide the Following:

Qty.	Catalog No.	Description
12	216-046	4' Borderlight 1 circuits with Locking Connectors. Colorado batten 72 tour LED RGBWA
24	138-059	Safety cables
24		1-1/2” Conduit clamps. Removeable

   Provide all required 5 pin DMX cables to each fixture and to dimmer board.

2. Front of House Lights, Torms, and Ladder Truss: Electrical Contractor shall furnish and install six (6) spot lights as indicated on plans and as mentioned below as part of base bid.

   a. Ellipsoidal Spotlights

   Provide:
   3 Etc. color source CE spot LED RGB-L, DMX XLR5, 26°

3 Etc. color source CE spot LED RGB-L, DMX XLR5, 36°
6 1-1/2” removeable conduit clamps.

Provide all required 5 pin DMX cables to each fixture and to dimmer board.

b. Par Spotlights

Provide:
15 Etc. color source PAR, LED RGB-L, DMX XLR5
15 1-1/2” removeable conduit clamps.

Provide all required 5 pin DMX cables to each fixture and to dimmer board.

3. Follow Spot: Provide (1) Follow spot kit with case of type Robert Juliat “Buxie” 575W fixture. Provide (3) spare lamps. Provide 25’ #10 heavy duty extension cord. Yellow in color, Turn unit over to Owner.

2.4 CONTROL CONSOLE (24/48)

A. General:

1. The control console shall be a microprocessor-based lighting control system specifically designed and constructed for the control of theatrical and television dimming systems. The control console shall provide for the control of up to 1536 dimmers on a maximum of 384 control channels, a maximum 500 cues, and a maximum 512 automated device traits. Output shall be USITT standard (DMX-512), A super VGA color monitor with a minimum of 800 by 600 lines of resolution with a 0.28mm dot pitch shall be supplied as an option.

2. The operating program shall be stored in an internal non-volatile read-only memory. Off-line show data storage shall be accomplished with a high density 3 1/2" floppy disk drive. Operating program updates shall be available from the manufacturer’s web site at no additional charge.

3. The console shall provide two modes of operation: two-scene preset operation and multiscene memory operation. In two-scene preset mode, the console shall provide two scenes of 24 control channels each. In multiscene memory mode, the console shall combine the two-scene channel fader controls into one scene of 512 control channels. Selection of the operating mode shall be accomplished in the Set Up display

B. Physical

1. The lighting control console shall be a freestanding table assembly with a separate video monitor. The console shall be no larger than 6" high x 15.5" deep x 46." long with a weight of 48 lbs.

2. The console shall be made of heavy-gauge sheet metal finished in a black with white and teal silkscreen graphics.

3. The console shall have a user-replaceable high voltage protection module that will protect the processor engine from any accidental high voltage entering via the control data line.

4. The video monitor shall be a high-resolution super VGA monitor with a minimum of 600 by 800 lines of resolution and 0.28 mm dot pitch. The monitor shall be switchable to use either 90 to 132V AC or 180 to 264V AC.

5. The LCD display mounted on the surface of the console shall offer a minimum 256 x 64 pixels. The physical size of this display shall not be less than 1.2” high x 4.7” wide. Consoles not offering both video and LCD displays shall not be considered equal and thus shall not be acceptable.

6. The power supply shall be dual voltage, capable of 85V to 135V or 185 to 250V AC 50 - 60 Hz.

7. The console shall provide at least two (2) switched convenience outlets for providing power to the monitor and any peripheral devices.

C. Mechanical – The lighting control console shall provide, but not be limited to, he following features:

1. Grand Master to provide a master level for all operational functions.
2. A Black-out switch.
3. Airflow LED indicating a loss of proper airflow.
4. Two scenes of 24 channel potentiometers for two-scene preset operation.
5. 24 individually-programmed, fully overlapping pile-on submasters or effect masters with 8 pages for a total of 192 submasters.
6. 96 Bump buttons for momentary control of channels.
7. Two independent crossfaders to provide a split dipless fade between Scene A and Scene B, and Scene C and D.

The Memory section shall have the following controls:

1. A group of eight (8) keys for calling up various displays on the monitor. The displays shall allow level setting, previewing, and modification of show data.

2. Expanded numeric keypad used to enter information regarding cue levels, cue timing, cue attributes, groups, submasters, effects, profiles, patching, and set-up. Keys shall also be provided for recording cues, groups, intelligent devices, and submasters live from the stage display.

3. A cursor position keypad with directional arrow keys.

4. A set of 8 “soft” function keys for access of up to 8 different functions in each display or sub display. These keys may change function in each display to focus the operator’s attention on commands which are useful in that display and to reduce congestion of the control surface.

5. Eight (8) macro keys for operator access to up to 2000 operator-programmable macros.

6. A trackball for adjusting channel levels proportionally, video cursor movements, and edits.

7. Seven (7) wheels with integrated LCD for adjusting intelligent device traits.

8. Two Rate keys for assigning live rate control of a selected effect or cue fade to a wheel.

9. Two Load keys for loading cues to playback faders.

10. Two GO buttons for initiating fades between cues in the normal numerically sequential order. The GO button shall provide positive tactile feedback to the operator to confirm its operation.

11. Two HOLD keys for stopping currently running fades, and two BACK keys for initiating fades backwards through the normal cue sequence.

12. Four (4) 100mm Playback Faders grouped as two pairs for manual control of cue fades.

13. All channel faders submasters, and bump buttons operational in two-scene mode shall also be operational in multiscene mode.

D. Operational

1. Displays: The console shall provide the following displays that can be selected by the operator to appear on the monitor at any time:

   a. Stage shall allow viewing of live channel levels (that appear on the stage), whether they come from cue levels, submasters, effects, or manual control. All channel levels may be viewed simultaneously. Cue fader status, current stage cue and parameters and tracking mode also shall be indicated in the stage display.

   b. Preview shall allow blind viewing and editing of cues in memory. the operator shall be able to specify an exclusive list of channels to be shown in the display at any time. The current stage cue and parameters and tracking mode also shall be indicated.

   c. Cuesheet shall be a numerically sequential list of all cues and their timing parameters. The Cuesheet display also shall indicate effects, profiles, links, macros, follows, and cleanup status assigned to cues.

   d. Tracksheet shall be a spreadsheet matrix of cues and channel levels. Up to 32 cues or cue parts by 24 channels may be viewed at one time. The operator shall be able to specify an exclusive list of channels to be shown in the display at any time. The display shall automatically page, centering on the selected preview cue.

   e. Playback is a non-editable cue sheet display, also showing playback fader status and submaster levels. The submaster levels section may be compressed to show only which submasters are active, and thereby show more cue sheet information.

   f. Patch shall allow viewing and editing of dimmer-to-channel assignments, and proportional dimmer delimiting (patch at level). The Patch display shall also indicate dimmer profile assignments, virtual non-dim assignments, and parked dimmer status. Patch information shall be selectable in the following formats: by Channel, by Dimmer, Non-dim Dimmers, and Parked Dimmers.

   g. Device shall show the status of five (5) intelligent devices at a time.

   h. Setup allows configuration of the console and selection of peripheral operations. The Setup display shall indicate the following information

2. Each display shall have the following elements:

   a command line showing command strings prior to their entry.
   a command history showing the last command entered.
   a selection of up to eight soft key functions.

3. Channel levels shall be displayed in different colors to indicate their source of status. Different colors shall indicate levels from cues, submasters, or effects.

   To optimize the use of the display area two different modes of text display shall be available for the operator to choose from. 25 lines per screen or 50 lines per screen. Consoles which do not provide expanded display area shall provide a second CRT.

4. Two-Scene Preset Operation: Fading between scenes shall be accomplished with the split crossfaders. Each crossfader may be assigned a separate fade time of up to 999.9 seconds, or may be operated manually in real time.

5. Multiscene Operation: Channel levels for channels 1 to 96 may be affected at any time by either the individual channel faders or by the keypad. If a channel level has been set by the keyboard, manual

control shall be regained by matching the current level with the channel/fader ("match & grab" operation). Channels 97-144 are addressable by the keypad.

E. Cues

1. Cues and cue parameters may be recorded in any order. Up to nine (9) cues may be inserted between numerically consecutive cues.

2. Each cue may have up to eight (8) separate parts.

3. A cue may be assigned split times for channel levels that increase and decrease.

4. Each cue or cue part may be assigned the following parameters (all times may be set in 0.1 second increments):

   fade and delay times.
   split fade and split delay times.
   manual fades.
   effects.
   Any effect assigned to a cue shall have its channel levels fade up (or down) in the cue fade time while the effect is running. Consoles which do not fade effects within cues are not considered equal and are not acceptable.
   links to cues out of sequence.
   link repetitions.
   When a link causes a loop, the number of repetitions of the loop may be specified.
   return to normal sequence.
   A return to the next cue in sequence may be specified after a linked execution of a cue out of numerical sequence.
   cue profiles.
   These shall be selectable from the list of sixteen (16) operator-defined profiles.
   macros.
   Any macro assigned to a cue shall execute when that cue is triggered.
   cleanup designation.
   A cue designated as a cleanup cue shall prevent any levels from tracking into subsequent cues.
   cue name.
   alphanumeric names may be assigned to cues.
   cue parameters (time, part, delay, profile, link, etc.) shall be accepted in any order when entered on the command line.
   groups.
   Any group may be assigned to a cue. When a group which is part of a cue is modified, the cue is likewise modified.

5. Cues may be recorded as tracking or not tracking, based on the tracking mode in effect at the time of recording. Three tracking modes shall be available: Tracking, Cue Only, and Cleanup. Cleanup mode shall prevent any kind of tracking whatsoever, and no zero levels shall be displayed while in Cleanup mode. Consoles which do not provide for user-defined cue recording modes are not considered equal and are not acceptable.

6. Cues, groups, and submasters may be recorded from any display, resulting in the recording of levels that are currently active on stage. Cues, groups, and effects may be created in the blind displays by selecting them by number within the preview display. Any editing done in the blind displays shall affect memory immediately without necessarily affecting stage levels (no use of the record keys is necessary). Consoles which require manual recording or recording in only limited displays are not equal and are not acceptable.

F. Groups: Any or all channels may be recorded at specific levels as a group. The console shall be able to record at least 500 different groups.

G. Submasters

1. Submasters shall operate in a Pile-on (highest level takes precedence), Inhibitive, or Effect mode. Visual indication of individual submaster modes shall be shown in the playback display.

   a. Normal mode: channel levels under control of the submaster handle.

   b. Inhibitive mode: Channels assigned to an inhibitive submaster shall have live stage levels output to dimmers only if the submaster is set above zero (the channel levels are proportionally "inhibited" by the current level setting of the submaster).

   c. Effect mode: any effect shall be assignable to the selected submaster, operating proportionally at its current level setting.

2. Each submaster shall have a memory of its channel level assignments for the pile-on mode. When modes are changed, the submaster will retain the level settings for the pile-on/normal mode. Up to 8 pages of submaster memory shall be provided. Consoles which do not provide for individually programmable submasters, and do not offer 8 pages of submasters or at least 192 total submasters are not considered equal and are not acceptable.

3. Each bump button shall be able to be assigned independently to a combination of the following operating modes: momentery, solo, toggle or off. For convenience, the operator shall have the option of assigning the mode of all bump buttons in one command.

4. A fade up and fade down time shall be programmable to each submaster. When the bump button is pressed, the submaster or effect will fade up. It will then fade down when the button is released in the momentary mode, or when it is pressed a second time in the toggle mode. The default shall be a time of 0 for instantaneous bump button control.

H. Effects

1. 600 different special effects may be recorded; they shall consist of a series of steps which repeat, forward or reverse, in any combination of the following patterns (positive or negative): alternate, bounce, build, and random. Any of a pool of 1000 steps may be assigned to each effect. A step can be built using a cue, group sub, channel list or combination of any of the above. A different dwell time and active and inactive levels may be assigned to each step. The dwell time shall be able to be set in 0.1 second increments.

2. Effects shall be designated to operate, in cues or submasters, in pile-on and take-control with device traits. An effect may be assigned to fade up in a cue so that the effect shall continue to run through a series of cues. The effect shall continue unchanged until it is designated to fade down in a subsequent cue. While an effect assigned to a cue is running, additional effects may be faded up in subsequent cues to run simultaneously. All running effects may then be faded out individually or simultaneously. Consoles which require effects to be assigned to a separate fader or submaster or do not fade in and out as part of a cue are not considered equal and are not acceptable.

I. Tracksheet:

1. The Tracksheet display shall allow level setting and restoration or prevention of tracking to recorded cues. The display shall indicate to the operator which levels are tracking and which are not.

2. Any changes made to levels in the tracksheet shall affect tracking levels according to the currently selected tracking mode.

J. Patch

1. An electronic soft patch shall be provided for assigning control of the dimmers to specified channels.

2. It shall be possible to assign to each dimmer the following:
   a proportional maximum output level when its patched control channel is at full.
   a profile defining its output curve.
   a status of "park" at a designated level.
   a status of virtual non-dim. The trigger point shall be definable.

3. Channels may be assigned a device trait for controlling automated devices. This separates the channel from the main stage display.

4. It shall be possible to group like traits of automated devices into one control channel

K. Trackball Operation

1. Any channel list may be selected for control by the trackball. All channel levels under control of the trackball may be adjusted proportionally even after some have reached full or zero. Systems not offering trackball control shall not be considered equal and are not acceptable

L. Command Line Syntax

1. The operator shall be able to use any combination of the following items for constructing channel lists: channels, groups, submasters, effects, or cues. These lists may be created using the "and", "thru", and "minus" commands.

2. When recording cues, the cue parameters shall be accepted in any order on the command line. When editing cue parameters, it shall not be necessary to specify the currently selected (default) cue or cue part.

M. Miscellaneous Operation

1. Channel. levels shall operate on a “highest level takes precedence” or “last action takes precedence” basis whether the levels originate from channel faders, cues, submasters, or effects.

2. A "Release" command shall be provided to release captured channel levels to their settings prior to their capture.

3. A facility shall be provided for completing a "dimmer check".

   Naming: The following items can be assigned alpha-numeric names:

   show files
   cues
   groups
   subs
   effects
   devices
   profiles

   Each name can have up to 16 characters. Names can be used to recall items if desired. Naming shall be accomplished through keys that are integral to the standard console. In addition it shall be possible to enter names via PC compatible keyboard. Consoles that require separate keyboards are not equal and not acceptable.

N. Real Time Clock: It shall be possible to trigger up to 500 events using the built in real time clock. Systems not offering real time clock shall not be acceptable.

O. MIDI Interface: A system of MIDI Show Control Commands, general MIDI commands and MIDI Output commands shall be included. MIDI "in, out and through" receptacles shall be provided. Consoles that offer MIDI support software as an option shall include it to be considered equal.

P. Macros

1. For convenience, the operator shall have the option of recording of up to two thousand (2000) different macros.

2. It shall be possible to view all macros.

3. The macros shall be grouped into pages of eight (8) macros each, with the current page indicated in every display.

4. Up to 8 macros may be accessed remotely by contact closures.

Q. DMX Input

1. It shall be possible for the console to receive DMX signals. The console shall allow for two modes of use of the DMX input.

2. DMX signals may be merged.

3. A Nine (9) channel range may be used to select scenes and patterns

R. Setup

Setup shall provide as a minimum the following:

- Selectable dimmer protocols: Colortran digital signal (CMX) and the USITT standard (DMX-512), (AMX optional).
- A set of diagnostic programs to check the functioning of the internal electronics, the top panel controls, and the selected peripherals.
- Full printing functions which print current channel formats as specified by the operator.
- The ability to view and manage multiple show files on a single floppy disk.
- Commands to selectively retrieve specific show information from a floppy disk with the ability to renumber items and add them to the existing console memory. Consoles that will load only entire shows are not equal and not acceptable
- The ability to selectively clear cues, groups, effects, submasters, macros, patch, profiles, defaults, or the entire system from the console memory. Consoles that do not provide for selective clearing are not equal and not acceptable.
- An indication of the number of cues, groups, and effects that remain available in memory.

S. Software Upgrades: Upgrades to the operating software of the console shall be able to be achieved by end user directly from a USB Drive and network connections**.** Consoles that require the physical replacement of PROMS or other memory devices, or that require site visits by a technician or return of the console to the factory for program upgrading are not acceptable.

T. Options: The following items shall be available as options:

A second local monitor video card.

Gooseneck worklights. Up to (3) supported.
A Hand Held Remote with recording and playback capabilities.
A ink jet or laser jet printer.

High Resolution VGA remote video supplied through the ColorNet system.
Remote Macro switch interface.

U. Warranty

1. A complete two (2) year warranty covering all parts and labor shall be provided for the control console and its peripheral devices. All software updates to the console released during the warranty period of the console shall be available to the owner free of charge.

2. It shall be required of the owner that a warranty registration card be completed and sent to the manufacturer in order to validate the warranty.

Provide The Following:

Qty.	Catalog No.	Description
1	7-0096	Colortran Innovator 24/48 Control Console
1	31388-00	Second Video Card
2	7-5052	Console Worklight
2	7-2091	Video Monitor, Color
1	7-5062	Innovator 24/48 Dust Cover
2	7-5101	Monitor Dustcover
1	7-5067	Innovator 24/48 Touring Case
2	7-5091	Monitor Touring Case
2	7-3014	25’ DMX Control Cable
4	7-4011	Flush Control In Connection Wall Plate (Furnish and installed as part of base bid)(single gang back box by others)

3. Refer to Floor Plans for additional control devices and fixtures.

PART 3 – EXECUTION

3.1 LOCATION

A. Site Verification: Verify that wiring conditions, which have been previously installed under other sections or at a previous time, are acceptable for product installation in accordance with manufacturer’s instructions.

B. Field Measurements: The electrical contractor shall be responsible for field measurements and coordinating the physical size of all equipment with the architectural requirements of the spaces into which they are to be installed.

C. Inspection: Inspect all material included in this contract prior to installation. Manufacturer shall be notified of unacceptable material prior to installation.

3.2 INSTALLATION

A. The Electrical Contractor, as part of the work of this section, shall coordinate, receive, mount, connect, and place into operation all equipment. The Electrical Contractor shall furnish all conduit, wire, connectors, hardware, and other incidental items necessary for properly functioning lighting control and dimming as described herein and shown on the plans. The Electrical Contractor shall maintain performance criteria stated by manufacturer without defects, damage, or failure.

B. Compliance: Contractor shall comply with manufacturer's product data, including shop drawings, technical bulletins, product catalog installation instructions, and product carton instructions for installation.

C. Circuit Testing: The contractor shall test that all branch load circuits are operational before connecting loads to dimmer system load terminals, and then de-energize all circuits before installation.

D. Application of Power: Power shall not be applied to the dimming system during construction and prior to turn-on unless specifically authorized by written instructions from the manufacturer.

E. Electrical Contractor shall be responsible to fill out the panel schedules that are part of the shop drawings to which fixtures are on what dimmer. These schedules shall be typed and copied into each Owner's Manual and installed on back of door in each dimmer.

3.3 DEMONSTRATION

A. Lighting Control Systems: Upon completion of the work, the Stage Lighting Contractor shall submit three (3) copies of a detailed Operating and Maintenance Manual including as-built shop drawings, equipment descriptions and parts lists. The Stage Lighting Contractor shall go through the manual with Owner-designated personnel to demonstrate and explain the maintenance and operation of the systems.

B. Installing Contractor shall provide Owner with eight (8) hours of training on equipment. This contract shall include videotaping of session and video tapes of instructions on the use of the equipment.

3.4 TESTING

A. Notification: Upon completion of the installation, the contractor shall notify the dimming system manufacturer that the system is available for formal checkout. Notification shall be given in writing a minimum of 18 days prior to the time factory-trained personnel are required on site. Manufacturer shall have the option to waive formal turn-on.

B. Turn-On: Upon completion of all line, load and interconnection wiring, and after all fixtures are installed and lamped, Manufacturer's Rep or, if waived, Contractor shall completely check the installation prior to energizing the system. Each installed dimmer system shall be tested for each level of brightness, proper ON/OFF operations, and proper LED illumination. Each installed control panel shall be tested with each scene: verifying that each dimmer-controlled fixture adjusts to the selected scene and that all scene-controller LED's illuminate properly. If hand-held remote-control scene controller is specified and furnished, all operations shall be similarly tested.

C. At the time of checkout and testing, the owner's representative shall be thoroughly instructed in the proper operation of the system.

3.5 PROTECTION AND CLEANING

A. Protect all equipment after installation from damage during construction. If despite such protection, damage occurs, remove and replace damaged components or entire unit as required to restore units to their original, undamaged condition.

END OF SECTION 26 09 30

SECTION 28 07 21
FIRE ALARM AND DETECTION SYSTEMS

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. The work covered by this section is to be coordinated with related work as specified elsewhere in the specifications. Requirements of the following sections apply:

1. Electrical
2. Common Work Results for Electrical
3. Water-Based Fire-Suppression System
4. Clean Agent Fire Extinguishing Systems
5. Heating, Ventilating, and Air-Conditioning (HVAC)
6. Integrated Automation

C. The system and all associated operations shall be in accordance with the following:

1. Requirements of the following Model Building Code: IBC, 2015 Edition
2. Requirements of the following Model Fire Code: IFC NFPA 1, 2015 Edition
3. Requirements of the following Model Mechanical Code: IMC, 2015 Edition
4. NFPA 72, National Fire Alarm Code, 2016 Edition
5. NFPA 70, National Electrical Code, 2014 Edition
6. NFPA 101, Life Safety Code, 2015 Edition
7. NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems, 2015 Edition
8. ANSI/ASME A17.1 / CSA B44, Safety Code for Elevators and Escalators, 2013 Edition
9. ICC/ANSI A117.1 Accessible and Useable Buildings and Facilities, 2015 Edition
10. Local Jurisdictional Adopted Codes and Standards
11. ADA Accessibility Guidelines

1.2 SUMMARY

A. This Section covers fire alarm systems, including initiating devices, notification appliances, controls, and supervisory devices.

B. Work covered by this section includes the furnishing of labor, equipment, and materials for installation of the fire alarm system as indicated on the drawings and specifications.

C. The Fire Alarm System shall consist of all necessary hardware equipment and software programming to perform the following functions:

1. Fire alarm system detection and notification operations.

2. Control and monitoring of elevators, smoke control equipment, door hold-open devices, fire suppression systems, emergency power systems, and other equipment as indicated in the drawings and specifications.

3. Two-way supervised firefighter's phone operations.

4. One-way supervised automatic voice alarm operations.

1.3 DEFINITIONS

A. ADA: Americans with Disabilities Act

B. AHJ: Authority Having Jurisdiction

C. ANSI: American National Standards Institute

D. ASME: American Society of Mechanical Engineers

E. FACU: Fire Alarm Control Unit

F. FM: Factory Mutual

G. IBC: International Building Code

H. ICC: International Code Council

I. IDC: Initiating Device Circuit

J. IEEE: Institute of Electrical and Electronic Engineers

K. IFC: International Fire Code

L. IMC: International Mechanical Code

M. IRI: Industrial Risk Insurers

N. LED: Light-emitting diode.

O. NAC: Notification Appliance Circuit

P. NFPA: National Fire Protection Association

Q. NICET: National Institute for Certification in Engineering Technologies.

R. RAC: Releasing Appliance Circuit

S. SLC: Signaling Line Circuit

T. UL: Underwriters Laboratories

U. ULC: Underwriters Laboratories, Canada

1.4 SCOPE OF WORK

A. This section to be completed by Engineer. Detailed description of system goals, operational requirements including unique sequence of operations, working hours, and other PROJECT SPECIFIC items should be included that are not clearly addressed in other sections of this document.

1.5 SYSTEM DESCRIPTION

A. General: Provide a complete, non-coded addressable, microprocessor-based fire alarm system with initiating devices, notification appliances, and monitoring and control devices as indicated on the drawings and as specified herein.

B. Power Requirements

1. The control unit shall receive AC power via a dedicated fused disconnect circuit.

2. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal AC power in a normal supervisory mode for a period of 24 hours with 15 minutes of alarm operation at the end of this period. The system shall automatically transfer to battery standby upon power failure. All battery charging and recharging operations shall be automatic.

3. All circuits requiring system-operating power shall be 24 VDC nominal voltage and shall be individually fused at the control unit.

4. The incoming power to the system shall be supervised so that any power failure will be indicated at the control unit. A green "power on" LED shall be displayed continuously at the user interface while incoming power is present.

5. The system batteries shall be supervised so that a low battery or a depleted battery condition, or disconnection of the battery shall be indicated at the control unit and displayed for the specific fault type.

6. The system shall support NAC Lockout feature to prevent subsequent activation of Notification Appliance Circuits after a Depleted Battery condition occurs in order to make use of battery reserve for front panel annunciation and control.

7. The system shall support 100% of addressable devices in alarm or operated at the same time, under both primary (AC) and secondary (battery) power conditions.

8. Loss of primary power shall sound a trouble signal at the FACU. FACU shall indicate when the system is operating on an alternate power supply.

C. Software: The fire alarm system shall allow for loading and editing instructions and operating sequences as necessary.

1. The system shall be capable of on-site programming to accommodate system expansion and facilitate changes in operation.

2. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control unit. Loss of primary and secondary power shall not erase the instructions stored in memory.

3. Panels shall be capable of full system operation during new site specific configuration download, master exec downloads, and slave exec downloads.

4. Panels shall automatically store all program changes to the panel’s non-volatile memory each time a new program is downloaded. Panels shall be capable of storing the active site-specific configuration program and no less than 9 previous revisions in reserve. A compare utility program shall also be available to authorized users to compare any two of the saved programs. The compare utility shall provide a deviation report highlighting the changes between the two compared programs.

5. Panels shall provide electronic file storage with a means to retrieve a record copy of the site-specific software and up to 9 previous revisions. Sufficient file storage shall be provided for other related system documentation such as record drawings, record of completion, owner’s manuals, testing and maintenance records, etc.

6. The media used to store the record copy of site-specific software and other related system documentation shall be electrically supervised. If the media is removed a trouble shall be reported on the fire alarm control unit.

D. History Logs: The system shall provide a means to recall alarms and trouble conditions in chronological order for the purpose of recreating an event history. A separate alarm and trouble log shall be provided.

E. Recording of Events: The system shall be capable of recording all alarm, supervisory, and trouble events by means of system printer. The printout shall include the type of signal (alarm, supervisory, or trouble) the device identification, date and time of the occurrence. The printout shall differentiate alarm signals from all other printed indications.

F. Wiring/Signal Transmission:

1. Transmission shall be hard-wired using separate individual circuits for each zone of alarm operation, as required or addressable signal transmission, dedicated to fire alarm service only.

2. System connections for initiating device circuits shall be Class B, Style D, signaling line circuits shall be Class B, Style 4 and notification appliance circuits shall be Class B, Style Y.

3. Circuit Supervision: Circuit faults shall be indicated by a trouble signal at the FACU. Provide a distinctive indicating audible tone and alphanumeric annunciation.

4. Constant Supervision Audio: When provided, audio notification appliance circuits shall be supervised during standby by monitoring for DC continuity to end-of-line resistors.

G. Supplemental Notification and Remote User Access (Fire Panel Internet Interface)

1. Fire Alarm Control Unit (FACU) shall provide the necessary hardware to provide supplemental notification and remote user access to the FACU using Ethernet and TCP/IP communications protocol compatible with IEEE Standard 802.3.

2. A standard RJ-45 Ethernet connection shall connect to the owner's Ethernet network. Provisions for that connection must be provided at each fire alarm control unit as part of the contract.

3. The means of providing supplemental email and SMS text messaging notification shall be agency listed for specific interfaces and for the purpose described in this section. The use of non-listed external third-party products and interfaces is not acceptable.

4. The fire panel internet interface shall be capable of sending automated notification of discrete system events via email and SMS text messaging to up to 50 individual user accounts and via email to up to 5 distribution lists.

5. Each user account and distribution list shall be capable of being configurable for the specific type of events to be received. Each account shall be configurable to receive notification upon any combination of the following types of events:

   a. Fire Alarm
   b. Priority 2
   c. Supervisory
   d. Trouble
   e. Custom Action Messages
   f. Fire Panel Internet Interface Security Violations

6. Each user account and distribution list shall be capable of being configurable for the specific content to be received. Each account shall be configurable to receive any combination of the following message content:

   a. Summary

b. Event Information
c. Message
d. Emergency Contacts
e. Host Fire Alarm Control Unit Information

7. Each user account and distribution list shall be capable of being configurable for the type of Fire Alarm Control Unit Logs and Reports to be received. Each account shall be configurable to receive any combination of the following Logs and Reports via email:

   a. Alarm Log
   b. Trouble Log
   c. Analog Sensor Status Report
   d. Analog Sensor Service Report
   e. Almost Dirty, Dirty and Excessively Dirty Sensor Report
   f. CO Analog Sensor Service Report
   g. Addressable Notification Appliance Candela Report
   h. Addressable Notification Appliance Status Report

8. Each user account and distribution list shall be capable of receiving email distribution of Fire Alarm Control Unit Logs and Reports On-Demand or automatically on a Pre-Determined schedule. Receipt of Logs and Reports shall be capable of being scheduled as follows:

   a. Weekly
   b. Bi-weekly
   c. Monthly

9. The Fire Alarm Control Unit Logs and Reports shall be sent in CSV file format which can be imported into common database applications for viewing, sorting, and customization.

   a. Each user account shall be capable of being configured to receive system events via email and/or SMS text messaging.
   b. Each distribution list shall be capable of supporting up to 20 email address recipients.

10. The means to provide email notification shall be compatible with SMTP mail servers, ISP email services, and Internet email services. Communication with the email server shall be verified at selectable intervals of 5 to 30 minutes.

11. Email operation shall be capable of being disabled for service by the system administrator.

12. An email log shall be accessible to authorized users. The email log shall display the 25 most recent email notifications sent.

13. The fire panel internet interface for supplemental notification and remote user access shall support:

   a. Secure HTTPS/SSL encrypted connections,
   b. Up to 50 individual password protected user accounts,
   c. Dynamic and Static IP addressing,
   d. IP Address Blocking,
   e. Restricted number of log-in attempts before lock-out configurable from 1 to 20,
   f. Lock-out duration after unsuccessful log-in attempts configurable from 0 to 24 hours,
   g. Email notification to Administrators of unsuccessful log-in attempts,
   h. Automatic lock-out reset upon a new event,
   i. Automatic inactivity logout configurable from 10 minutes to 24 hours,
   j. Firmware updates over Ethernet,
   k. Set-up and configuration via Local Service Port or via Remote Services over LAN/WAN connection

14. Authorized users shall be capable of accessing the fire alarm panel using a compatible web browser (Internet Explorer 6.0 or higher) and a secure HTTPS/SSL encrypted connection.

15. The fire panel internet interface shall support concurrent connections for up to 5 users plus 1 administrator.

16. Authorized users with remote access shall be capable of:

    a. Viewing the fire panel internet interface web home page

        (1) The fire panel internet interface home page shall display system status information and provide links to detailed status information and fire alarm panel reports and history logs

        (2) The web browser on the user's computer shall automatically refresh system status information upon a new event

            (a) Systems that require a manual refresh to acquire updated system status information shall not be accepted

    b. Viewing the fire alarm panel detailed card status information

    c. Viewing the fire alarm panel detailed point status information

    d. Viewing the fire alarm panel reports and history logs

    e. Viewing the fire panel internet interface email log

    f. Viewing system summary information

    g. Accessing Custom Hypertext Links

17. The fire panel internet interface home page shall support customization to display the following information:

    a. Customer Name and Address,
    b. Fire Panel Location or Building Name,
    c. Up to 10 Custom Hypertext Links with Text Descriptions

H. Remote Services Access:

1. Fire Alarm Control Unit (FACU) shall provide the necessary hardware to provide a remote service access feature using Ethernet and TCP/IP communications protocol compatible with IEEE Standard 802.3. The Remote Access feature shall provide automatic notification of system faults and remote diagnostics of system status for responding technicians prior to arrival on site.

2. A standard RJ-45 Ethernet connection shall connect to the owner's Ethernet network. Provisions for that connection must be provided at each fire alarm control unit as part of the contract.

3. The Ethernet access feature shall be agency listed for specific interfaces and for the purpose described in this section. The use of non-listed external third party interfaces is not acceptable.

4. The internet remote access service function shall provide automated real time off-site reporting of discrete system events to a remote service support center with details of internal FACU fault conditions allowing a pre-site visit analysis of repair requirements.

5. Existing FACU controls shall be capable of retrofitting the Remote Service module as a plug-in upgrade feature.

6. The remote service network shall work on the customers Ethernet infrastructure and be Fire-Wall friendly for two-way communications for off-site reporting. The feature shall be compatible with existing proxy servers and firewalls shall not require any special changes or modifications.

7. The remote service system shall be able to connect to the remote service center without the need for a VPN account or similar tunnel.

8. The remote service system shall be a non Windows based application to protect against conventional virus attacks.

9. The remote service system shall support a secure connection with strong encryption, 128 bit or better, and an optional secondary encryption method if required.

10. The remote service system shall be compatible with virtual LANS (VLAN).

11. The remote service system shall work on an outbound communication premise (panel calls home) in order to eliminate the possibility of any inbound connection into the network (from trusted or non trusted sites).

12. The remote service system shall provide an audit trail of all events and service connections.

13. The Remote Service connection will provide access for panel software downloads and uploads for archiving job specific programs back at the enterprise server.

14. The supplier shall provide a service contract for the Remote Service program that provides the following requirements:

    a. 24/7 recording of FACU service activity.
    b. Off-site diagnostics by a technical specialist to provide repair and parts guidance to the service technician prior to a site visit.

I. Required Functions: The following are required system functions and operating features:

1. Priority of Signals: Fire alarm events have highest priority. Subsequent alarm events are queued in the order received and do not affect existing alarm conditions. Priority Two, Supervisory and Trouble events have second-, third-, and fourth-level priority, respectively. Signals of a higher-level priority take precedence over signals of lower priority even though the lower-priority condition occurred first. Annunciate all events regardless of priority or order received.

2. Noninterfering: An event on one zone does not prevent the receipt of signals from any other zone. All zones are manually resettable from the FACU after the initiating device or devices are restored to normal. The activation of an addressable device does not prevent the receipt of signals from subsequent addressable device activations.

3. Transmission to an approved Supervising Station: Automatically route alarm, supervisory, and trouble signals to an approved supervising station service provider, under another contract.

4. Annunciation: Operation of alarm and supervisory initiating devices shall be annunciated at the FACU and the remote annunciator, indicating the type of device, the operational state of the device (i.e. alarm, trouble or supervisory) and shall display the custom label associated with the device.

5. Selective Alarm: A system alarm shall include:

a. Indication of alarm condition at the FACU and the annunciator(s).

b. Identification of the device /zone that is the source of the alarm at the FACU and the annunciator(s).

c. Operation of audible and visible notification appliances until silenced at FACU.

d. Closing doors normally held open by magnetic door holders.

e. Unlocking designated doors.

f. Shutting down supply and return fans serving zone where alarm is initiated.

g. Closing smoke dampers on system serving zone where alarm is initiated.

h. Initiation of smoke control sequence.

i. Transmission of signal to the supervising station.

j. Initiation of elevator Phase I functions (recall, shunt trip, illumination of indicator in cab, etc.) in accordance with ANSI/ASME A17.1 / CSA B44, Safety Code for Elevators and Escalators, when specified detectors or sensors are activated, as appropriate.

6. Supervisory Operations: Upon activation of a supervisory device such as a low air pressure switch, and tamper switch, the system shall operate as follows:

a. Activate the system supervisory service audible signal and illuminate the LED at the control unit and the remote annunciator.

b. Pressing the Supervisory Acknowledge Key will silence the supervisory audible signal while maintaining the Supervisory LED "on" indicating off-normal condition.

c. Record the event in the FACU historical log.

d. Transmission of supervisory signal to the supervising station.

e. Restoring the condition shall cause the Supervisory LED to clear and restore the system to normal.

7. Alarm Silencing: If the "Alarm Silence" button is pressed, all audible alarm signals shall cease operation.

8. Priority Two Operations: Upon activation of a priority two condition, the system shall operate as follows:

a. Activate the system priority two audible signal and illuminate the LED at the control unit and the remote annunciator.

b. Pressing the Priority 2 Acknowledge Key will silence the audible signal while maintaining the Priority 2 LED "on" indicating off-normal condition.

c. Record the event in the FACU historical log.

d. Transmission of priority two signal to the supervising station.

e. Restoring the condition shall cause the Priority 2 LED to clear and restore the system to normal.

9. System Reset

    a. The "System Reset" button shall be used to return the system to its normal state. Display messages shall provide operator assurance of the sequential steps ("IN PROGRESS", "RESET COMPLETED") as they occur. The system shall verify all circuits or devices are restored prior to resetting the system to avoid the potential for re-alarming the system. The display message shall indicate "ALARM PRESENT, SYSTEM RESET ABORTED."

    b. Should an alarm condition continue, the system will remain in an alarmed state.

10. A manual evacuation (drill) switch shall be provided to operate the notification appliances without causing other control circuits to be activated.

11. WALKTEST: The system shall have the capacity of 8 programmable passcode protected one person testing groups, such that only a portion of the system need be disabled during testing. The actuation of the "enable one person test" program at the control unit shall activate the "One Person Testing" mode of the system as follows:

    a. The city circuit connection and any suppression release circuits shall be bypassed for the testing group.

    b. Control relay functions associated with one of the 8 testing groups shall be bypassed.

    c. The control unit shall indicate a trouble condition.

    d. The alarm activation of any initiating device in the testing group shall cause the audible notification appliances assigned only to that group to sound a code to identify the device or zone.

    e. The unit shall automatically reset itself after signaling is complete.

    f. Any opening of an initiating device or notification appliance circuit wiring shall cause the audible signals to sound for 4 seconds indicating the trouble condition.

12. Install Mode: The system shall provide the capability to group all non-commissioned points and devices into a single "Install Mode" trouble condition allowing an operator to clearly identify event activations from commissioned points and devices in occupied areas.

    a. It shall be possible to individually remove points from Install Mode as required for phased system commissioning.

    b. It shall be possible to retrieve an Install Mode report listing that includes a list of all points assigned to the Install Mode. Panels not having an install mode shall be reprogrammed to remove any non-commissioned points and devices.

13. Module Distribution:

    a. The fire alarm control unit shall be capable of allowing remote location of the following modules; interface of such modules shall be through a Style 4 (Class B) supervised serial communications channel (SLC):

        (1) Initiating Device Circuits
        (2) Notification Appliance Circuits
        (3) Auxiliary Control Circuits
        (4) Graphic Annunciator LED/Switch Control Modules

(a) In systems with two or more Annunciators and/or Command Centers, each Annunciator/Command Center shall be programmable to allow multiple Annunciators/Command Centers to have equal operation priority or to allow hierarchal priority control to be assigned to individual Annunciator/Command Center locations.

(5) Initiating Device Signaling Line Circuits
(6) Notification Appliance Signaling Line Circuits
(7) Power Supplies
(8) Voice System Amplifiers

J. Analog Smoke Sensors:

1. Monitoring: FACU shall individually monitor sensors for calibration, sensitivity, and alarm condition, and shall individually adjust for sensitivity. The control unit shall determine the condition of each sensor by comparing the sensor value to the stored values.

2. Environmental Compensation: The FACU shall maintain a moving average of the sensor's smoke chamber value to automatically compensate for dust, dirt, and other conditions that could affect detection operations.

3. Programmable Sensitivity: Photoelectric Smoke Sensors shall have 7 selectable sensitivity levels ranging from 0.2% to 3.7%, programmed and monitored from the FACU.

4. Sensitivity Testing Reports: The FACU shall provide sensor reports that meet NFPA 72 calibrated test method requirements.

   a. Reports shall be capable of being printed for annual recording and logging of the calibration maintenance schedule.

   b. Where required, reports shall be accessible remotely through:

      (1) A Fire Panel Internet Interface using Ethernet and TCP/IP communications protocol compatible with IEEE Standard 802.3. The Fire Panel Internet Interface shall be capable of automatically scheduling email reports to individual user accounts on a weekly, bi-weekly, or monthly schedule

      (2) A PC Annunciator using an RS232-C connection to the FACU or a PC Annunciator Client using a TCP/IP communications protocol connection to the PC Annunciator server compatible with IEEE Standard 802.3.

5. The FACU shall automatically indicate when an individual sensor needs cleaning. The system shall provide a means to automatically indicate when a sensor requires cleaning. When a sensor's average value reaches a predetermined value, (3) progressive levels of reporting are provided. The first level shall indicate if a sensor is close to a trouble reporting condition and will be indicated on the FACU as "ALMOST DIRTY." This condition provides a means to alert maintenance staff of a sensor approaching dirty without creating a trouble in the system. If this indicator is ignored and the second level is reached, a "DIRTY SENSOR" condition shall be indicated at the FACU and subsequently a system trouble is reported to the Supervising Station. The sensor base LED shall glow steady giving a visible indication at the sensor location. The "DIRTY SENSOR" condition shall not affect the sensitivity level required to alarm the sensor. If a "DIRTY SENSOR" is left unattended, and its average value increases to a third predetermined value, an "EXCESSIVELY DIRTY SENSOR" trouble condition shall be indicated at the control unit.

6. The FACU shall continuously perform an automatic self-test on each sensor that will check sensor electronics and ensure the accuracy of the values being transmitted. Any sensor that fails this test shall indicate a "SELF TEST ABNORMAL" trouble condition.

7. Multi-Sensors shall combine photoelectric smoke sensing and heat sensing technologies. An alarm shall be determined by either smoke detection, with selectable sensitivity from 0.2 to 3.7 %/ft obscuration; or heat detection, selectable as fixed temperature or fixed with selectable rate-of-rise; or based on an analysis of the combination of smoke and heat activity.

8. Programmable bases. It shall be possible to program relay and sounder bases to operate independently of their associated sensor.

9. Magnet test activation of smoke sensors shall be distinguished by its label and history log entry as being activated by a magnet.

K. Fire Suppression Monitoring:

1. Water flow: Activation of a water flow switch shall initiate general alarm operations.

2. Sprinkler valve tamper switch: The activation of any valve tamper switch shall activate system supervisory operations.

3. Water flow switch and sprinkler valve tamper switch shall be capable of existing on the same initiating zone. Activation of either device shall distinctly report which device is in alarm on the initiating zone.

L. Audible Alarm Notification: By voice evacuation and tone signals on loudspeakers in areas as indicated on drawings.

1. Automatic Voice Evacuation Sequence:

a. The audio alarm signal shall consist of an alarm tone for a maximum of five seconds followed by an automatic digital voice message. At the end of the voice message, the alarm tone shall resume. This sequence shall sound continuously until the "Alarm Silence" switch is activated.

b. All audio operations shall be activated by the system software so that any required future changes can be facilitated by authorized personnel without any component rewiring or hardware additions.

M. Speaker: Speaker notification appliances shall be listed to UL 1480.

1. The speaker shall operate on a standard 25VRMS or 70.7VRMS NAC using twisted/shielded wire.

2. The following taps are available: 0.25W, 0.50W, 1.0W and 2.0W. At the 1.0W tap, the speaker has minimum UL rated sound pressure level of 84dBA at 10 feet.

3. The speaker shall have a frequency response of 400 to 4000 Hz for Fire Alarm and 125 to 12kHz for general signaling.

N. Manual Voice Paging

1. The system shall be configured to allow voice paging. Upon activation of any speaker manual control switch, the alarm tone shall be sounded over all speakers in that group.

2. The control unit operator shall be able to make announcements via the push-to-talk paging microphone over the pre-selected speakers.

3. Total building paging shall be accomplished by the means of an "All Call" switch.

O. Constant Supervision of Non-Alarm Audio Functions

1. When required, the system shall be configured to allow Non-Alarm Audio (NAA) functions such as background music or general/public address paging.

2. During NAA operation, the speaker circuit shall be electrically supervised to provide continuous monitoring of the speaker circuit.

3. During an alarm condition, supervision shall be disabled and alarm signals delivered to speakers.

P. Addressable Notification Appliances

1. Monitoring: The FACU shall monitor individual addressable notification appliances for status, condition, type of appliance, and configured appliance settings. A fault in any individual appliance shall automatically report a trouble condition on the FACU.

2. Individual Appliance Custom Label: Each addressable appliance shall have its own 40 character custom label to identify the location of the appliance and to aid in troubleshooting fault conditions.

3. Individual Appliance Information Display:

   a. The FACU shall be capable of calling up detailed information for each addressable appliance including the appliance location, status, condition, type of appliance, and configured appliance settings.

   b. Notification appliances that are not capable of communicating and reporting their individual location, status, condition, type of appliance, and configured appliance settings to the FACU shall not be accepted.

4. Programmable Appliance Settings:

   a. The selectable operation of each addressable notification appliance shall be capable of being configured by the FACU without having to replace or remove the appliance from the wall or ceiling.

      (1) Programmable appliance settings for applicable addressable notification appliances shall include:

         (a) Operation:

            General Evac
            Alert
            User Defined

         (b) Style:

            Indoor
            UL Weatherproof
            ULC Weatherproof

         (c) Candela Selections:

            Indoor: 15, 30, 75, 110, 135, or 185 cd (per UL1971)
            UL Weatherproof: 15 or 75 cd (per UL1971), and 75 or 185 cd (per UL1638)
            ULC Weatherproof: 20, 30 or 75 cd (per ULCS526)

(d) Horn Volume:

Hi
Low

(e) Horn Cadence:

Temporal 3
Temporal 4
March Time 20 bpm
March Time 60 bpm
March Time 120 bpm
Steady

(f) Horn Tone:

520 HZ
Bell
Slow Whoop
Siren
Hi / Lo

b. Systems that require replacement or removal of the appliances from the wall or ceiling to change their applicable operation or settings shall not be accepted.

5. Programmable Notification Zones:

a. Changing the notification zone assigned to a notification appliance shall be configurable by the FACU and shall not require additional circuits or wiring.

b. Systems that require additional circuits and wiring to change the notification zone assigned to a notification appliance shall not be accepted.

6. Other Emergency and Non Emergency Notification:

a. Where required, notification appliances for purposes not related to fire alarm shall be capable of:

(1) Being connected to the same circuit as the fire alarm appliances, and
(2) Being individually configured for their intended use without requiring additional circuits or wiring.

b. Systems that require separate circuits and wiring for other Emergency and Non Emergency notification shall not be accepted.

7. Addressable Notification Appliance Automated Self-Test:

a. The fire alarm control unit shall be capable of performing an automated functional self-test of all self-test notification appliances and meet the requirements in NFPA 72, 2013 Edition, 14.2.8 Automated Testing and Table 14.4.3.2 testing requirements.

b. Test results for each self-test notification appliance shall be stored in non-volatile memory at the fire alarm control unit.

c. The fire alarm control unit shall be capable of running a functional automated test for all self-test notification appliances in a general alarm group or for all self-test appliances within a specific notification zone.

d. The duration required to complete the automated functional test for all self-test notification appliances shall be accomplished in 2 minutes or less.

e. The automated test results for all self-test notification appliances shall be available from the fire alarm control unit within 4 minutes from the start of the test.

f. If any notification appliance fails its automated functional self-test an audible and visual trouble signal shall be annunciated at the fire alarm control unit.

(1) The self-test trouble signal shall be a latching trouble signal which requires manual restoration to normal.

8. Addressable Notification Appliance Reports:

a. The fire alarm control unit shall maintain configuration and test data for each self-test addressable notification appliance.

b. The fire alarm control unit shall be capable of generating configuration, self-test, and deficiency reports, that can be viewed through the fire alarm control unit user interface or printed via the fire alarm control unit service port.

(1) At minimum, the configuration report shall include the following information applicable for each addressable notification appliance:

Point ID
Custom Label
Device Type
Candela Setting

(2) At minimum, the self-test report shall include the following information applicable for each self-test notification appliance:

Point ID
Custom Label
Time and Date of last test
Pass / Fail results of last visual test
Pass / Fail results of last audible test

c. The fire alarm control unit shall also be capable of providing a deficiency report that includes a list of all self-test notification appliances that have failed self-test.

9. Magnet test: When the control unit is in diagnostic mode, the appliances shall be capable of being tested with a magnet. The magnet diagnostics shall:

a. Pulse the appliance LED to indicate appliance address,and
b. briefly sound the individual horn to confirm the audible appliance operation ,and
c. briefly flash the individual strobe to confirm visible appliance operation
d. briefly sound the individual speaker to confirm the audible appliance operation

1.6 SUBMITTALS

A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.

1. Product data sheets for system components highlighted to indicate the specific products, features, or functions required to meet this specification. Alternate or as-equal products submitted under this

contract must provide a detailed line-by-line comparison of how the submitted product meets, exceeds, or does not comply with this specification.

2. Wiring diagrams from manufacturer.

3. Shop drawings showing system details including location of FACU, all devices, circuiting and details of graphic annunciator.

4. System power and battery charts with performance graphs and voltage drop calculations to assure that the system will operate in accordance with the prescribed backup time periods and under all voltage conditions per UL and NFPA standards.

5. System operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. A list of all input and output points in the system shall be provided with a label indicating location or use of IDC, SLC, NAC, relay, sensor, and auxiliary control circuits.

6. Operating instructions for FACU.

7. Operation and maintenance data for inclusion in Operating and Maintenance Manual. Include data for each type product, including all features and operating sequences, both automatic and manual. Provide the names, addresses, and telephone numbers of service organizations.

8. Product certification signed by a certified representative of the manufacturer of the fire alarm system components certifying that their products comply with indicated requirements.

9. Record of field tests of system.

B. Submission to Authority Having Jurisdiction: In addition to routine submission of the above material, make an identical submission to the authority having jurisdiction. Include copies of shop drawings as required to depict component locations to facilitate review. Upon receipt of comments from the Authority, make resubmissions, if required, to make clarifications or revisions to obtain approval.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A factory authorized installer is to perform the work of this section.

B. Each and every item of the Fire Alarm System shall be listed under the appropriate category by a Nationally Recognized Testing Laboratory and shall bear the respective "NRTL" label.

1.8 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning with Substantial Completion, provide software support for two years.

C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.9 MAINTENANCE SERVICE

A. Warranty Maintenance Service: Provide maintenance of fire alarm systems and equipment for a period of

12 months, using factory-authorized service representatives

B. Basic Services: Routine maintenance visits on an “as needed” basis at times scheduled with the Owner. Respond to service calls within 24 hours of notification of system trouble either by customer visit or other customer contact as necessary. Adjust and replace defective parts and components with original manufacturer's replacement parts, components, and supplies.

C. Additional Services: Perform services within the above 12-month period not classified as routine maintenance or as warranty work when authorized in writing. Compensation for additional services must be agreed upon in writing prior to performing services.

D. Maintenance Service Contract: No later than 60 days prior to the expiration of the warranty maintenance services, deliver to the Owner a proposal to provide contract maintenance and repair services for an additional one-year term. As an option with this proposal, deliver to the Owner a proposal to provide scheduled inspection and testing services for a one-year term. Owner will be under no obligation to accept maintenance service contract proposal or inspection and testing proposal.

1.10 EXTRA MATERIALS

A. General: Furnish extra materials, packaged with protective covering for storage, and identified with labels clearly describing contents as follows:

1. Break Rods for Manual Stations: Furnish quantity equal to 15 percent of the number of manual stations installed; minimum of 6 rods.

2. Notification Appliances: Furnish quantity equal to 10 percent of each type and number of units installed, but not less than one of each type.

3. Smoke Detectors or Sensors, Fire Detectors, and Flame Detectors: Furnish quantity equal to 10 percent of each type and number of units installed but not less than one of each type.

4. Detector or Sensor Bases: Furnish quantity equal to 2 percent of each type and number of units installed but not less than one of each type.

PART 2 – PRODUCTS

2.1 ACCEPTABLE EQUIPMENT AND SERVICE PROVIDERS

A. Manufacturers: The equipment and service described in this specification are those supplied and supported by Tyco SimplexGrinnell and represent the base bid for the equipment.

1. Subject to compliance with the requirements of this specification, provide products by one of the following:

a. Simplex, a Tyco Company

B. Being listed as an acceptable Manufacturer in no way relieves obligation to provide all equipment and features in accordance with these specifications.

C. Alternate products will not be accepted.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

1. Manual stations.

2. Heat detectors.
3. Smoke detectors.
4. Duct smoke detectors.
5. Verified automatic alarm operation of smoke detectors.
6. Automatic sprinkler system water flow.
7. Fire-extinguishing system operation.
8. Fire standpipe system.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm at fire-alarm control unit and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Release fire and smoke doors held open by magnetic door holders.
6. Activate voice/alarm communication system.
7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
8. Close smoke dampers in air ducts of designated air-conditioning duct systems.
9. Activate emergency shutoffs for gas and fuel supplies.
10. Record events in the system memory.
11. Record events by the system printer.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. Low-air-pressure switch of a dry-pipe sprinkler system.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal AC voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.

E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer where provided.

2.3 FIRE ALARM CONTROL UNIT (FACU)

A. General: Comply with UL 864, "Control Units and Accessories for Fire Alarm Systems".

B. The following FACU hardware shall be provided:

1. Power Limited base panel with platinum cabinet and door, 120 VAC input power.

2. 2,500 point capacity where (1) point equals (1) monitor (input) or (1) control (output).

3. 2000 points of annunciation where one (1) point of annunciation equals:

a. 1 LED driver output on a graphic driver or 1 switch input on a graphic switch input module.
b. 1 LED on panel or 1 switch on panel.

4. 9 Amp Power Supply minimum with temperature compensated, dual-rate battery charger capable of charging up to 110 Ah batteries without a separate external battery charger. Battery charger voltage and amperage values shall be accessible on the FACU LCD display.

5. One Auxiliary electronically resettable fused 2A @24VDC Output, with programmable disconnect operation for 4-wire detector reset.

6. One Auxiliary Relay, SPDT 2A @32VDC, programmable as a trouble relay, either as normally energized or de-energized, or as an auxiliary control.

7. Three (3) Class B Addressable Notification Appliance Signaling Line Circuits (SLCs).

    a. Each Addressable Notification Appliance SLC shall be rated at 3A and capable of supporting up to 127 Notification Appliances per channel.

    b. Wiring shall be 18 AWG to 12 AWG unshielded twisted pair wire. Systems that require shielded wire for Notification Appliances shall not be accepted.

    c. A constant voltage under both primary and secondary power conditions shall be maintained at the notification appliance field wiring terminal connections in the FACU to ensure the voltage drop on the circuit is consistent under both primary and secondary power conditions.

    d. For systems that do not provide a constant voltage source at the FACU notification appliance field wiring terminal connections, the fire alarm contractor shall:

        (1) Provide separate point-to-point voltage drop calculations for all notification appliances under worst case secondary power specifications, and
        (2) Perform a complete functional test of all notification appliances under worst case secondary power conditions.

8. Three (3) Class B Notification Appliance Circuits (NAC; rated 3A@24VDC, resistive).

    a. NAC’s shall be conventional reverse polarity operation and shall be for synchronized strobes and independent horn/strobe operation over two wires.

    b. NACs shall be selectable as auxiliary power outputs derated to 2 A for continuous duty.

    c. Strobe synchronization and audible cadence synchronization shall be across all panel NAC circuits. Systems that cannot provide listed synchronization across all panel NAC’s shall not be acceptable.

9. Where required provide Intelligent Remote Battery Charger for charging up to 50Ah batteries.

10. Expansion Power Supplies with three (3) Class B integral Intelligent Addressable Notification Appliance Signaling Line Circuits (SLCs) for system expansion. Expansion power supplies shall provide complete capability as the primary power supply.

11. Four (4) form "C" Auxiliary Relay Circuits (Form C contacts rated 2A @ 24VDC, resistive), operation is programmable for trouble, alarm, supervisory or other fire response functions. Relays shall be capable of switching up to ½ A @ 120VAC, inductive.

12. The FACU shall support up to (5) RS-232-C ports and one service port. All (5) RS-232 Ports shall be capable of two-way communications.

13. Remote Unit Interface: supervised serial communication channel for control and monitoring of remotely located annunciators and I/O panels.

14. Programmable DACT for per Point Reporting.

15. Fire Panel Internet Interface to provide supplemental notification and remote user access to the FACU using Ethernet and TCP/IP communications protocol compatible with IEEE Standard 802.3.

C. Cabinet: Lockable steel enclosure. Arrange unit so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to form a complete control unit, provide exactly matching modular unit enclosures.

D. Alphanumeric Display and System Controls: Panel shall include an 80 character LCD display to indicate alarm, supervisory, and component status messages and shall include a keypad for use in entering and executing control commands.

E. Distributed Module Operation: FACU shall be capable of allowing remote location of the following modules; interface of such modules shall be through a Style 4 (Class B) supervised serial communications channel (SLC):

1. Addressable Signaling Line Circuits
2. Initiating Device Circuits
3. Notification Appliance Circuits
4. Auxiliary Control Circuits
5. Graphic Annunciator LED/Switch Control Modules

    a. In systems with two or more Annunciators and/or Command Centers, each Annunciator/Command Center shall be programmable to allow multiple Annunciators/Command Centers to have equal operation priority or to allow hierarchal priority control to be assigned to individual Annunciator/Command Center locations.

6. Amplifiers, voice and telephone control circuits

F. Voice Alarm: Provide an emergency communication system, integral with the FACU, including voice alarm system components, microphones, amplifiers, and tone generators. Features include:

1. Amplifiers comply with UL 1711, "Amplifiers for Fire Protective Signaling Systems." Amplifiers shall provide an onboard local mode temporal coded horn tone as a default backup tone. Test switches on the amplifier shall be provided to test and observe amplifier backup switchover. Each amplifier shall communicate to the host panel amplifier and NAC circuit voltage and current levels for display on the user interface. Each amplifier shall be capable of performing constant supervision for non-alarm audio functions such as background music and general paging.

2. Dual alarm channels permit simultaneous transmission of different announcements to different zones or floors automatically or by use of the central control microphone. All announcements are made over dedicated, supervised communication lines. All risers shall support Class B wiring for each audio channel.

3. Eight channel digitally multiplexed audio for systems that require more than two channels of simultaneous audio. Up to 8 channels of audio shall be multiplexed on either a style 4 or style 7 twisted pair.

4. Emergency voice communication audio controller module shall provide up to 32 minutes of message memory for digitally stored messages. Provide supervised connections for master microphone and up to 5 remote microphones.

5. Status annunciator indicating the status of the various voice alarm speaker zones and the status of fire fighter telephone two-way communication zones.

2.4 ADDRESSABLE INITIATING

A. ADDRESSABLE MANUAL PULL STATIONS

1. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

2. Description: Addressable single- action type, red LEXAN. Station shall mechanically latch upon operation and remain so until manually reset by opening with a key common with the control units. Station shall be pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit. Where double-action stations are provided, the mechanism shall require two actions push top activation door to initiate an alarm.

3. Provide with a front showing red LED showing that will flash each time it is scanned by the Control Unit (once every 4 seconds). In alarm condition, the station LED shall be on steady.

4. Indoor Protective Shield: Where required, or as indicated on the drawings, provide a factory-fabricated, tamperproof, clear LEXAN enclosure shield and red frame that easily fits over manual pull stations which shall be hinged at the top to permit lifting for access to initiate a local alarm. Unit shall be NRTL listed. Lifting the cover shall actuate an integral battery-powered audible horn intended to discourage false-alarm operation. The horn shall be silenced by lowering and realigning the shield. The horn shall provide 85dB at 10 feet and shall be powered by a 9 VDC battery.

B. ADDRESSABLE ANALOG SMOKE SENSORS

1. General Requirements for System Smoke Detectors:

a. Comply with UL 268, "Smoke Detectors for Fire Protective Signaling Systems." Include the following features:

b. Factory Nameplate: Serial number and type identification.

c. Operating Voltage: 24 VDC, nominal and shall be two-wire type.

d. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore normal operation.

e. Plug-In Arrangement: Sensor and associated electronic components are mounted in a module that connects to a fixed base with a twist-locking plug connection. Base shall provide break-off plastic tab that can be removed to engage the head/base locking mechanism. Provide terminals in the fixed base for connection to building wiring. No special tools shall be required to remove head once it has been locked. Removal of the detector head shall interrupt the supervisory circuit of the fire alarm detection loop and cause a trouble signal at the control unit. Sensors shall include a communication transmitter and receiver in the mounting base having a unique identification and capability for status reporting to the FACU. Sensor address shall be located in base to eliminate false addressing when replacing sensors. Integral Addressable Module shall be arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit. Each sensor base shall contain an integral visual-indicating LED that wi

f. Each sensor base shall contain a magnetically actuated test switch to provide for easy pre-certification alarm testing at the sensor location.

g. Each sensor shall be scanned by the Control Unit for its type identification to prevent inadvertent substitution of another sensor type. Upon detection of a "wrong device", the control unit shall operate with the installed device at the default alarm settings for that sensor; 2.5% obscuration for photoelectric sensor, 135-deg F and 15-deg F rate-of-rise for the heat sensor, but shall indicate a "Wrong Device" trouble condition.

h. Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit. Provide multiple levels of detection sensitivity for each sensor.

i. Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct smoke sensor shall be provided by the FACU.

j. The sensor's electronics shall be immune from nuisance alarms caused by EMI and RFI. Removal of the sensor head for cleaning shall not require the setting of addresses.

k. Bases: CO Sensor, relay output, sounder and isolator bases shall be supported alternatives to the standard base.

2. Addressable Sensor Bases

a. Standard base - Twist lock addressable base with address selection DIP switch accessible from front with sensor removed. Integral red LED for power-on (pulsing), or alarm or trouble (steady on). Locking anti-tamper design mounts on standard outlet box.

b. Sensor Base with remote device connection - All standard base features with wired connection for either a Remote LED alarm indicator or remote relay (relay is unsupervised and requires separate 24VDC)

c. Supervised Relay Bases - All standard base features and shall be available in either a 4-Wire Sensor Base to use with remote or locally mounted relay; requires separate 24 VDC, or as a 2-Wire Sensor Base to use with remote or locally mounted relay; no separate power required. Supervised relay operation shall be programmable and shall be manually operated from control panel.

d. Sensor base with built-in electronic alarm sounder - All standard base features and piezoelectric sounder shall provide high output (88 dBA) with low current requirements (20 mA). Sounder shall be synchronized via SLC communications or by the NAC if NAC powered, sounder shall operation shall be programmable and shall be manually operated from control panel.

e. 520 Hz Sensor base with built-in electronic low frequency sounder - All standard base features and piezoelectric sounder shall provide a low frequency 520 Hz Square Wave (85 dBA) with nominal current requirements (115 mA). Sounder shall be synchronized via SLC communications or by the NAC if NAC powered, sounder operation shall be programmable and shall be manually operated from control panel.

(1) Emitted tone shall be a 520Hz Square Wave signal in compliance with the requirements of the 2010 edition of NFPA 72 for sleeping areas.

(2) The 520Hz Sounder base shall be listed to UL 268 and UL464, Audible Signal Appliances.

C. ADDRESSABLE DUCT SMOKE SENSOR

1. Standard Addressable Duct Smoke Sensor Unit. Photoelectric type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions

where applied. Duct housing shall include relay or relay driver as required for fan shutdown.

a. Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct smoke sensor shall be provided by the FACU.

b. The Duct Housing shall provide a supervised relay driver circuit for driving up to 15 relays with a single "Form C" contact rated at 7A@ 28VDC or 10A@ 120VAC. This auxiliary relay output shall be fully programmable independent of the sensor head for activation by other alarm initiating devices within the fire alarm system. Relay shall be mounted within 3 feet of HVAC control circuit.

c. Duct Housing shall provide a magnetic test area and Red sensor status LED and Duct Housing shall provide a relay control Yellow LED trouble indicator.

d. Duct Housing shall have a transparent cover to monitor for the presence of smoke. Cover shall secure to housing by means of four (4) captive fastening screws.

e. Duct Housing shall provide two (2) Test Ports for measuring airflow and for testing. These ports will allow aerosol injection in order to test the activation of the duct smoke sensor.

f. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.

g. Each duct smoke sensor shall be provided with a Remote Test Station with an alarm LED and test switch.

h. Where indicated provide a NEMA 4X weatherproof duct housing enclosure that shall provide for the circulation of conditioned air around the internally mounted addressable duct sensor housing to maintain the sensor housing at its rated temperature range. The housing shall be UL Listed to Standard 268A.

D. ADDRESSABLE HEAT SENSORS

1. General Requirements for Heat Detectors: Comply with UL 521.

2. Thermal Sensor Combination type: Fixed-temperature and rate-of-rise unit with plug-in base and alarm indication lamp; Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.

3. Thermal sensor shall be of the epoxy encapsulated electronic design. It shall be thermistor-based, rate-compensated, self-restoring and shall not be affected by thermal lag. Selectable rate compensated, fixed temperature sensing with or without rate-of-rise operation.

4. Mounting: Twist-lock base interchangeable with smoke-sensor heads.

5. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

6. Sensor fixed temperature sensing shall be independent of rate-of-rise sensing and programmable to operate at 135-deg F or 155-deg F. Sensor rate-of-rise temperature detection shall be selectable at the FACU for either 15-deg F or 20-deg F per minute.

7. Sensor shall have the capability to be programmed as a utility monitoring device to monitor for temperature extremes in the range from 32-deg F to 155-deg F.

8. Unless otherwise indicated, sensors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for temperature by fire-alarm control unit.

    a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.

    b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).

E. ADDRESSABLE CO SENSOR

1. Addressable CO Sensor

    a. The CO Sensor shall be an addressable carbon monoxide (CO) sensing module providing both CO toxic gas detection and enhanced fire detection, and shall be listed to UL 268, Smoke Detectors for Fire Alarm Signaling Systems and UL 2075, Gas and Vapor Detectors and Sensors; allowing systems to be listed to UL 2034, Single and Multiple Station Carbon Monoxide Alarms.

    b. The CO Sensor shall include CO sensor element mounted in the sensor base which can be easily replaced without replacing the complete sensor base assembly.

    c. The CO Sensor base shall provide address selection in the base allowing the address to remain with its location when the sensor is removed for service or type change.

    d. The CO Sensor base shall include an integral red LED to indicate the power-on, trouble, test mode or alarm status.

    e. CO sensor shall provide enhanced fire detection with the addition of two selectable modes of operation: Nuisance Alarm Reduction Mode and Faster Fire Detection.

    f. The CO Sensor shall provide a 10 year life expectancy before replacement is necessary or required.

    g. The CO Sensor base shall report the following CO Sensor troubles: Communication loss, Disabled, Almost Expired 12 Months, Almost Expired 6 Months, Expired (End of Life), and Sensor Missing/Failed.

F. ADDRESSABLE CIRCUIT INTERFACE MODULES

1. Addressable Circuit Interface Modules: Arrange to monitor or control one or more system components that are not otherwise equipped for addressable communication. Modules shall be used for monitoring of waterflow, valve tamper, non-addressable devices, and for control of AHU systems.

2. Addressable Circuit Interface Modules will be capable of mounting in a standard electric outlet box. Modules will include cover plates to allow surface or flush mounting. Modules will receive their operating power from the signaling line circuit or a separate two wire pair running from an appropriate power supply, as required.

3. There shall be the following types of modules:

    a. Type 1: Monitor Circuit Interface Module:

        (1) For conventional 2-wire smoke detector and/or contact device monitoring with Class B or Class A wiring supervision. The supervision of the zone wiring will be Class B. This module will communicate status (normal, alarm, trouble) to the FACU.

(2) For conventional 4-wire smoke detector with Class B wiring supervision. The module will provide detector reset capability and over-current power protection for the 4-wire detector. This module will communicate status (normal, alarm, trouble) to the FACU.

b. Type 2: Line Powered Monitor Circuit Interface Module

(1) This type of module is an individually addressable module that has both its power and its communications supplied by the two wire signaling line circuit. It provides location specific addressability to an initiating device by monitoring normally open dry contacts. This module shall have the capability of communicating four zone status conditions (normal, alarm, current limited, trouble) to the FACU.

(2) This module shall provide location specific addressability for up to five initiating devices by monitoring normally closed or normally open dry contact security devices. The module shall communicate four zone status conditions (open, normal, abnormal, and short). The two-wire signaling line circuit shall supply power and communications to the module.

c. Type 3: Single Address Multi-Point Interface Modules

(1) This multipoint module shall provide location specific addressability for four initiating circuits and control two output relays from a single address. Inputs shall provide supervised monitoring of normally open, dry contacts and be capable of communicating four zone status conditions (normal, open, current limited, and short). The input circuits and output relay operation shall be controlled independently and disabled separately.

(2) This dual point module shall provide a supervised multi-state input and a relay output, using a single address. The input shall provide supervised monitoring of two normally open, dry contacts with a single point and be capable of communicating four zone status conditions (normal, open, current limited, and short). The two-wire signaling line circuit shall supply power and communications to the module.

(3) This dual point module shall monitor an unsupervised normally open, dry contact with one point and control an output relay with the other point, using a single address. The two-wire signaling line circuit shall supply power and communications to the module.

d. Type 4: Line Powered Control Circuit Interface Module

(1) This module shall provide control and status tracking of a Form "C" contact. The two-wire signaling line circuit shall supply power and communications to the module.

e. Type 5: 4-20 mA Analog Monitor Circuit Interface Module

(1) This module shall communicate the status of a compatible 4-20 mA sensor to the FACU. The FACU shall annunciate up to three threshold levels, each with custom action message; display and archive actual sensor analog levels; and permit sensor calibration date recording.

4. All Circuit Interface Modules shall be supervised and uniquely identified by the control unit. Module identification shall be transmitted to the control unit for processing according to the program instructions. Modules shall have an on-board LED to provide an indication that the module is powered and communicating with the FACU. The LEDs shall provide a troubleshooting aid since the LED blinks on poll whenever the peripheral is powered and communicating.

2.5 ADDRESSABLE NOTIFICATION

A. ADDRESSABLE ALARM NOTIFICATION APPLIANCES

1. Addressable Notification Appliances: The Contractor shall furnish and install Addressable Notification Appliances and accessories to operate on compatible signaling line circuits (SLC).

    a. Addressable Notification appliance operation shall provide power, supervision and separate control of horns and strobes over a single pair of wires. The controlling channel (SLC) digitally communicates with each appliance and receives a response to verify the appliance's presence on the channel. The channel provides a digital command to control appliance operation. SLC channel wiring shall be unshielded twisted pair (UTP), with a capacitance rating of less than 60pf/ft and a minimum 3 twists (turns) per foot.

    b. All Notification Appliances shall operate as a completely independent device allowing for specific location alerting of both fire alarm and Mass Notification functions. Each visible device (both clear fire alarm and amber mass notification) shall be capable of operating on multiple notification zones or completely separate from all other notification devices, this allows “On the fly” program operation changes for Mass Notification alerting and fire alarm notification.

    c. All Notification Appliances shall operate as a completely independent device allowing for appliances in handicap accessible rooms and other locations to operate on the same SLC and to activate individually based on an alarm condition in a room or as part of a general alarm condition where all appliances activate together.

    d. Individual Notification Appliances shall be able to be grouped into zones (or operational groups) by central programming at the main fire alarm control unit.

    e. Notification Appliances shall provide for “unobtrusive” testing. Each Notification Appliance shall be tested for audible and visible operation on an individual basis at the device or from the main fire alarm control unit, allowing for minimal invasive impact.

    f. Class B (Style 4) notification appliances shall be wired without requiring traditional in/out wiring methods; addressable "T" Tapping shall be permitted. Up to 127 addresses can be supported on a single channel.

    g. Each Addressable notification appliance shall contain an electronic module and a selectable address setting to allow it to occupy a unique location on the channel. This on-board module shall also allow the channel to perform appliance diagnostics that assist with installation and subsequent test operations. A visible LED on each appliance shall provide verification of communications and shall flash with the appliances address setting when locally requested using a magnetic test tool.

    h. Each addressable notification appliance shall have electrical test point access without removing the device cover.

    i. Both wall mount and ceiling mount devices shall be available.

2. Addressable Visible/Only: Addressable strobe shall be listed to UL 1971. The V/O device shall consist of a xenon flash tube and associated lens/reflector system, cover and mounting plate. For ease of installation the mounting plate shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. When the appliance is connected to an active circuit, the front cover of the appliance shall be removable without causing a trouble indication on the fire alarm control unit. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot. The V/O appliance shall be provided with multiple minimum flash intensities of 15cd, 30cd, 75cd, 110cd, 135cd and 185cd. The Candela levels shall be settable from the fire alarm control unit or by using a hardware selector on the appliance.

3. Standard Speaker: Speaker notification appliances shall be listed to UL 1480.

a. The speaker shall operate on a standard 25VRMS or 70.7VRMS NAC using twisted / shielded wire.

b. The following taps are available: 0.25W, 0.50W, 1.0W and 2.0W. At the 1.0W tap, the speaker has minimum UL rated sound pressure level of 84dBA at 10 feet.

c. The speaker shall have a frequency response of 400 to 4000 Hz for Fire Alarm and 125 to 12kHz for general signaling.

d. The speaker shall install directly to a 4" square, 1 ½" deep electrical box with 1 ½" extension.

4. Hybrid Speaker/Visible: Combination Speaker/Visible (S/V) units combine the speaker and visible functions into a common housing. The S/V shall be listed to UL 1971 and UL 1480. Addressable functionality controls visible operation, while the speaker operates on a 25VRMS or 70.7VRMS NAC.

a. Twisted/shielded wire is required for speaker connections on a standard 25VRMS or 70.7VRMS NAC and UTP conductors, having a minimum of 3 twists per foot is required for addressable strobe connections.

b. The following taps are available: 0.25W, 0.50W, 1.0W and 2.0W. At the 1.0W tap, the speaker has minimum UL rated sound pressure level of 82 dBA at 10 feet.

c. The S/V shall have a frequency response of 400 to 4000 Hz for Fire Alarm and 125 to 12kHz for general signaling.

d. The S/V installs directly to a 4" square, 1 ½" deep electrical box with 1 ½" extension.

5. Addressable Speaker: Addressable Speaker notification appliances shall be listed to UL 1480. Individual device level supervision and activation control shall be provided by the fire alarm control unit.

a. Speakers shall be individually powered, addressed, and controlled from a compatible fire alarm control unit Signaling Line Circuit (SLC) using Unshielded Twisted Pair (UTP) cable and T-taps shall be allowed for Class B installation reducing wiring costs and wiring distances. Shielded cable shall not be required.

b. Speakers shall provide for Fire Alarm and General Signaling functionality in a single unit, eliminating additional devices. Device “Self-Test” shall be supported by a compatible fire alarm control unit and shall be UL listed and NFPA 72 compliant. Speakers shall be UL listed to provide a 520Hz audio tone in compliance with NFPA 72 for sleeping areas.

c. The speaker audio shall be provided by a standard 25VRMS or 70.7VRMS audio circuit using Unshielded Twisted Pair (UTP) cable and T-taps shall be allowed for Class B installation reducing wiring costs and wiring distances. Supervision of this circuit shall be provided by the addressable speaker. Shielded cable shall not be required.

d. Speaker power taps shall be at a minimum of 0.25W, 0.50W, 1.0W and 2.0W. At the 1.0W tap, the speaker shall have a minimum UL rated sound pressure level of 86dBA at 10 feet for the Standard Output version and 84dBA at 10 feet for the High-Fidelity version.

e. Speakers shall be available in either “Standard Output” with a minimum frequency response of 400 to 4000 Hz or in “High Fidelity Output” with a minimum frequency response of 200 to 10,000 Hz. Standard Output speakers shall use a multi-tapped speaker for audio/tone notification.

f. Wall mount appliances shall be available in White and Red and ceiling mount appliances shall be available in White, Red, and Black. Labeling shall be available as either “FIRE”, “ALERT” or no labeling.

g. The speaker shall install directly to a 4" square, 2 1/8" deep electrical box. Extensions for these boxes shall not be required. Units shall be modular in design to allow for easy installation and for easy changing of device color and labeling.

6. Addressable Speaker/Visible: Combination Speaker/Visible (S/V) units combine the speaker and visible functions into a common housing. The S/V shall be listed to UL 1971 and UL 1480. Addressable functionality controls visible operation, while the speaker shall operate on a 25VRMS or 70.7VRMS NAC.

a. Operational functions and features of Addressable Speaker above shall apply to this section. Operational functions and features of Addressable Strobe above shall apply to this section.

b. Wall mount appliances shall be available in White and Red and ceiling mount appliances shall be available in White, Red, and Black. Labeling shall be available as either “FIRE”, “ALERT” or no labeling.

c. The speaker shall install directly to a 4" square, 2 1/8" deep electrical box. Extensions for these boxes shall not be required. Units shall be modular in design to allow for easy installation and for easy changing of device color and labeling

7. Isolator Module: Isolator module provides short circuit isolation for addressable notification appliance SLC wiring. Isolator shall be listed to UL 864. The Isolator shall mount directly to a minimum 2 1/8" deep, standard 4" square electrical box, without the use of special adapter or trim rings. Power and communications shall be supplied by the Addressable Controller channel SLC; dual port design shall accept communications and power from either port and shall automatically isolate one port from the other when a short circuit occurs. The following functionality shall be included in the Isolator module:

a. Report faults to the host FACU.
b. On-board Yellow LED provides module status.
c. After the wiring fault is repaired, the Isolator modules shall test the lines and automatically restore the connection.

2.6 FIRE FIGHTERS' TELEPHONES

A. Telephone Hand Sets: High-impact plastic handset, heavy-duty coil cord, and hook switch; connected to the FACU by means of dedicated, supervised communication lines. Handsets have a dynamic receiver and a carbon transmitter, operating on 24VDC.

B. A black master telephone handset with a push to talk button and a flexible-coiled self-winding five (5) foot cord shall be provided and recessed within a protective unit-mounted enclosure at the command center.

C. Cabinet: Flush- or surface-mounted as indicated, 18-gage, minimum, painted steel with a latched hinged door with trim labeled "Fire Fighters' Phone." Size to accommodate handset and cord.

2.7 MAGNETIC DOOR HOLDERS

A. Description: Units shall be listed to UL 228. Units are equipped for wall or floor mounting as indicated and are complete with matching door plate. Unit shall operate from a 120VAC, a 24VAC or a 24VDC source, and develop a minimum of 25 lbs. holding force.

B. Material and Finish: Match door hardware.

2.8 REMOTE LCD ANNUNCIATOR

A. Provide a remote LCD Annunciator, where required, with the same "look and feel" as the FACU operator interface. The Remote LCD Annunciator shall use the same Primary Acknowledge, Silence, and Reset Keys; Status LEDs and LCD Display as the FACU.

B. Annunciator shall have super-twist LCD display with two lines of 40 characters each. Annunciator shall be provided with four (4) programmable control switches and associated LEDs.

C. Under normal conditions the LCD shall display a "SYSTEM IS NORMAL" message and the current time and date.

D. Should an abnormal condition be detected the appropriate LED (Alarm, Supervisory or Trouble) shall flash. The unit audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.

E. The LCD shall display the following information relative to the abnormal condition of a point in the system:

1. 40 character custom location label.
2. Type of device (e.g., smoke, pull station, waterflow).
3. Point status (e.g., alarm, trouble).

F. Operator keys shall be key switch enabled to prevent unauthorized use. The key shall only be removable in the disabled position. Acknowledge, Silence and Reset operation shall be the same as the FACU.

2.9 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.
2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address or loss of power.
4. Low battery.
5. Abnormal test signal.
6. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.10 EMERGENCY POWER SUPPLY

A. General: Components include battery, charger, and an automatic transfer switch.

B. Battery: Sealed lead-acid or nickel cadmium type. Provide sufficient capacity to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 24 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all alarm notification devices in alarm mode for a period of 15 minutes.

2.11 DEVICE GUARDS

A. Provide monitor module for connection to the fire alarm system signaling line circuit.

PART 3 – EXECUTION

3.1 INSTALLATION, GENERAL

A. Install system components and all associated devices in accordance with applicable NFPA Standards and manufacturer's recommendations.

B. Installation personnel shall be supervised by persons who are qualified and experienced in the installation, inspection, and testing of fire alarm systems. Examples of qualified personnel shall include, but not be limited to, the following:

1. Factory trained and certified personnel.

2. National Institute of Certification in Engineering Technologies (NICET) fire alarm level II certified personnel.

3. Personnel licensed or certified by state or local authority.

3.2 EQUIPMENT INSTALLATION

A. Furnish and install a complete Fire Alarm System as described herein and as shown on the plans. Include sufficient control unit(s), annunciator(s), manual stations, automatic fire detectors, smoke detectors, audible and visible notification appliances, wiring, terminations, electrical boxes, Ethernet drops, and all other necessary material for a complete operating system.

B. Water-Flow and Valve Supervisory Switches: Connect for each sprinkler valve required to be supervised.

C. Device Location-Indicating Lights: Locate in the public space immediately adjacent to the device they monitor.

D. Install manual station with operating handle 48 inches (1.22 m) above floor. Install wall mounted audible and visual notification appliances not less than 80 inches (2.03 m) above floor to bottom of lens and not greater than 96 inches (2.44 m) above floor to bottom of lens.

E. Mount outlet box for electric door holder to withstand 80 pounds pulling force.

F. Make conduit and wiring connections to door release devices, sprinkler flow switches, sprinkler valve tamper switches, fire suppression system control units, duct smoke detectors .

G. Automatic Detector Installation: Conform to NFPA 72.

H. Ethernet Drop: A standard RJ-45 Ethernet connection to the owner's Ethernet network shall be provided at each fire alarm control unit as part of the contract.

3.3 PREPARATION

A. Coordinate work of this Section with other affected work and construction schedule.

3.4 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 m) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Alarm-initiating connection to smoke-control system (smoke management) at firefighter smoke-control system panel.

2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.

3. Smoke dampers in air ducts of designated air-conditioning duct systems.

4. Alarm-initiating connection to elevator recall system and components.

5. Alarm-initiating connection to activate emergency lighting control.

6. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.

7. Supervisory connections at valve supervisory switches.

8. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.

9. Supervisory connections at elevator shunt trip breaker.

10. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.

11. Supervisory connections at fire-pump engine control panel.

3.5 WIRING INSTALLATION

A. System Wiring: Wire and cable shall be a type listed for its intended use by an approval agency acceptable to the Authority Having Jurisdiction and shall be installed in accordance with the appropriate articles from the current approved edition of NFPA 70: National Electric Code (NEC).

B. Contractor shall obtain from the Fire Alarm System Manufacturer written instruction regarding the appropriate wire/cable to be used for this installation. No deviation from the written instruction shall be made by the Contractor without the prior written approval of the Fire Alarm System Manufacturer.

C. Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm initiating device circuits wiring and a different color code for supervisory circuits. Color-code notification appliance circuits differently from alarm-initiating circuits. Paint fire alarm system junction boxes and covers red.

D. Ethernet Circuits:

1. Ethernet circuits shall be provided to the Fire Alarm Control Unit as shown on the plans.

2. Where a dedicated Fire Alarm Ethernet LAN is specified only Agency Listed Fire Alarm Ethernet hardware shall be installed.

3. The electrical contractor shall coordinate and ensure proper Ethernet connections occur at the fire alarm control unit and other designated equipment locations prior to system turnover.

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.7 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.8 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.

B. Service personnel shall be qualified and experienced in the inspection, testing, and maintenance of fire alarm systems. Examples of qualified personnel shall be permitted to include, but shall not be limited to, individuals with the following qualifications:

1. Factory trained and certified.
2. National Institute for Certification in Engineering Technologies (NICET) fire alarm certified.

C. Pretesting: Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved.

D. Inspection:

1. Inspect equipment installation, interconnection with system devices, mounting locations, and mounting methods.
2. Verify that units and controls are properly installed, connected, and labeled and that interconnecting wires and terminals are identified.

E. Acceptance Operational Tests:

1. Perform operational system tests to verify conformance with specifications:

a. Each alarm initiating device installed shall be operationally tested. Each device shall be tested for alarm and trouble conditions. Contractor shall submit a written certification that the Fire Alarm

System installation is complete including all punch-list items. Test battery operated emergency power supply. Test emergency power supply to minimum durations specified. Test Supervising Station Signal Transmitter. Coordinate testing with Supervising Station monitoring firm/entity.

b. Test each Notification Appliance installed for proper operation. Submit written report indicating sound pressure levels at specified distances.

c. Test Fire Alarm Control Unit and Remote Annunciator.

2. Provide minimum 10 days notice of acceptance test performance schedule to Owner, and local Authority Having Jurisdiction.

F. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.

G. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Use NFPA 72 Forms for documentation.

H. Final Test, Record of Completion, and Certificate of Occupancy:

1. Test the system as required by the Authority Having Jurisdiction in order to obtain a certificate of occupancy. Provide completed NFPA 72 Record of Completion form to Owner and AHJ.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

3.10 CLEANING AND ADJUSTING

A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Clean unit internally using methods and materials recommended by manufacturer.

B. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound pressure levels and adjusting controls and sensitivities to suit actual occupied conditions. Provide up to three visits to the site for this purpose.

3.11 TRAINING

A. Provide the services of a factory-authorized service representative to demonstrate the system and train Owner's maintenance personnel as specified below.

1. Train Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventive maintaining of the system. Provide a minimum of 2 hours' training.

2. Schedule training with the Owner at least seven days in advance.

3.12 AS BUILT DRAWINGS, TESTING, and MAINTENANCE INSTRUCTIONS

A. <u>As Built Drawings</u>

A complete set of reproducible "as-built" drawings showing installed wiring, specific interconnections between all equipment, and internal wiring of the equipment shall be delivered to the owner upon completion of system.

B. Operating and Instruction Manuals

Three (3) complete sets of operating and instruction manuals, each placed in a 3-ring binder, shall be delivered to the owner upon completion. Each manual shall contain a copy of the as-built fire alarm system drawings. The instruction period for the owner or it's representatives shall be 4 hours, performed during normal business hours.

C. Testing Frequency Instructions

1. Complete, accurate, step-by-step testing instructions giving recommended and required testing frequency of all equipment, methods for testing each individual piece of equipment, and a complete trouble-shooting manual explaining how to test the primary internal parts of each piece of equipment shall be delivered to the owner upon completion of the system.

2. Maintenance instructions shall be complete, easy to read, understandable, and shall provide the following information:

   - Instruction on replacing any components of the system, including internal parts.
   - Instructions on periodic cleaning and adjustment of equipment with a schedule of these functions.

A complete list of all equipment and components with information as to the address and phone number of both the manufacturer and local supplier of each item.

3. User operating instructions shall be provided, and prominently displayed on the cabinet front or on a separate sheet located next to the fire alarm control unit, in accordance with UL Standard #864.

END OF SECTION 28 07 21

SECTION 28 07 25
INTRUSION SYSTEM

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. The Contractor shall provide, install, and program a functionally complete, integrated Intrusion System per Manufacturer's guidelines, codes described, within these specifications.

1.2 QUALIFICATIONS

A. The alarm contractor shall provide all equipment and accessories for a complete electrically supervised security alarm system as described herein and shown in the drawings.

B. Model numbers and designations, which appear herein, indicate design, quality, and type of material as well as operating characteristics.

C. The security alarm system products shall be built modular in construction for ease of expansion and service. Functions shall be on replaceable panels or modules to accommodate functional changes when required. All critical wiring and connectors shall be supervised so as to give a trouble signal if removed or disconnected.

1.3 MANUFACTURERS

A. The control/communicator, control stations, and programmers shall be supplied by SimplexGrinnell model Bosch 9512GV2 unless noted otherwise.

1.4 SUBMITTALS

A. Submittals at bid time:

1. For bid evaluation, bid submittals shall include six (10) sets of the items described below:

a. Specification sheets (cut sheets) of all proposed equipment.

b. Equipment list identifying:

Model number of each unit.
Quantities of each type of device.
Unit costs

2. Specification compliance: A letter submitted with the bid, responding to specification sub-sections individually, indicating exceptions, substitutions, and alternates. The Contractor shall submit requests for substitutions (as well as all relevant technical data pertaining to the substituted equipment) to the specifier 10 days prior to the close of bid for evaluation and approval.

B. Submittals after award of contract:

1. Drawings: Shop drawings to provide details of proposed system and the work to be provided. These include point-to-point drawings of systems and wiring diagrams of individual devices.

2. Permits: The Contractor shall be responsible for identifying requirements for permits from the local police department for the installation of the alarm system specified herein and shall assist the owner in obtaining the relevant alarm permits.

1.5 DOCUMENTATION TO BE SUBMITTED BY THE CONTRACTOR UPON COMPLETION OF SYSTEM INSTALLATION

A. "As-builts": Upon completion of installation, the Contractor shall prepare "as-built" drawings of the system. These "As-builts" shall be 30 in. x 42 in. (76 cm x 107 cm) reproducible drawings of each floor plan indicating exact device locations, panel terminations, cable routes and wire numbers as tagged and color-coded on the cable tag.

Additionally, final point-to-point wiring diagrams of each type of device (on 30 in. x 42 in. or 76 cm x 107 cm format) shall be included in the "as-builts."

"As-builts" shall be submitted to the Owner for approval prior to the system acceptance walk-through.

B. Operation and maintenance manuals: Three (3) sets of operating manuals shall be provided explaining the operation and maintenance of the system.

1.6 ON-SITE SECURITY PERSONNEL TRAINING

A. The Contractor upon completion of installation shall furnish training in the complete operation of the systems.

1.7 SYSTEM APPROVALS

A. The system shall be the standard product of one manufacturer, and the manufacturer shall have been in business manufacturing similar products for at least 5 years.

B. After-sales support: The Contractor shall be a factory-authorized and trained dealer of the system and shall be factory-trained and certified to maintain/repair the system after system acceptance.

1.8 QUALITY ASSURANCE

A. All equipment, systems, and materials furnished and installed under this section shall be installed in accordance with the applicable standards of:

National codes: NEC, NFPA, UBC, BOCA, SBCCI
Approvals and listings: UL, FM, (CSFM, NYC-MEA, when applicable)
Local Authorities Having Jurisdiction

1.9 WARRANTY

A. All components, parts, and assemblies supplied by the Manufacturers and installed by the Contractor shall be warranted against defects in material and workmanship for a period of at least 12 months (parts and labor), commencing upon date of acceptance by Owner. A qualified factory-trained service representative shall provide warranty service.

PART 2 – PRODUCTS

2.1 BASE SYSTEM PANEL (PC4020)

A. The base panel shall have a capacity of 16 hardwired zones and the ability to accommodate up to 128 addressable devices on two addressable loops. The total capacity of the security control panel shall be 128 zones. All zones shall be fully supervised and programmable. Panel shall be complete with integral power supply and supervised battery charger, auxiliary power for powering security detection devices, programmable switched auxiliary power supply for 4-wire smoke detectors, integral supervised digital alarm communicator, supervised bell/siren output, and two general purpose programmable outputs which can be programmed as general purpose outputs or as the system’s addressable loops.

1. System Communication Bus: The system shall be complete with a standard, non-shielded, 4-conductor station wire bus for powering and communicating with remote hardwired system expansion modules and devices. For the connection of various system modules, communication bus wire runs (#18 AWG) of up to 3500 ft (1066 m.) shall be standard, and the system shall allow for an additional 3500 ft (1066 m.) of communication bus wire for each communication bus expander added (max. 16).

2. Panel Zone Expansion: The panel shall be expandable to a maximum of 128 zones by adding standard hardwired 8 and/or 16-zone modules to the base panel, by adding up to 128 addressable detection devices to one or both of the addressable loops on the base panel, and by adding 64 wireless zones, and up to 8 wireless receivers to the four-wire communication bus. The system shall be capable of expansion using hardwired, addressable and wireless simultaneously in any combination that suits the application.

3. User Codes: The system shall provide for 1,500 user codes, select table as either 4 or 6 digits. For access control, user codes shall be assignable to 1 of 64 access levels. User codes shall be assignable to one or multiple partitions.

4. Partitions: The system shall be programmable for up to 8 fully independent partitions, with each partition having its own account code. Keypads shall be assignable as partition keypads or global keypads. Each zone in the system shall be assignable to one or more partitions.

5. Automation: The system shall be complete with an automation control module capable of controlling 32 X-10 or CEBus control devices, by event and by schedule. The system shall include 16 schedules to control automation devices. Automation shall be controllable from any system keypad and through a local or remote tone telephone.

6. Scheduling: The system shall provide for 99 date schedules with 4 intervals per schedule, 4 holiday schedules with 2 years of scheduling capacity, 50 open/close suppression schedules and 16 automation schedules. All schedules shall be programmable from the LCD system keypads and by either local or remote upload/download.

7. Ground Fault Detection: The system shall include an integral ground fault detector, which shall detect a single ground fault on any extended conductor in the system.

8. Supervision: Each zone in the system shall be supervised. The base panel and any remote panel with its own AC input shall be supervised for AC loss. Batteries for the base panel and all remote panels shall be supervised for low power and be short circuit-protected. Each addressable device and each wireless input device shall be supervised for its presence. The communications bus shall be supervised for low voltage and the presence of each enrolled module and keypad. Digital alarm communicators shall be supervised for telephone line trouble and failure to communicate.

9. Central Station Reporting: The system shall provide high speed 10 bps and 20 bps 1400/2300 Hz handshake, Contact ID and SIA reporting formats and shall be capable of being programmed to call up to 3 telephone numbers. The system shall also allow communication to a pager. The telephone numbers shall be programmable for backup dialing should the primary number fail. The system shall be programmable for split reporting so that alarms/restorals, openings/closing and miscellaneous events can be sent to different telephone numbers. The system shall report a separate account code for each partition and for non-partition (system) events. The system shall provide opening/closing scheduled suppression to prevent opens and closes from being reported to the central station. The system shall be capable of reporting all alarms, troubles, and system status information by combinations of all communication methods installed including: digital communication DVACS, and Cellemetry.

10. TCP/IP LAN/WAN Communications: The system shall have the ability to communicate all alarm signals to a central station or dedicated PC (equipped with appropriate software), through a constant

connection providing full supervision of the link between the panel and the TCP/IP receiver. Communication shall be via a LAN or WAN, compatible with 10BaseT and 100BaseT Ethernet TCP/IP communications.

11. System Printer: The system shall be capable of output to a serial printer installed anywhere on the communication bus, and capable of printing all system events, alarms and restorals, including the partition, date, and time of these events.

12. 2-Way Serial Port: The system shall support a 2-way data port, offering RS-232 serial communications at data transfer rates of from 300 to 4800 bps. This port shall provide real-time access to all system events and allow system integrators to send control commands to the control panel.

13. False Alarm Prevention: The system shall include the following false alarm prevention features:

    - audible exit delay, audible exit fault
    - arm/disarm bell squawk
    - urgency on entry delay
    - TLM trouble and low battery trouble transmission delay
    - swinger shutdown programmable by zone
    - transmission delay by zone
    - police code (cross zone) transmission
    - opening after alarm transmission
    - recent close code transmission
    - AC fail
    - arming/disarming from outside the protected space using access control or wireless key

14. Power Supply/Relay Output Modules: The system shall be capable of including up to 64 fully programmable output relays with form 'C' contacts rated 2 Amps at 30VDC. Relays shall be added in modules of four and may be located anywhere on the communication bus. Each module shall include a supervised 700mA 12VDC battery charger, and integral power supply to supply up to 2.2 Amps of auxiliary power at 12VDC to power directly connected devices or repower the communication bus.

15. Low Power Outputs: The system shall be capable of including up to 144 low power outputs with each output able to supply 50mA at 12 VDC. Outputs shall be added in increments of 16 and may be added anywhere on the communication bus.

16. System Event Buffer: The system shall have a 3,000-event buffer. All events shall be printable from the system printer. The 2,800 most recent events shall be viewable on the LCD system keypad. All events shall be viewable by upload/download to a PC.

17. System Software: The base panel shall come complete with the software necessary to implement every system feature and to allow for the addition of every expansion or functional module without changes or addition to the basic software.

18. System Programming: The system shall be fully programmable from the LCD keypads and shall also allow event buffer viewing at the keypads. Separate PC-based upload/download software shall allow programming and operation from a directly connected local computer, or from a remote computer via a telephone line or TCP/IP LAN/WAN communications. Remote access shall be controlled by the owner to prevent unauthorized access. All system programming shall be maintained in nonvolatile memory so that programming information is retained even if all AC and battery power is removed.

19. Remote Annunciation: The system shall be capable of remote zone alarm and system status annunciation of up to 144 points, by adding 12, 32 and 64 point annunciators anywhere on the communication bus. Annunciators shall be capable of being flush-mounted. The annunciators shall provide point and/or graphic annunciation capability.

20. System Keypads (LCD4501): The system shall accommodate up to 16 LCD keypads which are powered from the base panel via the four-wire communications bus. LCD keypads shall have a display capacity of at least 32 alphanumeric characters with adjustable brightness and contrast. Keys shall be backlit for low light ease of use. Keypads shall include individual "Armed", "Ready" and "Trouble" indicators, three keypad-activated alarm keys, and five programmable function keys.

2.2 MATERIALS

A. Addressable Contact Input Module: Provide DSC model # AMP-701 input module for non-addressable devices. Uses 2-wire connection for power and data to the control panel. The AMP-701 has three alarm input terminals to which an external device can be connected. The terminals monitor alarm, tamper and trouble states.

B. Interface to Door Hardware: Provide all necessary interface equipment required. Coordinate with door hardware provider.

C. Passive Infrared Motion Detector: Provide as shown on plans PIR detectors.

1. Wall-Mounted Units: Maximum detection range for individual units exceeds scheduled distance by 25 percent, but not less than 50 feet (15m)

2. Ceiling-Mounted Units: Full 360-degree conical spot-detection pattern. With the device mounted at 8 feet above the floor the pattern at floor level is a minimum diameter of 24 feet. With device mounted at 12 feet above the floor the pattern at floor level is a minimum diameter of 40 feet.

D. Door Switches: Provide as shown on plans magnetic type door switch.

1. Flush-mounted units: unobtrusive, flush with surface of door frame and door.

2. Overhead door units: door mounted magnet and floor mounted switch. Unit shall be listed for outdoor locations.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install all equipment and materials in accordance with the "current" recommendations of the manufacturer. The work shall also be in accordance with:

1. Installation criteria defined in these specifications and in the construction documents.
2. Factory Representative.
3. Approved submittals.
4. Applicable requirements of referenced standards.

3.2 SUPERVISION

A. The contractor shall provide the following services as part of the contract:

1. Supervision of sub-contractors.
2. Coordination of other contractors for system-related work (electrical contractor, finish hardware contractor, architect, and general contractor).
3. Attending site construction/coordination meetings.
4. Keeping updated construction drawings at the construction site.
5. Meeting construction deadlines per the construction schedule.

3.3 PROGRAMMING

A. Programming of the system shall include the following tasks:

1. Programming system configuration parameters (hardware and software, zone/circuit numbers, communication parameters).

2. Programming operational parameters such as opening/closing reports and windows, system response text (custom English) displays of events, activation of relays that drive auxiliary devices, and identifying types of zones/loops.

3. Programming pass codes according to the authorities and functions defined by the owner.

4. Other system programming tasks required by the owner. These additional programming requirements shall be coordinated between the owner and the contractor.

3.4 TESTING

A. Operational Testing: The contractor shall perform thorough operational testing and verify that all system components are fully operational.

B. Hard-copy System Printout: The contractor shall submit a hard-copy system printout of all components tested and certify 100 percent operation indicating all devices/panels/units have passed the test criteria set forth by the manufacturer.

C. Acceptance Test Plan Form: An acceptance test plan form shall be prepared/provided by the contractor prior to the acceptance walk-through.

This form shall include separate sections for each device/panel/unit as well as a column indicating the manufacturer's performance allowance/margin, a column indicating the result of the testing performed by the contractor (pass/fail), and an empty column for recording findings during the walk-through.

3.5 COMMISSIONING

A. The contractor shall certify completion in writing and schedule the commissioning walk-through. The contractor shall provide all the tools and personnel needed to conduct an efficient commissioning process.

END OF SECTION 28 07 25

SECTION 28 07 27
INTEGRATED ACCESS CONTROL & SECURITY MANAGEMENT SYSTEM

PART I – GENERAL

1.1 GENERAL DESCRIPTION

A. The Security Management System (SMS) shall be a powerful, flexible, multi-function and object-oriented security and event management system that features a variety of customizable interfaces for maintaining the system and for monitoring the desired secure sites. The SMS shall provide an option to display these management and monitoring interfaces in the native languages of the people using the system. The security and event management system shall be flexible in order to meet specific requirements and quickly respond to evolving security challenges. The SMS shall be a scalable platform, simple and economical enough to support a single site, yet upgradeable enough to manage a multi-site network. The SMS shall use an open, distributed architecture, where database servers could reside in geographically separate locations.

B. The SMS shall provide extensive information management capability using Microsoft .NET Framework V4.6. It shall operate in a Client / Server configuration on personal computers with a Windows-based platform. Its distributed client-server architecture shall be capable of supporting up to 256 simultaneous clients, multiple types of controllers, and over 20,000 input devices, including cameras and multiple types of card readers. The SMS shall be constructed to be database independent and shall support at a minimum Microsoft SQL Server 2008R2 (Express, Standard, or Enterprise), for data protection, redundancy and manageability.

C. The SMS shall have true multi-tasking, multiprocessor and remote client support; allowing independent activities and monitoring to occur simultaneously at different locations. The operator workstation (Client) shall be user friendly, employing icon-based menus and providing a mouse-driven interface for system operation and the creation of color graphic maps. The user interface shall be customizable, capable of delivering a unique look and feel without a unique version release. It shall be an intuitive user interface that is similar to Microsoft's Outlook and Explorer with its easy navigation and tree structures. A practical application layout editor shall let users drag and drop any application onto one screen and create a customized hub for all activities via a single "command and control" center.

D. Field devices such as card readers, alarm inputs, control points, etc. shall be connected to fully distributed intelligent field controllers or directly through a Software Development Kit or Web Services, and be capable of operating without host computer intervention. All objects within the SMS, i.e. doors, readers, time intervals, etc. shall be addressed by a unique name as opposed to point numbering or mnemonics. The SMS shall have badge generation tools to create and manage badges using a graphical interface and convenient query features to manage large numbers of badges.

1.2 SUBMITTALS

A. Shop Drawings

1. Prior to assembling or installing the SMS, the Contractor shall provide complete shop drawings which include the following:

   a.....Architectural floor plans indicating all system device locations.
   b.....Full schematic wiring information for all devices. Wiring information shall include cable type, cable length, conductor routings, quantities, and point-to-point termination schedules.
   c.....Complete access control system one-line block diagram.
   d.....Statement of the system sequence of operation.
   e.....Riser diagrams showing interconnections.
   f. ....Detail drawings showing installation and mounting.
   g.....Fabrication drawings for console arrangements and equipment layout.

2. All drawings shall be fully dimensioned and prepared in DWG format using any CAD-based software capable of exporting the format (such as AutoCAD).

B. Product Data

1. Prior to assembling or installing the SMS, the Contractor shall provide the following:

a.....Complete product data and technical specification data sheets that include manufacturer's data for all material and equipment, including terminal devices, local processors, computer equipment, access cards, and any other equipment provided as part of the SMS.

b.....A system description, including analysis and calculations used in sizing equipment required by the SMS. The description shall show how the equipment shall operate as a system to meet the performance requirements of the SMS. The following information shall be supplied as a minimum:

.....(1) Central processor configuration and memory size.
.....(2) Description of site equipment and its configuration.
.....(3) Protocol description.
.....(4) Rigid disk system size and configuration.
.....(5) Backup/archive system size and configuration.
.....(6) Start up operations.
.....(7) System expansion capability and method of implementation.
.....(8) System power requirements and UPS sizing.
.....(9) A description of the operating system and application software.

C. As-Built Drawings

1. At the conclusion of the project, the Contractor shall provide "as built" drawings. The "as built" drawings shall be a continuation of the Contractor's shop drawings as modified, augmented, and reviewed during the installation, check out and acceptance phases of the project. All drawings shall be fully dimensioned and prepared in DWG format using any CAD-based software capable of exporting the format (such as AutoCAD).

D. Manuals

1. At the conclusion of the project, the Contractor shall provide copies of the manuals as described herein. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each security system integrator installing equipment and systems and the nearest service representatives for each item of equipment for each system. The manuals shall have a table of contents and labeled sections. The manuals shall include all modifications made during installation, checkout, and acceptance. The manuals shall contain the following:

a.....Hardware Manuals

.....(1) The hardware manuals shall describe all equipment furnished including:
.....(2) General description and specifications.
.....(3) System layout drawings and schematics.
.....(4) Manufacturers' repair parts list indicating sources of supply.

b.....Software Manuals: The software manuals shall describe the functions of all software and shall include all other information necessary to enable proper loading, testing, and operation. The manual shall include:

.....(1) Definition of terms and functions.
.....(2) Use of system and applications software.
.....(3) Initialization, start-up, and shut down.

.....(4) Alarm reports.
.....(5) Reports generation.
.....(6) Database format and data entry requirements.

c.....Operator Manual: The operator manual shall fully explain all procedures and instructions for the operation of the system including:

.....(1) Computers and peripherals.
.....(2) System start-up and shut down procedures.
.....(3) Use of system, command, and applications software.
.....(4) Recovery and restart procedures.
.....(5) Graphic alarm presentation.
.....(6) Use of report generator and generation of reports.
.....(7) Data entry.
.....(8) Operator commands.
.....(9) Alarm messages and reprinting formats.
.....(10) System access requirements.

d.....Maintenance Manual: The maintenance manual shall include descriptions of maintenance for all equipment including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. The manufacturers of all hardware and software components employed in the SMS shall be established vendors to the access control/security monitoring industry for no less than five (5) years and shall have successfully implemented at least 5 systems of similar size and complexity.

B. Contractor / Integrator Qualifications

1. The security system integrator shall have been regularly engaged in the installation and maintenance of integrated access control systems and have a proven track record with similar systems of the same size, scope, and complexity.

2. The security system integrator shall supply information attesting to the fact that their firm is an authorized product integrator certified with the SMS. A minimum of one technician shall be a Certified SMS installer.

3. The security system integrator shall supply information attesting to the fact that their installation and service technicians are competent factory trained and certified personnel capable of maintaining the system and providing reasonable service time.

4. The security system integrator shall provide a minimum of three (3) references whose systems are of similar complexity and have been installed and maintained by the security system integrator in the last five (5) years.

5. There shall be a local representative and factory authorized local service organization that shall carry a complete stock of parts and provide maintenance for these systems.

C. Testing Agencies

1. The SMS shall be tested and listed by Underwriters Laboratories (UL) for UL/cUL 294 for Access Control System Units.

2. The SMS shall be tested and listed by Underwriters Laboratories (UL) for UL/cUL 1076 for Proprietary Burglar Alarm Units.

3. The SMS shall employ a FIPS 197-listed AES 256-bit encryption between the SMS Servers, Clients, and iSTAR Ultra/eX/Edge Controllers.

4. The SMS shall include full support for FIPS 201 initiative:

   a.....Ability to customize a system-wide Card Holder Unique Identification number (CHUID).

   b.....Ability to configure custom, extended card formats, including GSA 75-bit Wiegand standard, and to download them to the card access panels.

   c.....Ability to use Hashed Message Authentication Codes (HMAC) for medium assurance profile.

   d.....Enhanced data fields per the FIPS 201 standard, including Agency Code, System Code, Credential Series and Credential Issue Code.

5. The SMS hardware shall comply with the following regulatory requirements:

   a.....FCC Class A.
   b.....FCC Class B.
   c.....CE.
   d.....Canadian Radio Emissions requirements.
   e.....Restriction of Hazardous Substances Directive (RoHS) 2002/95/EC.
   f. ....FIPS 140-2 encryption (certified for the iSTAR Ultra/Edge/eX controllers).

6. The SMS shall support Americans with Disabilities Act (ADA) compliance in door and access operation.

D. Licensing: Licensing shall be required for the SMS software. The licensing shall include:

1. Series (Model).
2. Number of online readers.
3. Number of online inputs.
4. Number of online outputs.
5. Number of card holders.
6. Number of simultaneous clients.
7. Number of simultaneous badging stations.
8. Optional Features.

1.4 WARRANTY

A. The SMS shall be provided with a 14-month product warranty from date of shipment or 1 year from date of registration, whichever is shorter. The SMS Hardware shall be provided with a 5-year product warranty from date of manufacture. Software version upgrades shall be available for no charge during this warranty. The software media warranty shall be 90 days per the C•CURE software licensing agreement.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. The SMS shall be the Software House C•CURE 9000 system. The Badging Solution shall be Software House C•CURE ID. The SMS field controllers shall be the Software House iSTAR family of controllers. The hardware manufacturer shall be an ISO 9001:2000 registered company.

2.2 DESCRIPTION

A. The SMS shall be an integrated system that utilizes a single, industry-standard relational database management system for the storage and manipulation of related data. The SMS shall include a server with operating system and applications software, operator and administrator terminals with appropriate software, hard copy printers and fixed magnetic storage media. The security devices shall communicate with the field panels via a dedicated cable network. The field panels shall communicate to the server via a Fast Ethernet 10/100 or 1 Gb, TCP/IP network.

B. The SMS shall allow for growth and scalability from a low-end or entry level system to a high end or enterprise system by increasing CPU power, memory and database. The SMS shall be modular in nature, allowing system capacities to be easily expanded without requiring major changes to system operation. All defined system data as well as historical information shall be maintained. Customizable user interfaces shall allow management of system information and activity for administrators and operators. The SMS shall include an intuitive .NET based badging solution with a WYSIWYG badge layout editor and GUI for badge design.

2.3 SMS Functionality

A. Partitioning

1. The SMS shall allow system administrators to separate the creation and viewing of objects into partitions. SMS operators shall be associated with partitions and this shall determine which objects operators have the ability to create and or view. The SMS shall support an unlimited number of partitions.

   a.....The SMS partitions shall include but not be limited to the following objects:

   .....(1) Personnel
   .....(2) Clearances
   .....(3) Doors
   .....(4) Controllers with all associated hardware (readers, inputs, outputs, etc)
   .....(5) Video servers with all associated objects (cameras, tours, views, etc)
   .....(6) Application layouts
   .....(7) Events
   .....(8) Dynamic views
   .....(9) Maps
   .....(10) Reports, forms, results
   .....(11) Holidays
   .....(12) Badge layouts
   .....(13) Queries
   .....(14) Images

2. Through the use of privileges, the SMS System Administrator shall be able to determine which objects are associated with a particular partition. These objects shall then be assigned to System Operators with the appropriate privilege.

3. The SMS shall support a super-user assigned the ‘System All’ privilege who shall have full access to all objects in all partitions.

4. Any operator shall have the ability to be assigned access rights to any partition. Individual Access rights shall be created and have the ability to be assigned to any users of the SMS.

5. The SMS shall allow objects to be created in any partition. The SMS shall have the ability to grant or remove permission from any object in any partition.

6. The SMS shall provide the ability to move objects from one partition to another partition without the requirement of deleting and recreating.

7. The SMS shall provide the ability to import/export any configured object.

8. The SMS shall support the display of all associated objects contained within a partition.

B. Enterprise Architecture

1. The SMS shall provide an Enterprise Architecture, licensable option that allows you to configure multiple Satellite Application Servers (SAS) to communicate with a Master Application Server (MAS). The Master Application Server shall provide a platform for global management of the personnel, video, and access control security objects on two or more Satellite Application Servers (SAS) in an enterprise.

2. The Enterprise Architecture shall work by synchronizing each SAS system's database with the MAS database. The MAS shall contain the global data that is used across every server, such as global personnel records, global clearances, and global schedules. The global data shall be synchronized to each SAS to provide enterprise-wide security. The MAS shall be used to remotely monitor and manage controllers and video servers attached to SAS's in the enterprise, however it shall not support any directly connected controllers or video servers.

3. The MAS shall provide the capability for Central Monitoring of the entire enterprise, using the Monitoring Station application. From a Central Monitoring Station connected to the MAS, the system shall be capable of viewing events, activities, and status of every SAS in the enterprise. Alternatively, you can connect to an individual SAS to monitor that system and its connected hardware. In addition, the MAS shall provide the ability to integrate with external sources via LDAP, XML, CSV or ODBC imports both manually or automatically through scheduled processes.

4. Each SAS shall contain database records for all connected video and access control devices, as well as local personnel, clearances, privileges, and other related data. Each SAS shall synchronize with the MAS so that SAS local data is replicated to the MAS for central management and monitoring. In addition, the MAS shall provide central reporting capability for replicated SAS objects including journal and audit transactional data. [Note, for Connected Program integrations, SAS local data is not replicated to the MAS and central reporting is limited.]

5. All local data shall be synchronized immediately to the MAS or queued if a server is offline. All queued data shall be replicated automatically upon restoral of communication. Global data that is created or changed at the SAS/MAS shall be replicated to all locations. Journal and Audit data shall be synchronized either manually or on a configurable schedule, providing the ability to manage bandwidth usage and load balancing.

6. Operators in the enterprise architecture shall be configured as local or global. Global operators shall be subject to the user privileges as defined on each SAS.

7. The Enterprise Architecture shall support a Standalone to SAS Migration Utility that shall be used to merge a standalone SMS server into an existing SMS Enterprise site.

8. The Enterprise Architecture option shall include:

   a.....Global Administration of Personnel and Clearances, Images, Card formats, CHUID Formats, Holidays, Personnel groups, and Operators and Privileges
   b.....Centralized Reporting
   c.....Central Monitoring of Events and Activities across the Enterprise
   d.....Central Management of Access Card Enrollment
   e.....Central Badging and Image processing
   f. ....Global Management of Badge Layouts

g.....Single Card Access across the Entire Enterprise
h.....Increased Scalability of Security Hardware and Video
i. ....End-to-End Encryption
j. ....Automated Synchronization of Enterprise Security Databases
k.....Central Management of Video and Hardware Resources
l. ....Remote Editing of Global and Local Data

9. The SMS Enterprise model shall not restrict the addition and/or configuration of over 40 regional application servers configured to a master application server. Testing and qualification has been completed for up to 40 regional servers. However, the SMS shall have no technical restrictions to regional server capacity limits other than system performance.

10. The SMS shall support the configuration of multiple Global partitions in addition to the default Global partition providing the SMS more organization options for objects within the Enterprise system.

11. The Enterprise Architecture option shall provide Multi-Version support. Multi-Version support shall allow SASs running a prior version of the SMS software to continue to synchronize with the MAS allowing for a phased deployment during an Enterprise-wide upgrade. Client connectivity between MAS and Multi-version SASs for monitoring and administration is supported

C. Graphical User Interface (GUI)

1. The SMS shall employ a standard Windows graphical user interface (GUI). A mouse and keyboard shall be the primary operator interface with the system. Operator screens shall utilize all standard Windows-style functions such as drop-down menus, context menus, radio buttons, and lists, as appropriate. The interface shall utilize a ‘tree structure’ similar to Windows Explorer.

D. Administration Operator Interface

1. The SMS shall employ an Administration Operator Interface to control the following:

a.....Hardware (readers, inputs, outputs, video systems, door controls, CCTV, and other systems).
b.....Configuration of personnel records, operators and operator privileges.
c.....Graphical Maps.
d.....Application Layouts.
e.....Dynamic Views.
f. ....Queries.
g.....Import/Export of objects, including images.
h.....System Variables.
i. ....Reports (either periodic or one-time).
j. ....System functions (event command and control, actions, schedules).
k.....Display of a list of objects in a grid that can have their values modified and respond to real-time status changes.
l. ....Scheduling of backups.
m. ..Monitoring of system settings and performance.
n.....Designing of and printing of badges.

2. The GUI shall be configurable by the system administrator to control the views and access of each Monitoring Station operator.

E. Monitoring Operator Interface / Activity Monitoring

1. The SMS shall contain a monitoring component that is capable of, among other things, displaying the current state of any object in the system. Additionally the monitoring station shall be capable of displaying a log of all activity that occurs in the system, from object state changes, to access control

information. All text for events (alarms) in the system shall be configurable to be displayed in color based on the user-specified priority of the event.

2. The Monitoring Station shall be capable of showing all changes occurring to an object without requiring the associated activity messages for that object to be routed to that monitoring station. The SMS shall require the operator to have appropriate permissions to view and/or control any object.

3. The monitoring station interface shall be user-customizable. The SMS shall support the ability of the end user to create a customized application layout for the monitoring station. The monitoring station shall support multiple application layouts that can be assigned to the operators. Each application layout can have multiple panes in the same window. The panes can have multiple tabs so that different objects such as cameras and tours can be displayed in the same pane. The panes shall have the ability to include: General activity; Event (Alarm) activity; Dynamic card swipe information; Video cameras and tours; Maps; Dynamic Views; Reports; and links to external applications. Each pane shall have the ability to be moved to a specific screen.

4. The SMS monitoring station shall support a Swipe and Show Viewer. The Swipe and Show Viewer shall monitor a configurable list of Doors, and shall display a portrait or multiple portraits of personnel who present an access credential at a Reader on an included Door or Elevator. The SMS shall allow multiple Swipe and Show Viewers to be added to an Application Layout. The Swipe and Show Viewer shall provide configurable image border colors that shall correspond to access transaction states (Admit, Reject etc.,). The Swipe and Show Viewer shall display the date and time of the transaction, the location, area, Cardholders name and the status of the transaction. The Swipe and Show Viewer shall allow an Operator with the appropriate Privileges to perform the following functions from the Viewer:

   a.....View/Edit the Cardholder record
   b.....Perform a momentary unlock of the associated door
   c.....Grace the Cardholder (allow the cardholder into an APB area)
   d.....Perform an Area Lockout Grace of the cardholder
   e.....Perform an APB reset on the cardholder

5. The SMS shall support the ability to configure an Operator's Application Layouts to open in separate instances of the Monitoring Station to enhance the performance of multiple displays. Each Application Layout shall support the assignment of a monitor number. The Operator opening the Monitoring Application shall automatically open a separate instance of the Monitoring Application on each assigned Monitor. The SMS shall support up to Ten (10) assigned monitors for Application Layouts.

6. The SMS shall provide the Monitoring Operator with following functional capabilities:

   a.....Shall provide a scrolling list of lines or tiles showing current activity on the system.

   b.....Shall display activity in real-time as data is being transmitted by field hardware.

   c.....Shall include icons that indicate the type of activity and textual description of the activity.

   d.....The color of the frames of the tiles, icons, and/or text shall indicate the type or importance of the information contained therein.

   e.....A series of menus, driven by drop-down or trees, shall allow the Monitoring Station operator to perform manual actions, such as “momentary door unlock” for a given door.

   f. ....As part of the manual action capability, the system shall provide screens or boxes that query the operator on specifics, such as start and end time, and offer guidance on performing the manual actions.

   g.....Ability to view a sortable list of active alarms or events and recently active alarms or activity.

h.....Ability to view video from DVMS systems within the same GUI. The video screen GUI shall be able to display multiple panes of live or recorded video and have on-screen camera controls for each live window, providing PTZ control of individual cameras.

i. ....A GUI that minimizes the number of operator mouse clicks or keyboard strokes.

j. ....Mouse controls include “right-click” pop-ups and highlighted default selections.

k.....Objects shall be displayed to the operator based on his/her assigned operator privilege. The operator shall only be able to monitor/command those objects for which he or she has been assigned privilege.

l. ....When an operator logs out of a workstation and a new operator logs on, the objects displayed on the workstation screen shall by dynamically updated to display only those objects for which the new operator has privilege.

m. ..Allow the customization of columns as defined by the operator privilege, including:

.....(1) Adjusting width (on the fly or pre-programmed).
.....(2) Not displaying Columns (on the fly or pre-programmed).
.....(3) Sorting on selected columns (to follow standard Windows conventions).

n.....Allow for a “freeze” function. This includes a configurable “freeze time-out” that permits an activity to be selected and temporarily prevents the display of subsequent activities which push the selected activity off the screen. A break-through event disables the freeze function. The freeze function shall provide a graphic bar where the remaining time available in the freeze timeout shall be displayed. Selecting the freeze timeout icon before the time elapses shall extend the freeze timeout to the maximum.

o.....Provide Acknowledge All, Acknowledge and Clear All and Silence All buttons for events.

p.....Support multiple panes for the display of events, activities, video, personnel images, and maps.

q.....Display the number of active causes of an event.

r. ....Support the ability to attach a log message to an event, even after the event has been acknowledged.

s. ....Provide the ability to attach Predefined Log Messages to an event upon acknowledgement.

t. ....Shall allow a Monitoring Operator to select on-screen transactions (both events and system activity) and Email the transactions with a single mouse click.

7. Pre-defined Alarm Acknowledgement Messages

a.....The SMS shall provide the ability to create Predefined Log Messages. Each log message shall have a Name, Description, Label and Message Text. These messages shall be assigned to any event providing the ability to select the appropriate response that resolved the event. The SMS shall provide the ability to group multiple log messages and then assign the group to an event. Each group shall contain up to one hundred messages and each event shall support up to one hundred messages. The SMS shall allow only users with specified operator privileges to add, modify, or delete messages or message groups. Predefined messages shall be editable by an operator with the proper privilege and may be appended as required by the operator.

b.....Messages shall have the following characteristics:

.....(1) Message Name shall be configured with up to 500 characters

.....(2) Message Description shall be configured with up to 500 characters
.....(3) Message Label shall be configured with up to 100 characters
.....(4) Message Text shall be configured with up to 3000 characters

8. The SMS shall support audible alarm annunciation at operator workstations (operator configurable audio [WAV] files associated with alarms).

9. The activity monitoring screen shall be capable of displaying the following features:

a.....System clock.
b.....Date/time when the activity actually occurred and the date/time when the activity was received by the server shall be displayed (when they are different).
c.....Real time event counters.
d.....Count of the active events.
e.....Count of the events requiring operator acknowledgment.
f. ....Name of operator logged on at the workstation.
g.....Real-time display of the current activity on the system in chronological order.
h.....Acknowledge All and Silence All buttons for events.
i. ....Manual Action command buttons.
j. ....Pre-defined and configurable acknowledgement messages.
k.....Log message.
l. ....Clear event.
m. ..Clear group of events.
n.....Event action message (automatically display selected message for event).
o.....Dynamic views.

F. Web Client

1. The SMS shall support a Thin Client to provide remote access to the SMS Server via a web browser. The Thin Client shall support Microsoft® Internet Explorer 7.0 and Mozilla Firefox® 3.0 or greater. The Thin Client shall support 128-bit AES encryption to the SMS Server.

2. The Thin Client shall support Single Sign-on utilizing Windows Authentication. The privileges of the SMS operator shall be propagated to the Thin Client User allowing only access to Security Objects for which the SMS Operator is authorized. The Thin Client shall provide support for Partitioning of the system and utilize the Partitions assigned to the Operator.

3. All changes made to the SMS database via the Thin Client shall be recorded in the Audit Trail Database.

4. The Thin Client shall provide Personnel Management including:

a.....Shall allow the operator to create and modify personnel data (includes adding/removing clearances, schedules, and expiration dates).

b.....Operator shall have the ability to enable and disable cards.

c.....Operator shall have the ability to search for, edit, add, and delete Personnel records from the SMS database.

d.....Search function shall allow wildcards and shall include First name, Last name, card number, and user defined text.

e.....Shall support the Auto-increment Card Number feature for Credentials created using the Web Client.

f. ....Shall support a Change CHUID Format button on the Credentials tab that allows you to change the CHUID format of a Credential.

g.....Shall support an Auto Generate button that allows you to randomly generate a PIN for PIN-only Credentials.

h.....The SMS thin client shall provide a personnel image tab that includes image display, Image capture from a file or a local USB camera, and the capability to crop the Image and save it to the SMS personnel record.

i. ....The SMS thin client shall support the previewing/printing of badges.

5. The Thin Client shall support an Activity Monitor to provide a scrolling display of system activity. Activity shall be restricted based upon the Operator's Privilege and Partition assignments. Display controls shall include page up, page down, and a freeze function.

6. The Thin Client shall support acknowledgement of an Event from the Event Dynamic View.

7. The Thin Client shall support for logging an Event Message from the Event Dynamic View

8. The Thin Client shall support Manual Actions to include the Locking/unlocking of doors, and the Activation/deactivation of events.

9. The Thin Client shall support the display of Dynamic Views as defined by the SMS. Dynamic Views shall provide a real time view of SMS data including Journal and Audit Trail history. Viewing of Multiple Dynamic Views shall be supported.

10. The Thin Client shall support creating, configuring, loading and saving of reports. Reports shall consist of personnel history activity or audit data. The report data shall allow sorting within the thin Client view page by any displayed field in ascending or descending order. The Thin Client shall allow reports to be saved in the following formats: XLS, CSV, XML, TXT or PDF. The operator shall have the option to save the report to a file or send it via email.

11. The Thin Client shall support Manual Action Challenges. The Manual Action Challenge shall require an operator to enter their login credentials (User name and password) when executing a manual action, such as a door unlock, from within the Thin client.

12. The Thin Client shall support the ability to query on a specific cardholder or a group of cardholders for the purpose of assigning clearances to multiple cardholders at once. Once the query is complete, the operator shall have the ability to assign a single access clearance or a group of clearances to all cardholders.

13. The Thin Client shall support the ability to display a door activity report from the web client cardholder record configuration view. In addition, it shall provide the ability to display the Activation / Expiration Date and Time for each credential assigned to a cardholder. The thin client shall display all user-defined personnel fields and the details of each assigned access clearance in a separate window.

14. The Thin Client shall support Auto-Logoff based upon inactivity. The Thin Client shall monitor user activity and shall automatically log a user out of the workstation after a user defined timeout period.

15. The Thin Client shall support the ability to assign or remove clearances to multiple cardholders simultaneously.

G. SMS Mobile Application

1. The SMS shall support a Mobile Application allowing operators to monitor or administer the SMS system by way of mobile device. The device shall be connected via the phone network and a VPN or via Wi-Fi to the SMS server utilizing Web Service (IIS - Web Service).

2. The SMS Mobile software shall be available for download from the following locations:

   a.....Apple App Store
   b.....Google Play

3. The Mobile Application shall support mobile phones and tablets running the following operating systems.

   a.....Apple iOS 7.1 and higher (iPhone, iPad, iPod Touch)
   b.....Android OS 4.0 and higher

4. The Mobile Application shall connect to a standalone SMS server, including an Enterprise Satellite Application Server (SAS) and Site Server (Appliance).

5. The SMS Mobile Application shall support connection to the SMS system through a 3G (minimum), 4G, or Wi-Fi connection.

6. The number of mobile connections allowed by the SMS server shall be based on the SMS licensing model. Each connection made through the SMS Web service shall be considered a simultaneous client connection.

7. Operator login to the SMS Mobile Application shall be consistent with the SMS thick client application, authenticating login credentials via Windows Single Sign-On (SSO).

8. The SMS Web Service shall require Internet Information Services (IIS) be installed on the target system. The SMS Web Service shall be installed on the IIS server during installation.

9. The SMS Mobile Application user interface shall be localized with supported SMS languages: Arabic, Czech, Danish, Dutch, English, French, German, Hungarian, Italian, Japanese, Korean, Polish, Portuguese (Brazilian), Russian, Simplified Chinese, Spanish, Swedish, Traditional Chinese, and Turkish.

10. The SMS Mobile Application shall support SSL-encrypted communications with the remote Mobile Web Service.

11. The SMS Mobile Application shall provide a search and filter option to refine query results.

12. The SMS Mobile Application shall provide a link to a context menu while viewing objects, providing the operator the ability to perform SMS operations consistent with the SMS administration and monitoring applications.

13. The SMS Mobile Application shall provide the following core features:

    a.....The SMS Mobile Application shall provide operators with the appropriate privilege, access to tools used for inspecting the SMS Journal and Audit Logs.

    b.....The SMS Mobile Application shall provide a collection of tools to monitor SMS events and other objects. Monitoring shall show active SMS events in real time.

    c.....The SMS Mobile Application shall provide a collection of tools to manage personnel and shall allow for the following:

.....(1) Create/Update Personnel Records
.....(2) Assign/Remove a card/credential to personnel.
.....(3) Capture an image and associate that image with personnel.
.....(4) Grace personnel, Antipassback Card Reset, Area Lockout Grace, and remove personnel from an Area

14. The SMS Mobile Application shall provide tools used to explore, edit and control the following objects:

    Favorite Filters
    Favorite Monitors
    Query
    Events
    Manual Actions
    Operators
    Controllers
    Doors
    Elevators
    Inputs
    iSTAR Clusters
    Outputs
    Readers

15. The SMS Mobile Application shall provide an editor for local application preferences such as:

    a.....Login Parameters – Encryption, Inactivity Timer, etc.
    b.....Data Collection – Page Size
    c.....Monitoring – Polling Intervals, etc.

H. Graphic Maps

1. The SMS shall support unlimited graphic maps and icons to be displayed on the operator workstation monitor.

2. The system shall support an operator-programmable, color graphic map display that:

    a.....Shall be capable of showing the floor plan, the location of alarm devices, and alarm instructions for a facility.

    b.....Shall be centralized in the system configuration and displayed on the operators' workstations.

    c.....Shall allow various maps to be associated with different areas to create a hierarchy of maps.

    d.....Shall support graphic maps having a resolution of 1024x768 Pixels or greater.

3. Operators shall be able to use drag-and-drop mouse technique to place dynamic system level object icons of all objects such as: cameras, video servers, inputs/outputs, events, maps, reports, dynamic views, and door/elevator icons. These dynamic object icons shall allow a system operator to perform tasks and issue commands related to the object by double-clicking on the icon.

4. The SMS shall allow the addition of new layers to the drawing (such that if the drawing must ever be reloaded due to an update of the drawing, the layer(s) created within the SMS will be added back automatically without additional reconfiguration).

5. The SMS shall be able to directly import the following file formats for the map:

    AutoCAD (.DWG)

DXF
JPEG (.JPG)
PNG

6. The Maps feature shall include two operational modes: an administrative mode to allow configuring of the facility floor plans or site plans that show exterior features and a runtime mode to allow monitoring and interacting with the configured facility layouts or site plans.

I. Information Storage, Backup and Transfer

1. All programmed information, as well as transactional history, shall be automatically stored in the database for later retrieval and backup. The SMS shall support configurations where the SMS database(s) may be installed on a hard drive on the SMS server, on an independent database server, or in an existing corporate database server.

2. The SMS shall be capable of backing up and restoring all system data and transactional history. The server shall be capable of transferring all programmed data and transactional history to CD-ROM, DVD, or Hard Drive (including networked drives).

3. The SMS shall allow activity history to be written to a database. The system shall have the capacity to store a minimum of 50 million transactions. There shall be a method of backing up the activity history on external media and then restoring and replaying it.

4. The SMS shall support AES 256-bit encrypted communications between server and user client.

5. The SMS shall support AES 256-bit encrypted communications between server and controller. The encryption shall support both local and third-party digital certificates.

J. Communication Ports

1. The SMS shall be able to support multiple serial devices. In addition to COM1 and COM2, up to [8, 16, 32, to 256] additional ports may be configured through the use of a port expander or its equivalent. These serial ports may be used for connection to CCTV matrix switchers, or apC panels.

2. The SMS shall support the use of Ethernet networks as the communications path between the host computer and field devices such as, iSTAR, apC, apC 8/x, controllers, and CCTV matrix switchers. This communications path shall be the same network used for communications between the host server and the operator workstations. The communications between the host computer and the field devices shall be encapsulated in a TCP/IP network/transport layer. The SMS shall support IPv6. (IPv6 shall be supported only on iStar Ultra controllers.)

K. Printers

1. The SMS shall support report printing. The report printer(s) may be connected directly to the client PC, or shared over a network. The SMS shall support as report printer(s) any printer for which a printer driver exists within the Operating System supported by the current SMS version.

L. Software Configuration

1. The SMS configuration tools shall utilize intelligent configuration controls. The system shall be structured so an operator is unable to perform configuration functions that are invalid based on the configuration used. The system shall support the ability to search within browser lists using filtering operators such as “begins with”, “ends with”, “contains”, etc. The system shall also allow an operator to do searches using filtering operators on any class of object in the system, both in the Administration application and the Monitoring Station application.

2. The SMS shall allow text description of all configured objects. The SMS shall allow the renaming of an existing title description without removing the sub-components of that configuration object. The SMS shall automatically remove from the system all configuration references to an object being deleted. The SMS shall automatically provide default names for all inputs, outputs, readers, and extension boards. The SMS shall clearly display which hardware objects (inputs, outputs, readers) on a controller are configured, and which are not.

3. The SMS shall provide for the configuration of templates. Templates of supported objects shall be operator-configurable to provide default values by pre-populating commonly used data fields.

4. The SMS shall support an unlimited number of groups for any object type. The SMS shall support unlimited object group definitions. In general, a group shall be usable wherever an individual object is referenced in the SMS. For example, a group may be used instead of an object when configuring a schedule/object pair in a clearance, and a group may be used instead of an object when performing a manual action to unlock a door.

5. The SMS shall generally allow any object in the system to be grouped including personnel, doors, inputs, outputs and clearances.

6. The SMS shall restrict the viewing and controlling of objects in the administration and monitoring stations via operator privileges. The SMS shall support the configuration of operator restrictions on an object class basis, and on an object-by-object basis. The SMS shall maintain a distinction between objects that are being monitored and objects that are being controlled, preventing operators from issuing object manual actions to objects for which the operator does not have manual action privileges. There shall be different levels of controls within the system for administration privileges versus monitoring privileges.

7. The SMS shall support unlimited operator accounts with unlimited definable privilege levels.

8. The SMS shall allow configuration of controllers using hierarchical tree-based navigation and context menus.

9. The SMS shall support the ability to download firmware updates to the controllers.

10. The SMS shall support the following methods for Operator authentication and authorization:

    a.....Windows Single Sign-On (SSO).
    b.....Basic User Authentication with locally defined user names and passwords with strong password rule enforcement.

11. The SMS shall provide an automatic client update process for quick distribution of application updates.

12. The SMS shall have context sensitive online help (at the screen level) available at any point requiring operator input.

M. Personnel Records

1. The SMS shall provide Personnel Templates that shall eliminate repetitive data entry by pre-configuring Personnel Records with data common to all Personnel.

2. The SMS Personnel records shall provide multiple tabbed pages of personnel data containing default system and user-defined fields. The SMS shall support an unlimited number of tabs allowing an unlimited number of user-defined fields. Labels for user-defined field tabs shall be customizable by the System Administrator with the appropriate privileges. Each user-defined field shall allow a name, description and label. A default language shall be selectable by the System Administrator for the user-defined field labels.

3. User-defined fields shall be definable as Mandatory or Unique and shall support the following field types:

   Character
   Integer
   Logical
   Date/Time
   Date
   Time
   Enumerated List
   Multi Line
   Decimal
   Identity

4. User-defined fields shall support masking to provide consistency of data entry across all system operators. Custom masks, as well as the following predefined masks, shall be available:

   Alphabetic
   Alphanumeric
   Numeric
   Phone Number – USA
   Zip Code
   Zip Code +4
   Alpha – All Caps
   Alpha – All Lower case

5. The SMS shall provide a “Personnel Record Document Object” option which allows the operator to assign / attach up to two (2) documents (such as URL, PDF, or TXT files) to the personnel record. The document may be applied to the record as a:

   a.....'Shared' Document - added to the SMS via the Documents Editor.
   b.....'Private' Document - imported from outside the system, such as a birth certificate or a diploma.

6. The SMS shall include a "Documents" tab to user-defined personnel views as well as the default view "Personnel View with Portrait in Header" to support the association of documents. The documents are available for viewing by operators with appropriate privilege.

7. The SMS shall support the generation of a unique random card number for an access credential for all Personnel records. The unique card number shall contain up to the maximum number of digits for the CHUID format chosen for the credential.

8. The SMS shall support the configuration of a trigger for a Personnel record that pulses an Event whenever a 'Card Admitted'/'Card Rejected' message is logged to the Journal for that person at a defined Door/Elevator.

9. The SMS shall support an email address field for each Personnel Record and shall support the sending of emails to Personnel Groups.

N. Credentials

1. The SMS shall support a minimum of five (5) credentials (cards) per Personnel record and shall only count Active and/or Expired Cards towards the maximum assignable Cards per Person. Cards designated as Lost, Stolen and Disabled shall not count towards the maximum assignable Cards per Person.

2. The SMS shall support the ability to define the default period of time (in Days, Hours or Years) from a Credential's Activation Date until its Expiration. The SMS shall support an override of the default Expiration time period for individual Personnel Types.

3. The SMS shall support Temporary Credentials. Temporary Credentials shall be available for general re-use without being associated to specific Personnel records. Temporary Credentials shall be assignable to visitors and can also serve as temporary replacement cards for Personnel who misplaced or forgot their regular Credentials. The SMS shall support the configuration of a default number of days for Temporary Credentials to remain active after they are created.

4. The SMS shall provide the ability to define background colors for the Active/Expired Credential Status fields in the Personnel Record.

5. The SMS shall support a system-wide setting to automatically disable Personnel Credentials that have not been used for a specified period of time. The Disable by Inactivity process shall support a user configurable daily scan time.

O. Personnel Views

1. The SMS shall support user-defined Personnel Views. Personnel Views shall provide the ability to customize the Personnel record by adding and/or removing certain objects from the operator's view. Personnel Views shall be assignable to SMS operators via the operator's assigned privilege and shall be definable for use in the creation and/or editing of the Personnel record. All Personnel Views enabled for an operator shall be selectable from the current view to allow an operator to switch views in real time. Personnel Views shall support the following:

   a.....Adding/Removing Fields (including all user-defined fields)
   b.....Custom Field Labels
   c.....Adding Boxes to group together common fields
   d.....Adding/Removing tabs to organize fields
   e.....Custom Tab Labels
   f. ....Customization of Tab display order
   g.....Background/Foreground color control of fields and labels
   h.....Personnel Record Document Object – to associate up to two (2) documents to the record

P. Language Localization

1. The SMS shall be configured so the information presented to system operators is displayed in a language native to the system operator provided that the proper translation files exist.

2. It shall be possible to translate the SMS into any left-to-right or right-to-left language supported by Unicode and by the Microsoft Windows operating system.

3. Languages shall include English, Arabic, Brazilian Portuguese, Dutch, French, German, Italian, Polish, Simplified Chinese, Spanish and Japanese.

Q. Inputs

1. The SMS shall monitor both supervised and unsupervised hardware inputs as well as virtual inputs such as predefined system messages. These inputs include door / elevator inputs and monitor points. The SMS shall also monitor controller inputs such as tamper, AC fail, and low battery.

2. The SMS shall have the ability to name and allow for user-defined descriptions for individual inputs, outputs, and readers as well as input and output modules.

3. There shall be three separate and distinct states for inputs, which can be defined on the input configuration screen: Disabled, Enabled / Disarmed and Enabled / Armed.

4. The SMS shall allow configuration to link the state of an input to an output. The system shall allow multiple inputs to activate a single output or group of outputs.

R. Outputs

1. The SMS shall have outputs, also known as Control points, which associate an input or event action with a relay output. These output uses include doors / elevators, alarms and industrial control.

2. There shall be three types of outputs available: dry contact / Form C relays, wet or voltage sourced relays and Open Collectors. Outputs shall be configured such that they can be activated, deactivated or pulsed by system actions.

S. Card and Reader Support

1. The SMS shall be designed to support multiple card formats and card reader types.

2. The SMS shall support the following features for directly connected readers:

a.....OSDP. (Open Suprevised Device Protocol), v2.1.6 or higher. OSDP shall only be supported with the iStar Ultra and qualified OSDP capable readers, using OSDP Secure Channel AES128 encryption.

b.....User defined card formats up to 256 bits.

c.....Unlimited number of SMS card formats.

d.....The ability to assign up to 10 card formats per reader.

e.....The ability to show reader status on RM LCD.

f. ....Support Wiegand and 3x4 matrix keypads.

g.....The enrollment of biometric templates to smartcards.

h.....Custom CHUID FIPS201-compliant supporting full 256-bit data.

i. ....The SMS shall support readers that provide Wiegand signaling and magnetic signaling to include:

.....Software House RM readers.
.....Software House Multi-technology readers.
.....Wiegand swipe/insert readers.
.....Proximity readers.
.....Biometric readers.
.....Smart card readers.
.....Wireless readers.
.....Magnetic readers.

T. Advanced Door Monitoring

1. The SMS shall support Advanced Door Monitoring allowing additional monitoring inputs and lock sensing equipment at all doors. Advanced Door Monitoring shall allow integration with third-party lock release inputs, such as fire and crash bar devices, that control emergency egress.

2. Advanced Door Monitoring shall include:

   a.....Multiple inputs – Advanced Doors shall support up to 16 inputs.
   b.....Single and double-leaf doors with multiple DSM or Request To Exit (RTE) inputs.
   c.....Shall support Lock sensing devices – to monitor locking on magnetic bonds, bolts, and cams.
   d.....Integrated lock releases – to integrate door unlocking with fire, crash bar, power fail, and key switch inputs.
   e.....Special events and actions – to create keypad commands that lock, unlock, and secure doors for a specific time period.
   f. ....Alarm Suppression and RTE control on a per door basis.
   g.....Enhanced Shunt control.
   h.....Grace and change timing options – to fine tune the SMS timing to avoid the effects of 'door bounce'.
   i. ....Journal reports and Monitor Station activities – to manage the system and monitor door activity.
   j. ....Additional Event Actions related to Advanced Doors

U. Keypad Commands

1. The SMS shall support keypad commands. Keypad commands shall be up to Nine digits in length. Keypad commands shall be entered at a keypad connected to an iSTAR controller and shall be used to activate system events. The event shall be configurable to activate any allowable event action.

2. Keypad Commands shall support Personnel Permission options to accompany the command and validate the issuer's identity. Keypad Commands shall be configurable to require a valid credential or a valid credential plus a PIN. Keypad Commands shall also be available to all Personnel or only selected Personnel as part of a Personnel Group.

3. The SMS shall support the assignment of certain users as Keypad Command Administrators. These users shall be able to issue all Keypad Commands and shall not be required to be part of a Personnel Group assigned to a Keypad Command.

4. Keypad commands shall have the ability to be limited to specific doors as part of a Door Group within an iSTAR Cluster. In addition, specific readers shall be configured to allow or disallow keypad commands.

5. Keypad Commands shall support segmentation of the nine-digit code in the form of Prompt Codes. Prompt Codes shall allow the user to utilize some digits of the Keypad Command to correspond to a command such as a door unlock, and the remaining digits to correspond to an object such as a door. When using Prompt Codes, the first segment shall be entered and the SMS shall prompt the user on the reader LCD module to enter the remaining digits. The SMS shall support two Prompt Codes per keypad command.

V. RM Reader LCD Messages

1. The SMS shall provide custom LCD messages to be displayed on the LCD screen of RM readers. All messages, as well as date and time formats, shall be downloaded to the controller and will be used on all supported readers configured on that panel. The ability for the System Administrator to change the Language for LCD messages shall be provided. (The reader LCD supports Western character sets only. No double-byte languages are supported.)

W. Wireless Reader Devices

1. The SMS shall provide for a Wireless Lock solution. The SMS shall interface to the wireless lock via panel interface modules. The panel interface modules (PIM) shall support a direct connect Wiegand or RS-485 interface to the Intelligent Controller.

2. The SMS shall support up to 16 wireless readers per controller. The readers shall support communicating to a single panel interface module (PIMs) or up to 16 PIMs depending on reader type and physical location of reader.

3. The SMS shall provide a Wireless Reader configuration tab within the Intelligent Controller UI for the setup of the RS-485 version of panel interface modules.

4. The wireless reader editor shall support the following input configuration:

   Wireless DSM
   Wireless RTE
   Wireless Reader Tamper
   Wireless Reader Communication Fail
   Low Battery
   The wireless reader editor shall support the following output configuration:
   Door Latch Relay

5. The SMS shall also support a Wiegand interface module to communicate to the iSTAR and apC family of controllers as a standard Wiegand reader signal.

X. Door Configurations / Elevator Control

1. The SMS shall allow doors to be configured to operate in any of the following access control modes:

   a.....Unlocked
   b.....No Access (Secure mode)
   c.....Any combination of the following, as defined by schedule, event: card only, PIN only, Card + PIN, Card entry through keypad.

2. The SMS shall allow a door to be configured to operate using the following functions:

   a.....Readers shall read cards while the door is in the open position.
   b.....Door lock relay shall automatically lock upon the door being opened.
   c.....Allow for a user-defined delay relock time period.
   d.....Allow for a user-defined door unlock time and door held open time.
   e.....A separate (alternate) shunt timer for ADA flagged cardholders
   f. ....The operator shall be able to specify a shunt expiration output to be triggered for a configurable time (in hh:mm:ss) before the expiration of the door open or alternate shunt. Can be enabled for ADA only, or all the time.
   g.....Allow for a user-defined door unlock and door held time, in seconds.
   h.....PIN-only access (keypad).
   i. ....PIN-entry on the reader keypad shall be required during a specified schedule after a card access (unless a manual action or event has disabled PIN).
   j. ....Card entry through keypad.

3. The SMS shall allow each door to be configured to cause a variety of events such as alarms to occur based on activity at that door.

4. The SMS shall support the activation of an event after a user-defined number of consecutive cards are rejected at a door. A user-configurable timer shall be available to determine the time-frame for the consecutive rejects. The timer shall restart after a valid card read. Separate triggers shall be available for inbound and outbound directions on doors with in and out readers.

5. The SMS shall support configuration of unlimited elevators.

6. The SMS shall support an extended unlock function initiated via two valid card presentations to a single reader or a 'double swipe'. The double swipe feature provides the ability to designate doors at which cardholders with double swipe privileges may perform an extended lock or unlock of the door. The double swipe feature shall support the following:

   a.....Toggle mode – the first double swipe shall unlock the door and the second shall relock it. Toggle mode shall support the assignment of a cardholder group that can perform the double swipe.
   b.....Cardholders shall be required to have proper clearance to perform double swipe action.
   c.....Each SMS door shall be uniquely configurable for double swipe.
   d.....Reset of a double swipe unlock (relock) via a scheduled event.
   e.....Event activation to reflect double swipe state (Lock, Unlock).
   f. ....Modified reader beeper pattern to reflect the extended unlock mode.

7. The SMS shall support a two-person mode for unlocking certain doors – two-person mode shall require two cardholders to present valid cards to unlock a door. Two-person mode shall support the assignment of separate cardholder groups for each cardholder that can perform the unlock. (Two person mode shall only be available on doors connected to iStar Ultra Controllers)

Y. Maintenance Mode

1. The SMS shall support a Maintenance Mode to facilitate the installation, testing and maintenance of selected SMS objects. Maintenance Mode shall be used to limit information about an object displayed on the SMS Monitoring Station. An SMS System Operator, with the appropriate Privileges, shall be able to place SMS objects into Maintenance Mode. Placing an object into Maintenance Mode shall not prevent SMS actions associated with that object from occurring. Maintenance Mode shall only affect the Monitoring Application and shall allow the System Operator to:

   a.....Only view those objects in Maintenance Mode
   b.....Exclude those objects in Maintenance Mode from an Operator's view
   c.....View information about all System objects, including those in Maintenance Mode

2. Operator Privilege and Application Layout Filtering assignments shall determine whether or not an object in Maintenance Mode is viewable as being in Maintenance Mode on the Monitoring Station. Only Monitoring Station operators with the correct privilege and Application Layout Filtering shall be able to view objects in Maintenance Mode. Maintenance Mode shall only be reported in Journal messages when an object is placed in Maintenance Mode.

3. The following objects shall be supported in Maintenance Mode (at a minimum):

   a.....iSTAR Clusters
   b.....Controllers
   c.....Doors
   d.....Readers
   e.....Input/Output Modules
   f. ....Inputs
   g.....Outputs
   h. Elevators
   i. Events
   j. Areas
   k. Intrusion Zones
   l. Keypad Commands

X. Area Control and Antipassback

1. The SMS shall support the ability to define Area configurations. Areas are defined as physical regions bounded by doors. An area shall consist of a room, a specific location(s) within a building, or an entire building

2. All configured areas shall have in/out access doors providing the ability to run reports showing all present cardholders in each area. There shall be no way to leave an area without presenting a credential to a reader/door.

3. The SMS shall support Global Antipassback and shall allow an area to be configured to cross multiple clusters (groups of controllers) to enforce Global Antipassback decisions.

4. The SMS shall provide the ability to run a Roll Call report. The host shall maintain a current area for each personnel record, and the time at which the area was entered (AreaAccessTime).The current area shall represent the last area entered by the cardholder based on a valid admit.

5. The SMS shall support Area control to provide the ability for tracking personnel. With this function, an operator shall obtain the current location of cardholders. Dynamic views and or reports can be generated to show specific cardholders who are present in each defined area.

6. Each cardholder's record shall provide easy access to view and maintain their current area location. This card record property will be updated as a person moves from one area to another using a valid credential.

7. The SMS shall support the configuration of an area as a Mustering area. A Mustering area is an area where Personnel gather in an emergency. A Roll Call report shall be supported for the tracking of Personnel present during an emergency. The SMS shall also support the definition of a De-Mustering area. The De-Mustering area shall be used to place all Personnel in a neutral area to accurately track Personnel as they re-enter a facility.

8. The local controller shall provide the ability to manage and control the Area configuration in the event that it loses communication with the SMS system server.

9. The SMS Area configuration shall have three modes of operations: None, Antipassback, and Timed Antipassback.

10. Antipassback shall control access based on the cardholder's location. The SMS shall deny access to cardholders who are in violation of antipassback rules. In the event that a cardholder leaves an area without presenting their credential to the out access reader/door and then tries to enter back into the area by swiping the In access reader/door, a denial of access will occur. The SMS shall provide the ability to grace individual cardholders who have violated antipassback rules. The Grace option shall also provide the ability to grace all cardholders.

11. Antipassback shall continue to be enforced during communications failure. SMS controllers shall have the ability to be clustered in a group. The master controller in the group and all other controllers within that group shall have full access to the existing antipassback information. The cluster can be configured for 'No Access' Communications Failure mode or for 'Local' Communications Failure mode.

12. Clustered controllers configured in 'Local' mode that are disconnected from the master controller shall grace all cardholders from antipassback violations. The disconnected controller shall then follow antipassback rules specific to the areas defined on that controller. If the controller does not know if a cardholder is in antipassback violation based on areas that are configured between controllers, access will be granted.

13. Clustered controllers configured in 'No Access' mode that are disconnected from the master controller mode shall not grace all cardholders from antipassback violations. All cardholders will receive a denial of access until communications is restored.

14. The SMS shall support Timed Antipassback. Areas configured for Timed Antipassback shall require a cardholder use an exit reader to exit an area. Cardholders who do not exit properly shall be required to wait for a predetermined period of time before re-entering the area.

15. The SMS shall support Pass-through Areas. Area Pass-through shall serve to restrict the length of time that Personnel can remain in an Area before being required to exit or pass through to another area. The SMS shall support a user-defined time period for the Pass-through area. Personnel Groups shall be

configurable with Pass-through Restrictions and each Personnel Group shall support a separate, user-defined time period that may be different than the Area-wide time interval. Personnel Groups shall be configurable to be exempt from Pass-through Restrictions.

16. The SMS shall provide occupancy restrictions for areas. Restrictions shall be applied to individual cardholders (personnel) or user defined groups of cardholders. Areas shall be configurable to provide limits for the maximum and minimum number of personnel who can access an area at one time. It shall be possible to trigger an event based upon a violation of either of these rules. Events shall be configurable based upon the following criteria:

    Maximum occupancy status
    Minimum occupancy status
    Group Maximum occupancy status
    Group Minimum occupancy status
    Personnel Count (user-defined)
    Violation status (Antipassback entry/exit violation etc.)

17. The SMS shall support Soft occupancy restrictions for both maximum and minimum occupancy to allow reporting of violations while still allowing access to the area.

18. The SMS shall support Area Lockout. Area Lockout shall restrict or lockout certain cardholders from an area once they have accessed another area. The cardholder shall be locked out of the designated target Area or Group of Areas for a specified period of time. The maximum time period for lockout shall be five (5) days. The target locked-out Area shall be any of the following:

    Same Area
    Another Area
    Area group

19. The SMS shall allow a System Operator with the appropriate privileges to cancel the lockout time (lockout grace) for all or individual cardholders, thereby canceling the area lockout.

AA. Dynamic Area Manager

1. The SMS shall support the Dynamic Area Manager feature. The Dynamic Area Manager feature shall allow the first qualified person admitted to the Area to act as the Area Manager. This person shall be the first to enter the area and shall be required to be the last to leave the area.

2. An area designated for the Dynamic Area Manager feature shall have an entry reader and an exit reader.

3. The SMS shall deny any exit request from the area manager until all other occupants have left the area.

4. The Dynamic Area Manager feature shall support the use of the Conditional Access feature for the designated area.

5. The Area status display shall show the following Personnel counts:

    Area Manager count
    Managed Personnel Count (All Personnel admitted after the Dynamic Area Manager)
    Conditionally Admitted Personnel Count

BB. Carpool Antipassback

1. The SMS shall provide Carpool Antipassback to facilitate parking lot area controls. Carpool Antipassback shall support the organization of Personnel into Carpool Groups which shall be permitted to park in designated Carpool Areas. The SMS shall move Carpool Groups in and out of Carpool areas

based upon the driver's credential. The Carpool Antipassback feature shall allow the monitoring of vehicle counts in the Carpool Area to facilitate parking lot area Occupancy Restrictions. The SMS shall support Timed Antipassback for Carpool Antipassback areas.

CC. Escorted Access

1. The SMS shall provide an Escorted Access feature that gives the ability to control, track, and report on the movements of Personnel designated as Escorted Visitors. An Escorted Visitor shall be a visitor who can only move around a facility in tandem with an employee designated as an Escort.

2. There shall be two Escort Visitor modes: Companion mode and Remote Escort Mode. In Companion mode the system shall allow multiple Escorted Visitors to be accompanied by one escort. In Remote Escort mode the system shall allow Escorted Visitors and the Escort to present their credentials on opposite sides of a door to gain access.

3. The SMS shall have the ability to configure a designated Area to allow an Escorted Visitor to enter/exit the area without an Escort.

DD. Conditional Access

1. The SMS shall support Conditional Access that shall allow an occupant on one side of a door to grant temporary access to a cardholder who does not have clearance and was denied access to that door.

2. The SMS shall support the configuration of an event to be used to notify the occupant that a cardholder is attempting to gain access through the door.

3. The SMS shall support the configuration of a second event to be used to unlock/grant access to the door based upon a response from the occupant or a privileged SMS Operator.

4. The Conditional Access function shall support an Operator configurable timer that shall be used to cancel the Conditional Access request if the occupant is unavailable or chooses to deny access

5. The SMS shall support the use of Conditional Access in conjunction with the Dynamic Area Manager feature.

EE. After Hours Enabling Reader

1. The SMS shall support an After Hours Enabling Reader that shall be used to allow a cardholder access to a group of readers during off hours.

2. The SMS shall support the definition of a group of readers (the After Hours Reader Group) that shall be disabled during a pre-defined after hours period.

3. The SMS shall support the definition of a schedule to be assigned to the after hours reader group defining the time the readers shall be disabled.

4. The SMS shall allow a cardholder access to all readers in the after hours reader group once the cardholder presents a card at the enabling reader.

5. The SMS shall require the cardholder to have proper clearance for any reader before granting access.

FF. Intrusion Zones

1. The SMS shall support the configuration of Intrusion Zones. An Intrusion Zone is a user-defined group of Doors and Inputs on the same local Controller that delineates a physical area. This area shall be monitored and produce an alarm during any violation of the objects associated with the Zone.

2. The local controller shall provide the ability to manage and control the Intrusion Zone in the event that it loses communication with the SMS system server.

3. The Intrusion Zone shall have 2 modes of operations: Armed or Disarmed. When an Intrusion Zone is in an armed mode, the state of the Intrusion Zone shall either be Violated or Not Violated based on the state of the inputs and doors associated with the Zone. If the Zone is violated the SMS shall provide the ability to execute any defined event(s) within the SMS.

4. The SMS shall provide the ability to display the "Ready to Arm State" of any configured Zone. The "Ready to Arm State" shall be able to be displayed from any SMS monitoring application or from a local reader with an LCD display. All off-normal points/doors shall be able to be displayed from both locations. If any point or door associated with a Zone is not in a normal state, the Zone shall show a "Not Ready to Arm State".

5. When a door is placed in a Zone, the operation of the door shall be configured based on the state of the Zone (unlocked, locked, secure). Specific doors assigned to the Intrusion Zone shall be configured as entrance or exit points for the Zone. When the Zone is being armed or disarmed, a user-definable time shall be set for exit or disarm operations. Specific readers/doors shall have the ability to be defined as arm/disarming stations.

6. The Intrusion Zone shall be configured such that when an input configured in a Zone is active, the Zone cannot be armed without executing a force arm. When a Zone is force armed, the input(s) that were in an active state shall not function as part of the Zone until they are placed back in a normal state and the Zone is disarmed and rearmed.

7. Inputs configured in a Zone shall have the ability to be configured as Controlled Inputs or Monitored Inputs. A Controlled Input shall follow the state of the Zone. If the Zone is disarmed, the Controlled Input shall be disarmed as well. A Monitored Input shall have the ability to cause a Zone violation even if the Zone is in a disarmed state.

GG. Schedules

1. The SMS shall support unlimited operator configurable schedules. Each schedule shall allow unlimited individual time intervals.

2. Each system controller shall support a minimum of 128 schedules and a minimum of 18 time intervals per schedule.

3. Each schedule shall consist of operator-defined time segments. Each time segment shall be day(s) of the week and include holidays and starting and ending times. The system shall provide grouping of days.

4. Recurring schedules shall be supported and provide hourly, daily, weekly, bi-weekly, monthly, quarterly, annual and semi-annual intervals. Recurring schedules shall support a start date and shall be configurable to end by a certain date or after a pre-defined number of occurrences.

5. Recurrence patterns shall be supported to allow:

   a.....Schedule recurs every X year(s)
   b.....Schedule activates on the last day of each month
   c.....Schedule activates on the specified day of each month
   d.....Schedule activates on the first, second, third etc. weekday of each month

HH. Holidays

1. The SMS shall support unlimited holidays.

2. The SMS shall support holiday type designations as Recurring Day of Month, Recurring Relative Monthly, Non-Recurring or Day of Week. The SMS shall allow assignment of duration to each holiday.

3. Holiday groups can be assigned to a Schedule.

II. Time Zones

1. The SMS shall maintain time zones to be used when configuring certain system objects. A time zone shall adhere to standard international Time Zone behavior, and the system shall support all time zones supported by the Windows OS.

2. The SMS shall allow time zones to be assigned to IP devices, controllers, CCTV matrix switchers, DVRs, and scheduled Manual Actions.

JJ. Clearances

1. The SMS shall support configuration of unlimited Clearances.

2. The iSTAR controllers shall support up to 150 clearances per person except for the iSTAR Ultra controller, which shall support up to 1000 clearances per person.

3. The SMS shall support clearance activation and expiration date and time.

4. The SMS shall support unique activation and expiration dates and times for clearances for each Cardholder. (This functionality requires the iStar Ultra Controller)

5. The SMS shall support the ability to select multiple personnel from a Dynamic View and assign clearance(s) to the selected personnel.

6. The SMS shall support the ability to select multiple personnel from a Dynamic View and remove clearance(s) from the selected personnel.

KK. Custom Clearances

1. The SMS shall support the configuration of up to 20 Custom Clearances per Personnel record and up to 100,000 system-wide. Custom clearance shall give unique individualized access to Doors/Door Groups and Elevators/Elevator Groups during an assigned schedule. The SMS Custom Clearances shall also support the assignment of activation and expiration dates.

2. The SMS shall support a process to remove expired custom clearances from personnel records. The process shall be configured as a system-wide event action with the option to activate by schedule.

LL. Clearance Filters

1. The SMS shall support Clearance Filters. Clearance Filters shall provide the ability to dynamically change the access rights of personnel (cardholders) or groups of personnel. Personnel with a lower Clearance Filter level than that assigned to a card reader shall be denied access to that card reader (door). Clearance Filter levels shall be assignable to card readers either manually or automatically via event logic or a time schedule.

MM. Events

1. The SMS shall support unlimited operator configurable events, including the scheduling of events, and action-based trigger of events.

2. The system shall provide 8 configurable event priority levels with a total of 200 numbered event priorities. The system shall allow the operator to define custom colors and labels per individual priority level.

3. The system shall allow an event to be configured to:

   a.....Be sortable by event name, date/time, priority, state, and any other displayable information.
   b.....Be routed to operators by operator privileges, including support for the routing by time of day feature.
   c.....Require or not require operator acknowledgment.
   d.....Require or not require operator clearing.
   e.....Require or not require a log message to be entered by the system operator acknowledging the event.
   f. ....Require or not require a log message to be entered by the system operator clearing the event.
   g.....Display or not display the event activation.
   h.....Require the object(s) causing the event activation to reset before the operator may acknowledge the event.
   i. ....Display an operator-defined text message upon event activation.
   j. ....Display an operator-defined text message when the event is deactivated.
   k.....Be associated with a map so the map opens automatically on the monitoring station when the event activates.
   l. ....Activate a second event when the first event activates and is unacknowledged for a specified period of time.
   m. ..Activate a second event when the first event activates, is acknowledged and is not cleared for a specified period of time.
   n.....Allow the operator to associate an audio wave file with the event.
   o.....Allow for minimum activation time and delayed activation time for events.
   p.....Download events to the iSTAR controllers.
   q.....Run imports and exports.
   r. ....Run reports and remove report results.

4. Event Instructions: .... Each event shall support event instructions to be displayed in the Event Details Screen. Event instructions shall support a maximum of five hundred characters and shall support website addresses, UNC addresses and local file paths.

5. Latch, Unlatch, Toggle, and Pulse for Event: The SMS shall support Event Actions and Manual Action buttons that can be used to Latch, Unlatch, Toggle, and Pulse other Events.

   a.....The SMS shall support a “Latch” Event Action which shall cause it to activate and remain activated.

   b.....The SMS shall support an “Unlatch” Event Action which shall cause it to deactivate and remain inactive.

   c.....The SMS shall support a “Toggle” Event Action which shall reverse an Event’s Latch-Unlatch state: switching a Latched Event to an Unlatched Event and vice versa.

   d.....The SMS shall support a “Pulse” Event Action which shall cause an event to activate momentarily.

6. The SMS shall allow an operator to create a copy of an existing event from within the event editor.

7. Event Assessment:

   a.....The SMS shall provide an Event Assessment Feature which allows an operator to quickly view all objects associated with an event in a user defined Event Assess Application Layout.

   b.....The SMS shall not require the operator to navigate away from the event assessment window to review objects associated with the event.

c.....The SMS shall provide an Event Editor "Assess Configuration" to allow an operator to configure the objects available during the assessment of an event in the Monitoring Station.

d.....The Assess Event Application Layout shall have the following capabilities:

.....(1) View any documents associated with the Event.
.....(2) View live video associated with the Event.
.....(3) View recorded video associated with the Event.
.....(4) View Event details.
.....(5) View a Map associated with the Event.
.....(6) View a Journal Replay of the event, based on a query associated with the Event.
.....(7) Use an Event Details Viewer with additional quick action buttons to process the Event.

e.....Each event shall provide the ability to show the entire Event Assessment with a single mouse click via an icon.

f. ....The event assessment layout shall only be available for viewing by operators with appropriate privilege.

NN. Dual Phase Event Acknowledgement

1. The SMS shall have the capability of configuring user defined events (alarms) to require Dual Phase Acknowledgement. Dual Phase Acknowledgement shall provide a Pending Acknowledgment window and a Pending Clear event monitoring window in addition to the System Activity window. Each event in the SMS shall be configurable individually to use Dual Phase Acknowledgement. Once the event is acknowledged, it shall be removed from the Pending Acknowledgment window and shall appear in the Pending Clear event monitoring window. A monitoring station operator with the appropriate privilege to clear events can select the event from the pending clear event monitor window and click the clear event button to clear the event. Events that require clearing and are waiting to be cleared shall be configurable to require acknowledgement upon re-activation of the event.

2. Events configured for Dual Phase Acknowledgement shall have the following features:

a.....The event shall be configurable to require a log message for alarm acknowledgement and or alarm clearing.

b.....Predefined log messages shall be assignable to alarm acknowledgement and or alarm clearing.

c.....The SMS shall support the configuration of an Operator's monitoring station permissions to determine if the operator can only acknowledge events, only clear events, or can acknowledge and clear events.

d.....Operators with acknowledge and clear privileges shall be able to acknowledge and clear events in a single action.

e.....A Dual Phase Acknowledgement event shall be configurable so the acknowledging operator can't clear the event. (In this configuration, clearing the event shall be required by a different operator.)

f. ....Events that are acknowledged or silenced shall be configurable to remain silent until cleared.

g.....A user-defined timer can be configured to activate a second event if acknowledgement of an event, or clearing of an event, does not take place within the specified time frame. The timer shall start when the event is activated.

OO. Sounds

1. The SMS shall include a Sound editor that allows an operator to create Sound objects to associate with 'Play Sound' Actions for Events. A single Sound object may be associated with multiple Events, rather than having to save an individual sound file multiple times—each associated with a single Event.

2. Sounds shall be saved in a Sound table in the SMS database.

3. Sounds shall replicate, on an enterprise system, but they will be Local Only.

4. The SMS shall support the ability to import and export Sounds in .WAV file format. The size of the .WAV files that are imported shall be enforced to be less than 1460000 bytes (1.39 MB).

5. Sounds shall be Privilege based.

PP. Journal Triggers

1. The SMS shall support a Journal Triggers editor that allows an operator to define Triggers to activate an Event when a specified Journal Message occurs. The Journal Trigger shall be a Query-like object that evaluates Journal Messages and pulses an Event when the criteria specified in the configured trigger is logged in the Journal.

2. The SMS shall support an Event Action that sends email notification with a description of the activation cause each time a Journal trigger is activated.

3. The SMS Monitoring Event Status screen shall display the reason a particular Event was pulsed by a Journal trigger.

4. The SMS shall support up to a maximum of 500 Journal Triggers.

QQ. Audit Triggers

1. The SMS shall support an Audit Triggers editor that allows an operator to define Triggers to activate an Event when a specified Audit Log Entry occurs. The Audit Trigger shall be a Query-like object that evaluates Audit Log Entries and pulses an Event when the criteria specified in the configured trigger is logged in the Audit Log.

2. The SMS shall support up to a maximum of 500 Audit Triggers.

RR. Manual Action Challenge

1. The SMS shall support Manual Action Challenges. The Manual Action Challenge shall require a SMS operator to enter their login credentials (User name and password) when executing a manual action from within the SMS.

2. The Manual Action Challenge shall be available from both the Administration and Monitoring Applications.

3. The Manual Action Challenge shall be assigned to a Privilege and the Privilege shall be assigned to the SMS operator.

SS. Document Editor

1. The SMS shall support the ability to import multiple types of document objects to include:

   PDF, TXT, XML, DOC, XLS, JPG, GIF, PNG, TIF

2. The SMS shall have the ability to attach these object types to the following areas:

   a.....Personnel records to provide additional information.
   b.....Events as part of the Events Assessment Feature.
   c.....A Guard Tour

TT. Integrated Email

1. The SMS email system shall have the ability to interface directly to an SMTP-compliant email system supplied and configured by the user.

2. The email configuration shall support user authentication via a password and SSL encrypted communication to the email server.

3. The email system shall support the ability to send emails to Personnel Groups.

UU. Import / Export

1. The SMS shall provide a means for manually importing and exporting selected data in XML format. This mechanism shall support the import and export of any and all classes or types of data in the system. Specific data validation and logging requirements shall be met.

2. The system shall also support importing from CSV files.

3. The SMS shall provide an automated import mechanism (preferably XML-based). This mechanism shall support the import of most classes or types of data into the system. Specific data validation and logging requirements shall be met.

4. The SMS shall have the capability to perform automated imports from an Open Database Connectivity (ODBC) data source allowing the import of personnel data directly into the system database.

5. The system shall have the ability to connect to a directory service source via the Lightweight Directory Application Protocol (LDAP). The connection to the LDAP source shall be user-configurable directly from the SMS and shall not require custom code. The LDAP interface shall also support the automatic assignment of SMS clearances based on data contained in the LDAP record. The LDAP feature shall support the following features:

   a.....LDAP server name and user-defined port number.
   b.....A base distinguished name for the root of searches.
   c.....A user-definable LDAP search filter to refine object search.
   d.....User-defined mapping of attributes to SMS personnel fields.
   e.....The use of a Distinguished Name (DN) entry for the SMS to authenticate to LDAP.
   f. ....Option to search all sub-levels of the directory from the base DN.
   g.....Preview sample-data based on SMS LDAP import settings.
   h.....Automatic roles-based SMS clearance(s) based on two fields of source data.
   i. ....Automatic import of directory entries from the LDAP source.
   j. ....Authentication via a user-definable LDAP user account and SSL.
   k.....Automatic SMS clearance assignment.

6. The SMS shall provide a Data Mapping feature that provides field mapping information using the XSLT file based on the input data or an external XSLT file.

7. The SMS shall support Import and management of Operators with their respective Privilege Groups using XML and LDAP role-based templates.

VV. Objects

1. Each object within the SMS shall be addressed by a unique operator-defined name. Object names shall be unique within object types.

2. The SMS shall provide the ability to add description text to each object definition.

WW. Reports

1. The SMS shall support a Report Service that runs as a Windows Service. The Report Service shall operate in either 64 or 32 bit mode. The Report Service shall execute Reports that are either run on the Server by an Operator or configured to run automatically as an Event Action.

2. The SMS shall provide configurable data reports for database configuration, historical activity (Journal) and audit tracking. Pre-defined reports shall be available for download and import into the system.

3. The SMS report function shall perform the following:

   a.....Create reports about any object.
   b.....Create report templates to simplify report design.
   c.....Run reports on demand.
   d.....Save report results for sharing between different users of the application.
   e.....Export reports into formats such as PDF, RTF, TXT, TIFF, Excel (XLS), and MHTML.
   f. ....Specify a query to select and filter the records on which to report.
   g.....Specify the data fields to be included in a report.
   h.....Specify a design for the report layout.
   i. ....Design a report form to be used as a layout for headers / footers for multiple reports.
   j. ....Access and use system pre-defined report forms.
   k.....Select tabular, multi-line, or free form report layouts.
   l. ....Report on objects linked together with parent / child relations.
   m. ..Schedule reports to run automatically on a customized schedule.
   n.....Send exported report files to the printer or to external recipients via e-mail.

4. The SMS shall support integration to The Business Intelligence Reporting Suite (BIRS). The suite shall offer web-based reporting as well as data warehousing of SMS historical and system data. The suite shall include multiple pre-written reports such as 24 Hour Journal Messages, 24 Hour Trouble Messages, Graphical Usage and Count of Door Group. The open system procedures shall allow the reports to be written and saved for repeat use.

5. The reporting suite shall provide an interactive user experience via any standard web browser, allowing the user to scrutinize the information without needing to print or review hard copies.

6. The reporting suite shall support connecting to one or more SMS systems. This shall provide data and reports across an enterprise solution to allow segregated reports that reflect both satellite application server data as well as master application server data.

7. The reporting suite shall allow an enterprise to share and blend data from other sources such as ERP and Time and Attendance systems to yield critical business information and reporting.

8. The reporting suite shall provide information delivery options such as email, CSV export, PDF export, XML data transfer, or database pool offerings. The suite shall also be a critical resource in system review and audit procedures such as system maintenance and performance.

9. The Reporting Suite shall:

   a.....Provide Intuitive user interface and web-based reporting for SMS customers

b.....Share and blend data from other sources to yield critical business information
c.....Leverage Microsoft® Business Intelligence (BI) tools
d.....Include Reporting Service for report delivery and presentation
e.....Perform Reporting and processing from the SMS host
f. ....Include Subscription options for automated delivery of reports
g.....Include Dashboard, graphical, and statistical reports, and reports customized by user
h.....Generate Reports on any PC with compatible Web browser without SMS Client software
i. ....Offer and secure Data via Active Directory and SQL permissions
j. ....Include Optional front end or other application integration including SharePoint

XX. Dynamic Views

1. The system shall support a grid format displayable report that will be usable to display homogeneous lists of objects within the system. This display shall be configurable both at configuration time and also at run time.

2. The Dynamic views shall have the following features:

a.....Real-time updating and display of property values.
b.....The display shall be sortable.
c.....Groupable by any number of columns.
d.....Filterable based on user selectable criteria.
e.....Printable.
f. ....Can be saved as a MS Excel file from the current view.
g.....Exportable in either XML or CSV file formats.
h.....The export file shall be viewable in Excel (Excel must be installed separately).
i. ....The export file shall be able to be emailed.
j. ....The user shall be able to add and remove columns from the grid at runtime to enhance the user experience even if displaying a preconfigured view.
k.....The view shall be capable of pre-configuration so that repeatable displays of objects are possible.
l. ....The view shall support in-place editing of properties of the object.
m. ..Bulk operations shall be performed via multi-selection. The operations shall consist of (but are not limited to) setting a property to a value and deletion.

YY. Query

1. The SMS shall provide a Query engine to be useful for users without any knowledge of SQL or any other specific query language. It shall allow users to make requests against data sets with preconfigured relations between tables. The relations shall reflect the actual relations between database objects and the user shall be able to put conditions on any available field in the selected object type and its subordinate objects.

2. The users shall be able to construct a proper query expression selecting all available operations, column names, and table names from prompted lists. It shall eliminate the necessity to memorize any particular expression syntax. References to existing configuration objects shall also be prompted through a list of existing objects where applicable, eliminating the necessity of memorizing names. The Query feature also shall support complex logic, such as AND/OR.

3. Negative logic Queries using the new NOT IN operators
The SMS shall support Query filters that perform AND/OR operations to narrow Query results. The SMS shall also support building complex query operations by use of block filters that perform AND/OR/AND NOT IN/OR NOT IN operations to further narrow Query results.

4. The SMS shall provide a Journal Query Assistant as a special method of the Query engine to query on XML fields within Journal Messages. This method shall allow the user to build queries on Journal messages. The Journal Query Assistant shall support Card Admitted, Card Rejected, Operator Login and

Operator Activity message types, Area Activity, Object Changed State and Manual Action message types.

ZZ. Guard Tour

1. The SMS shall support Guard Tours.

2. A Guard Tour shall consist of a series of predetermined Stops requiring a Guard to check-in at each Stop to complete the Tour within the specified time. The Guard Tour shall consist of any combination of Doors, Elevators, and Inputs.

3. The SMS shall support a maximum of two hundred Guard Tours.

4. The maximum number of Stops per Guard Tour shall be one hundred.

5. The SMS shall support up to a maximum of fifty simultaneous running Guard Tours.

6. The SMS shall support two types of Guard Tours: Sequential and Random requiring the Guard to check all Stops in sequence or in a random order.

7. A sequential tour shall be configured with a minimum and maximum time that a guard shall have between stops.

8. Each Tour shall be configured with a specific group of guards that shall be allowed to execute the Tour.

9. The following Tour states shall be available to activate preconfigured events in the SMS:

   a.....Activated
   b.....Started On Time
   c.....Started Early
   d.....Started Late
   e.....Suspended
   f. ....Suspended too Long
   g.....Resumed
   h.....Cancelled
   i. ....Completed
   j. ....Completed Early
   k.....Completed Late
   l. ....Inactive
   m. ..Not completed On Time
   n.....Failed To Start
   o.....Error Occurred

10. A guard Tour shall have the ability to be initiated from:

    a.....The reader configured as the first Stop of the Tour
    b.....An Event (Manually activated or on a Schedule)
    c.....A manual Action from an Operator at the SMS Monitoring Workstation

11. The SMS shall support sending an email notification to a Guard of the impending start of the scheduled Tour.

12. A Guard shall be required to complete check-ins at all Guard Tour Stops before the maximum completion time expires and shall be required to spend at least the minimum amount of time on the Tour.

13. A Tour shall be canceled by either an error, event action or a manual action from an Operator at the SMS Monitoring Application.

14. Each Tour shall be able to be configured with a minimum and maximum time of completion.

15. The system shall indicate that a Tour Stop was reached early and started early if a guard checks in at the first stop before the minimum stop time expires.

16. The system shall indicate that a Tour Stop was reached late when a guard checks in at the first Stop after the maximum time expires.

17. The System shall indicate that a Tour Stop was not reached on time when a guard has not checked in after the maximum Stop time expires.

18. In the SMS Monitoring Station Application, it shall be possible to display the details of all the Guard Tour Stops and the current status of the Tour.

19. Each Guard Tour shall have the ability to attach up to a maximum of ten documents explaining the details of the configured Guard Tour.

20. Each Guard Tour shall support Predefined Log Messages or Message Groups.

21. Tour status shall be available from the SMS Monitoring Station Application and shall provide the following information:

    a.....Tour Type
    b.....Last Tour Status
    c.....Current Tour Status (Running/Not Running)
    d.....Guard Name (if active)
    e.....Last Completed Stop
    f. ....Percentage Completed.

22. The SMS shall provide the ability to configure an icon on an SMS MAP representing a Guard Tour. An Operator shall have the ability to start the Tour and manually assign a specific Guard responsible for completing the Tour from the MAP.

23. The icon representing the Tour shall change appearance based upon the current state of the tour.

24. The SMS shall provide the ability to run a Journal Report providing the details of any completed or active Tour including:

    a.....Time scheduled
    b.....Guard assigned
    c.....Activation time
    d.....Stop status

AAA. Hand Held Reader

1. The SMS shall support a portable hand-held reader that shall provide identity verification. The portable hand-held reader shall support the following:

   a.....The portable hand-held reader shall work on an Android device

   b.....This android device shall support Bluetooth communication to three types of Multi technology readers.

c.....The readers shall be capable of reading:

.....(1) HID Proximity and iCLASS SE PACS data
.....(2) HID Proximity and custom MIFARE sector with key
.....(3) HID Proximity and (Mifare, Desfire) csn

d.....Act as a single door controller much like a conventional door in online or offline modes. Offline modes shall support the following functions:

.....(1) Offline mode shall support 100,000 cardholders
.....(2) All card transactions shall be stored locally and uploaded to the SMS when the unit is placed online.
.....(3) Offline mode shall support storing 10,000 transactions

e.....Online mode shall support all cardholders in the SMS

f. ....Shall securely communicate to the SMS using web services (encrypted using TLS) supporting (3G/4G or Wi-Fi)

g.....Allow Operators with appropriate permissions to log into the device using single sign on authentication

h.....Specific cardholders shall be downloaded to the device based on clearance assignment

i. ....Shall have the ability to display

.....(1) access grant
.....(2) denial of access
.....(3) cardholders portrait
.....(4) card number

j. ....It shall be possible to set the amount of time that the display shows the last card transaction

k.....Shall be available to download from the Google Play app store

l. ....Shall support phones and tablets running Android OS 5.0 and higher

2. Roll Call

a.....The portable hand-held reader shall be able to perform a Roll Call feature.

b.....As cardholders present their cards at this mobile device, the SMS shall have the ability to remove the cardholder from their current area and place them in a muster area.

c.....During a Roll Call, it shall be possible for an operator, from the SMS, to display a list of cardholders including their names and portraits in their respective areas.

BBB. Random Screening

1. The SMS shall support a Random Screening feature.

2. The Random Screening feature shall allow SMS doors to be configured to randomly reject cardholders for the purpose of identity verification or baggage searches etc.

3. The SMS shall allow each door to be configured with a percentage value to define the frequency of the random screening action.

4. The SMS shall provide a Random Screening event for each door that shall be activated when a cardholder is rejected for Screening. The event shall be used for notifying the proper Personnel of the Screening activity.

5. The SMS shall log all Screening activity for reporting or auditing purposes.

CCC. CCTV Integration / Digital Video

1. The SMS shall provide extensive integration with American Dynamics DVR/NVR solutions.

2. The SMS server shall be connected to the DVR/NVR during the configuration process enabling the SMS to query the DVR/NVR for setup information.

3. The SMS shall use tree controls to drag and drop video servers or cameras directly into the interface for intuitive and instantly active video integration.

4. The SMS shall provide live camera display during configuration.

5. The SMS shall provide the ability to drag cameras into tours.

6. The SMS shall provide the ability to identify and automatically configure all cameras on a controller.

DDD. General Purpose Interface

1. The SMS shall support a licensable General Purpose Bi-directional Serial Interface.

2. The General Purpose Interface shall be a programmable bi-directional communication protocol that shall provide a general mode of communication between the SMS General Purpose Interface driver and a third-party device.

3. The third-party device shall send pure ASCII messages via a serial port (RS-232) or remotely via a TCP/IP port (via a Terminal Server) into the General Purpose Interface driver.

4. The SMS shall interpret messages in two ways:

   a.....As journal messages recorded into the SMS historical journal.
   b.....As any of five Monitoring Point status changes configured to trigger an SMS event.

5. The General Purpose Interface supports the following functionality:

   a.....Input: where the input strings are sent from the device through the Serial/Network port to the SMS Server. The General Purpose Message Protocol object is used to define and parse the information.
   b.....Output: where the output is an Action and requests a response from the device.
   c.....Poll: where the poll is an action that requires a response from the device.

EEE. ID Badging Subsystem

1. The SMS shall include an embedded ID Badging Subsystem. The ID Badging subsystem shall utilize a common database with and be an integral part of the SMS. The ID Badging Subsystem shall provide the ability to capture cardholder images and design and print user-defined badge layouts. The Badging Subsystem shall support the following capabilities:

   a.....Unlimited number of badge design layouts.
   b.....WYSIWYG badge designer.
   c.....Background color detection in the portrait image.

d.....Threshold level selection to apply to background detection.
e.....User-defined selection of background color.
f. ....User-defined selection of replacement color or transparency setting.

g.....Edge-detection setting, to aid in replacing only the selected background and not any matching color within the portrait image.
h.....Capture, import, and display portraits.
i. ....Capture, import, and display signatures.
j. ....Capture and display fingerprints.
k.....Insert, import, and display foreground and background images.
l. ....Print two-sided badges.
m. ..Encode magnetic data onto personnel badges.
n.....Insert 1D or 2D bar codes.
o.....Insert or replace color and transparent effects for image and background display.
p.....Support a variety of image formats including .bmp, .jpg, .tif, and .wmf.
q.....Custom functions using the Expression builder.
r. ....Multiple images per cardholder.
s. ....Diagonal and Square borders. Each type of border shall support a user-defined width and height setting, and individual color settings for each border side.
t. ....Proper Case (first letter in string is set to uppercase, all other characters set to lowercase).
u.....Year display (four- or two-digit).
v.....Month display (full or abbreviated name, or numeric).
w....Day display (full or abbreviated name, or week/month numeric).
x.....Hour display (12 or 24 hour format).
y.....Minute display.
z.....Second display.

FFF. Visitor Management

1. The SMS shall support an optional, embedded Visitor Management feature. The SMS shall support the creation and management of visitor appointments. The Visitor Management feature shall serve as a replacement for paper-based visitor log books and shall support the organization and tracking of visitors. The Visitor Management feature shall support the following features:

   a.....Keep track of visits (and Visitors) in progress
   b.....Single-/multi-visitor group appointment scheduling
   c.....Temporary credential issuance
   d.....Visitor check-in/check-out
   e.....Visit Templates
   f. ....Visit Sites
   g.....e-mail notification of visitor arrivals
   h.....Manage unplanned visits and anonymous visitors
   i. ....Manage the return of credentials and the end of a visit
   j. ....Configure Instructions for the visit
   k.....Configure personnel as visit hosts
   l. ....The capability to check-in and check-out visitors by presenting a valid card at a designated reader.
   m. ..The ability to scan a license or a passport when adding a new visitor. Each field associated with a license or passport can be individually selected for import.
   n.....Run reports and queries on both scheduled or completed visits

2. The SMS shall provide the ability to schedule a nightly event that shall perform an automatic checkout of all visitors per partition.

3. The SMS shall support an optional Visitor Management Web portal that shall allow a host to create and manage visits and visitors via a standard web browser. The initial browser logon shall allow customization to display a unique name.

4. The SMS Visitor Management Web portal shall support the following Web Browsers:

   Internet Explorer
   Chrome
   FireFox
   Safari on IOS

5. An SMS Operator shall be able to perform the following Visit Site functions:

   a.....Create and Configure Visit sites
   b.....Customize the Portal for each visit site
   c.....Assign a custom image that represents the visit site
   d.....Assign the visit site to a partition
   e.....Create and configure visitor templates for a site (which can include Clearances for the Visit)
   f. ....Create and configure a Visit Template for a site
   g.....Specify what fields are to be used when creating a new visitor in a site
   h.....Individually select which fields are mandatory
   i. ....Add additional details to a visit site including user definable fields
   j. ....Designate which hosts can access a site to create a visit
   k.....Assign a document to a visit site
   l. ....Configure the details for the welcome Email to hosts
   m. ..Configure a Visitor Management Door Action for card swipe check-in and checkout

6. A Host using the Visitor Management Web portal shall be able to do the following:

   a.....Create, edit and delete Visits
   b.....Utilize Visit Templates to create Visits
   c.....Search for existing Visits
   d.....Add instructions for the visit and attach pertinent documents to the visit
   e.....Add additional Hosts to a Visit
   f. ....Create New Visitor records and add Visitors to Visits
   g.....Email all visitors and hosts associated with the created visit

7. The SMS shall support a Kiosk for self-visitor check-in

   a.....The SMS system shall support an unlimited number of Check-in sites. Each Check-in site shall be configured with a Kiosk application that operates on an iPad. This Kiosk application shall be used to allow a visitor to self-check-in as a new or pre-enrolled visitor. Each site shall have the ability to customize how the Kiosk Check-in application works. The Kiosk shall provide the following features:

   b.....Each Kiosk shall support the creation of custom messages for each check-in site:

   .....(1) Welcome message
   .....(2) Visitor not found message
   .....(3) Check-in complete message
   .....(4) Registration complete message

   c.....The Kiosk shall have the ability to accept unregistered visitors (Optional) via the following steps:

   .....(1) Enter a new visit (First, Last, Email)
   .....(2) Take a picture
   .....(3) Enter and assign Host via context sensitive lookup that shall show the host name and image as you type
   .....(4) Require acknowledgement of an NDA or other document (Optional)

.....(5) Automatically email host when check-in is complete
.....(6) Automatically check-in visitor (optional)

d.....The Kiosk shall have the ability to add a Pre-enrolled visitor via the following steps:

.....(1) Find visitor by either Email Address or First/ Last Name via context sensitive lookup
.....(2) Take a picture
.....(3) Require acknowledgment of an NDA or other document (Optional)
.....(4) Automatically email host when check-in is complete
.....(5) Automatically check-in visitor (optional

GGG. Access Management Workflow

1. The SMS shall support an Access Management Workflow feature including a Web Portal. This workflow shall allow different types of requests and approvals to automate the assignment of clearances. The following features shall be supported by the Access Management Workflow feature:

a.....The creation of an unlimited number of Access Request Sites

b.....Each access request site shall be uniquely configurable with the following:

.....(1) Show selected personnel fields from requesters
.....(2) Display General site information
.....(3) Show additional user definable fields
.....(4) Select authorized requesters
.....(5) Select available clearances
.....(6) Select Personnel for access request assignment

c.....The Access web portal shall support the following:

.....(1) Customized portal name display

.....(2) Single Sign on authentication

.....(3) Creation of Access requests, which shall provide the following:

..... (a) Name of the request
..... (b) Available site clearance selection
..... (c) Justification statement
..... (d) Request Status
..... (e) Personnel associated with the request
..... (f) Attach a document relative to the request
..... (g) Ability to save the request without submittal
..... (h) Ability to submit the request

.....(4) Access approval with the following capabilities:

..... (a) List the assigned submitted pending requests
..... (b) Show all details pertaining to the request
..... (c) Ability to approve or deny the request
..... (d) Provide comments on the reason for the approval/denial
..... (e) Review the history (audit) of previously submitted requests
..... (f) Provide the ability to revoke a previously approved request

d.....The SMS shall provide the following Internal Request features:

.....(1) Clearances shall be configurable with the following approval rules:

..... (a) Auto approve
..... (b) Any approver from a partition
..... (c) Any selected approvers
..... (d) Only allow assignment via approved request

.....(2) Door activity shall also provide the ability to automatically generate an approval request which shall be:

..... (a) Subject to a schedule
..... (b) Subject to direction of the swipe (in/out)

2. All generated requests shall viewable within the SMS showing current status and details.

HHH. Smart Card / Proximity Card Enrollment

1. The SMS shall provide a smart card enrollment feature as part of the ID Badging Subsystem. The smart card enrollment feature shall allow a user to enroll MIFARE, iCLASS or DESFire cards utilizing a USB wedge reader or a Manufacturer-approved badge printer.

2. The SMS shall provide a proximity card enrollment feature as part of the ID Badging Subsystem. The proximity enrollment feature shall allow a user to enroll the card number of proximity cards on a Fargo HDP 5000 printer that is equipped with an OMINKEY CardMan 5x25 encoder.

3. The ID Badging Subsystem shall support the creation of Smart Card Templates to define the smart card configuration. Templates shall be used to define the data transfer between the physical card and the Personnel Record. Templates shall define the card type as MIFARE, iCLASS or DESFire. When programming a card, the system shall be able to read and write to all relevant data such as personnel fields, card fields or card formats. The Badging Subsystem shall provide the ability to Enroll MIFARE, iCLASS or DESFire. The Badging Subsystem shall provide the ability to Program and Enroll MIFARE.

4. Templates shall also be utilized to define the Security Keys needed to access the data on the smart card. Templates shall be assignable to the enrollment device (wedge reader or printer).

5. The ID Badging Subsystem shall support both the enrollment (reading of data from the card) and programming (writing of data to the card) for MIFARE cards. The ID Badging Subsystem shall support the enrollment of DESFire cards and shall support Card Serial Number data only. The ID Badging Subsystem shall support the enrollment of iCLASS cards and shall support Card Serial Number data only.

6. The ID Badging Subsystem shall support the creation of Custom read/write Keys. Custom Keys are private keys supplied by a third party. Custom Keys shall be assigned to Software House Readers via Program Cards supplied by the Manufacturer.

III. System Parameters (Based on a single credential per cardholder)

1. The SMS shall have a maximum capacity of:

a.....5,000 online readers
b.....20,000 online inputs
c.....20,000 online outputs
d.....500,000 enabled Personnel Records
e.....256 Simultaneous Clients (256 is a design capability while the tested limit is 100)

2. The SMS shall support a Master Application Server (Enterprise Architecture) with maximum capacity of:

   a.....40 Satellite Application Servers (tested limit)
   b.....500,000 Global enabled Personnel Records
   c.....100 Simultaneous Clients

3. The SMS shall support an Enterprise Architecture (based on 40 SAS) with a maximum capacity of:

   a.....200,000 online readers
   b.....800,000 online inputs
   c.....800,000 online outputs
   d.....20,000,000 local enabled Personnel Records
   e.....500,000 Global enabled Personnel Records
   f. ....20,500,000 Total enabled Personnel Records

2.4 OPERATION

A. The SMS shall provide the following operational functionality:

1. The system shall control access to a designated area.

2. The system shall validate cardholder credentials by use of downloaded personnel records, card formats, PINs, biometric enrollment and multiple active cards. The system shall compare the time, location, and unique credential number of an attempted entry with information stored in memory.

3. Access to a designated area will be validated only when a user's credential has a valid number for its facility and the number is valid for the current time and for the reader where it is used.

4. The system shall access the hardware that validates the person and monitor the security of a building by use of controllers, doors, readers, elevators, inputs and outputs. When access has been validated, a signal to the door locking device shall be activated to enable alarm-free access at that location.

5. The system shall configure itself as required by use of an Administrative application, and shall provide Configuration templates.

6. The system shall monitor access control activities by use of Monitor Station, Alarm configuration, NetVue, CCTV, and dynamic Graphical Maps display of alarm, door, and event activity (Maps based on CAD data).

7. The system shall restrict administrative and Monitoring Station activity by use of Privileges and Authentication (User Password) using Microsoft Windows OS Password Function.

8. The system shall report on various aspects of the system by use of Reports (canned and configurable). Reports shall be able to export to a printer.

9. The system shall have the capability to report off-normal security device conditions both audibly and visually.

10. The system shall control hardware from the monitoring station by use of Manual actions, Events, and cause lists.

11. The system shall provide Record and Data Management by use of Historical Journal (archive and replay), Full Audit Trail and automated and manual import and export (data and images).

12. The system shall allow for data to be imported from other products by use of database Migration tools (Card Holder data and configuration data) from, C·CURE 800/8000 and 3rd party applications via XML formatted data exchange.

2.5 EQUIPMENT

A. Server Requirements

1. The SMS Server shall meet or exceed the SMS Manufacturers requirements for the current version and series of the SMS software.

B. Client Workstation Requirements

1. The SMS client workstation shall meet or exceed the SMS Manufacturers requirements for the current version of the SMS software.

C. Badging Station Requirements

1. The SMS badging workstation shall meet or exceed the SMS Manufacturers requirements for the current version of the SMS software.

D. Controllers

1. The SMS shall support the following controller hardware:

   Note: For additional information, please refer to individual A&E specifications for the controllers listed below:

   a.....Software House iSTAR Classic
   b.....Software House iSTAR Pro
   c.....Software House iSTAR eX
   d.....Software House iSTAR EDGE
   e.....Software House iSTAR Ultra/Ultra SE
   f. ....Software House apC, apC/8X, apC/L

E. Clustering

1. The SMS shall support a user-defined grouping of iSTAR controllers defined as a cluster. iSTAR controllers within a cluster shall be able to communicate in a peer-to-peer scheme should the SMS server lose communication with the cluster.

2. Clustering shall support the following features:

   a.....Assignment of Master controllers for cluster communication to the SMS server
   b.....Primary and backup communication paths to the SMS server
   c.....Up to 16 controllers per cluster
   d.....Logical event linking between controllers in a cluster independent of SMS server communication
   e.....Antipassback control within a cluster shall be independent of SMS server communication
   f. ....Asynchronous communication via TCP/IP (Polled devices shall not be acceptable)
   g.....Dialup Communications. Dialup shall only be supported on iSTAR Pro and iStar Ultra SE (in Pro Mode)
   h.....Encrypted communications

3. The SMS shall support iSTAR clusters in two types: Encrypted and Non-Encrypted. Encrypted clusters shall support iSTAR Edge/eX/Ultra controllers. Unencrypted clusters shall support iSTAR Classic/ iSTAR Pro/unencrypted Ultra controllers.

4. Network communications between a cluster master and the host, and between a cluster master and cluster members, shall be done using AES 256 bit symmetric encryption, tested and verified by an independent lab and listed for FIPS 197.

5. Encrypted iSTAR controllers shall be listed for FIPS 140-2, which meets the necessary physical, operational, and cryptographic requirements for a cryptographic module for the National Institute of Standards (NIST).

PART 3 – EXECUTION

3.1 TESTING

A. The software shall be entered into the SMS computer systems and debugged. The Contractor shall be responsible for documenting and entering the initial database into the system. The Contractor shall provide the necessary blank forms with instructions to fill in all the required data information that will make up the database. The database shall then be reviewed by the Contractor and entered into the system. Prior to full operation, a complete demonstration of the computer real-time functions shall be performed. A printed validation log shall be provided as proof of operation for each software application package. In addition, a point utilization report shall be furnished listing each point, the associated programs utilizing that point as an input or output and the programs which that point initiates.

B. Upon satisfactory on-line operation of the system software, the entire installation including all subsystems shall be inspected. The Contractor shall perform all tests, furnish all test equipment and consumable supplies necessary and perform any work as required to establish performance levels for the system in accordance with the specifications. Each device shall be tested as a working component of the completed system. All system controls shall be inspected for proper operation and response.

C. Tests shall demonstrate the response time and display format of each different type of input sensor and output control device. Response time shall be measured with the system functioning at full capacity. Computer operation shall be tested with the complete data file.

D. The Contractor shall maintain a complete log of all inspections and tests. Upon final completion of system tests, a copy of the log records shall be submitted as part of the as-built documentation.

3.2 TRAINING

A. The Contractor shall provide a competent trainer who has extensive experience on the installed systems and in delivering training to provide the instruction. As an alternative, the Contractor may propose the use of factory training personnel and coordinate the number of personnel to be trained.

3.3 MAINTENANCE

A. The Contractor shall offer a Software House Software Support Agreement (SSA) in order for Software House Technical Support Specialists to reactively troubleshoot system problems.

B. As part of the agreement, 5x9 telephone support (Standard and Enhanced SSA) will be provided to the Contractor by Certified Technicians. An option of 7x24 Standby telephone support (Enhanced SSA) shall be offered.

C. As part of the agreement, Flashable and Non-Flashable (Chips) firmware and documentation shall be provided.

D. As part of the agreement, access to SMS patches and software release updates shall be provided.

E. The SSA shall cover the current SMS release one full version back, and associated controller hardware.

END OF SPECIFICATIONS 28 07 27

SECTION 28 07 28
CCTV – NETWORK DIGITAL VIDEO MANAGEMENT SYSTEM

PART 1 – GENERAL

1.1 SYSTEM DESCRIPTION

A. The Network Digital Video Management System ("Network DVMS") shall be a feature-rich IP video distributed solution, designed for multi-site and multiple-server installations requiring 24/7 video surveillance.

B. The Network DVMS shall consist of the following major components:

1. Client Viewer.
2. NVR (Network Video Recorder) Server.
3. Add on: Transaction Data Integration Module.
4. Add on: Central Alarm Management Module.
5. Add on: PDA Server and PDA Client

C. The Network DVMS - Client Viewer ("Client Viewer")

1. The Client Viewer shall be the central operating control point for the Network DVMS system. The Client Viewer shall provide the end-user full video monitoring and control for a fully distributed solution for either single-site or multi-site applications for single-server or multiple-server installations requiring 24/7 surveillance with support for devices from different vendors.

2. The Client Viewer shall uniquely integrate a multitude of disparate solutions into a single feature-rich application including seamless integration with a fully distributed, centralized-managed video surveillance platform.

3. The Client Viewer shall provide an easy to use, fully integrated GUI (Graphical User Interface) that supports within the same application the following features:

a. Scalability - For enterprise and other high-end users, the Client Viewer shall scale to provide support for an unlimited number of cameras using multiple NVR servers. Overall, the Client Viewer shall be fully scalable to support a varying number of cameras based on the NVR server selected by the end-user, including the following other options:

(1) For small-to-medium (SMB) users, the Client Viewer shall scale to provide support for a maximum of 25 cameras using a single NVR server.

(2) For commercial users, the Client Viewer shall scale to provide support for a maximum of 64 cameras using a single NVR server.

b. Touch Screen Controls - The Client Viewer shall support intuitive touch-screen controls, menus and video navigation. Through the touch-screen interface the end-user shall be able to navigate menus directly from the video viewing monitor without the aid of a keyboard or mouse (no need to right click, etc.).

c. NVR Management - The Client Viewer shall support the management of a single Network Video Recorder (NVR), and an entire system of NVRs.

d. Intelligent Menus and Controls - The Client Viewer shall provide intelligent menus that automatically appear and disappear as needed by the operator to only show those controls necessary to perform the end-user function. For example, for a PTZ camera, the GUI shall intelligently show a virtual joystick to control optical zoom, digital zoom and preset controls

within the camera view. The GUI shall react to the user's actions and only present those controls and tools required by the current mode of operation.

e. Kinetic / Horizontal Timeline – The Client Viewer shall provide a user interface to allow for "kinetic" manipulation of a graphical timeline representation of recorded video. The user shall uniquely be able to kinetically (i.e., via the momentum and speed of mouse movement) vary the speed that the recorded video timescale is moved forward/backward in time.

f. Instant Video Playback and Analysis "Timeslicer" - The Client Viewer shall provide for instant video playback and analysis of video content/events by providing a spectrum of video thumbnails over a period of time for quick end-user analysis.

g. Integrated Event Management - The Client Viewer shall provide integrated event management including automation of event push video, pop-up events, and alerts without the need of additional software modules or add-on software.

h. Mapped Based Navigation - The Client Viewer shall provide a map-based navigation of cameras and/or camera groups.

i. Integration of Data for Multiple-Users – The system shall provide the ability to share and store common bookmarks and event handling data across multiple users.

j. Interactive Carousel - The Client Viewer shall provide fully interactive video carousel functionality, whereas a series of video camera views will presented to the end-user as a rotating carousel. For the rotating carousel, the end-user shall have the full capability to interact with the video including the ability to interrogate the video as a clip, expand the video view for the video shown, control the camera, etc.

D. The Network DVMS – NVR

1. A single NVR Server or multiple NVR Servers shall provide video recording for the Network DVMS. The NVR Server shall consist of the following software components which may be resident on a single server, or installed on multiple servers within an overall Network DVMS:

   a. Recording and Image server
   b. Administrator Application
   c. PDA Server.

2. The Network DVMS shall support multiple NVR Servers. Each of the NVR Servers shall be assignable as either a master or a slave NVR Server.

3. The NVR Server shall be used for recording video feeds and for communicating with cameras and other devices.

4. The system shall support an unlimited number of NVR Servers. One or more NVR Servers may be used in a system depending on the number of cameras or physical system configuration.

5. The NVR Server shall support the use of pre and post recording on motion/event recording. The pre and post recording time period shall be selectable in seconds.

6. Logging – The Network DVMS shall provide an overall System log, an Event log, and an Audit log.

E. Transaction Data Integration Module

1. The Network DVMS shall include support for an add-on Transaction Data Integration Module designed to integrate with Point of Sale (POS) or Automated Teller Machine (ATM) data and time-link

video recordings with POS or ATM transactions.

F. Central Alarm Management Module

1. The Network DVMS shall include support for an add-on graphical Central Alarm Management application module. The alarm management module shall allow for the continuous monitoring of the operational status and event-triggered alarms from system servers, cameras and other external devices. The alarm management module shall support graphical displays with interactive icons to display the status of cameras and other inputs.

G. PDA (Personal Digital Assistant) Server and Client

1. The Network DVMS shall include support for add-on PDA Servers and PDA Clients to allow for viewing using a remote wireless PDA.

H. Certified Installer Program

1. The Network DVMS software vendor shall provide a certified partner program, whereby training and certification programs shall qualify the suitability of the installers. The vendor shall provide various levels of training including advanced training (i.e., “Gold” level).

I. Network Topology

1. The Network DVMS System shall support the use of separate or common networks, VLANS or switches for connecting cameras to the NVR servers/clients. This shall provide physical network separation between the camera and servers/clients.

J. Virtual Computing

1. The Network DVMS System shall support the use of VMware to run NVR servers and client applications on virtual computers, servers, and networks.

PART 2 – PRODUCTS

2.1 NETWORK DVMS – CLIENT VIEWER

A. The main end-user interface and therefore the core application for the DVMS shall be the Client Viewer. The Client Viewer shall support the following features:

1. A scalable solution that is frontward and backward scalable with an entire line of Network Video Recorders (NVRs).

2. Intuitive, touch screen-enabled interface.

3. Intelligent GUI that reacts to the user’s actions at any given moment, presenting only the controls and tools required by the current mode of operation.

4. Kinetic / Horizontal Timeline – The following features shall be supported:

a. Kinetic variability (i.e., via the momentum and speed of mouse movement) of the speed that the recorded video timescale is moved forward/backward in time. The faster the mouse is “swiped”, the faster the timeline will move.

b. The timeline GUI shall provide intelligent pop-up controls for controlling forward, reverse, pause, etc. controls.

c. The timeline GUI shall provide simple "+" and "-" controls to quickly change the scale of the timeline.

d. The timeline GUI controls shall provide an intuitive "odometer" like numerical interface for reading and changing the recorded time viewed.

5. Exporting Clips – The Client Viewer shall provide multiple methods to export video clips including:

   a. The ability to export a video segment via clicking on start and stop times (via icons) of recorded video using a timeline.

   b. The ability to export a video segment via the use of the tool bar.

   c. Export options shall include the ability to export to print, individual frames, and create bookmarks (on the timeline).

6. "Timeslicer" Instant Video Playback and Analysis - The Client Viewer shall provide for instant video playback and analysis of video content/events by providing a spectrum of video thumbnails over a period of time for quick end-user analysis. The user shall have the ability to vary the thumbnail intervals based on:

   a. Time – Intervals shall be selectable.
   b. Motion – Intervals shall be based on time or amount of motion.
   c. Alerts.
   d. Sequences.

7. PTZ Controls – The Client Viewer shall provide a wide variety of PTZ controls:

   a. Both optical PTZ (if the camera is a PTZ camera) and digital PTZ controls shall be provided, including:

      (1) Point to a location to re-center the pan-tilt field of view.
      (2) Drag a rectangle within the current field of view to zoom into.
      (3) Virtual joystick with intelligent pop-up menus.
      (4) Preset overlays.

   b. Digital PTZ controls shall be provided for both fixed cameras and PTZ cameras. Digital PTZ controls shall include instant investigation in live monitoring mode as well as for stored video. A window-in-window view shall be provided to show both the zoomed in area, as well as the full field of view of the camera.

8. Highly configurable carousel mode with controls for previous/next camera in sequence, pause/resume carousel, instant investigation capability, and optical and digital PTZ control.

9. Automated (on-event) or manual (peer-to-peer) push live video.

10. Shared and private views, configurable for up to 64 cameras from multiple servers (in multiple server installations).

    a. Multiple hotspots.
    b. Carousel views.
    c. Push video views.
    d. Web pages.

11. Multiple screen support for dual-screen and quad-screen systems.

12. Instant camera change. Quickly substitute one or more of a view's cameras with other cameras.

13. Control PTZ (Pan/Tilt/Zoom) and 360° view cameras, including a virtual PTZ joystick.

14. Use digital zoom on live as well as recorded video.

15. Manually activate surveillance system events.

16. Manually activate external outputs (e.g. sirens or lights).

17. Use sound notifications for attracting attention to detected motion or system events.

18. Get quick overviews of video sequences with detected motion.

19. Get quick overviews of detected alerts or system events.

20. Perform “Smart Searches” to quickly search selected areas of video recordings for motion.

21. Skip gaps during playback of recordings.

22. Configure and use several different joysticks.

23. Print images, with optional comments.

24. Copy images for subsequent pasting into word processors, e-mail, etc.

25. Export recordings (e.g. for use as evidence) in AVI (movie clip), JPEG (still image), and surveillance system database formats. The AVI and database formats can include audio.

26. Select between language versions, independent of the language used on the main surveillance system.

B. Log-on and Authentication

1. The Client Viewer log-on shall provide the option to select either Basic or Windows based authentication.

   a. Basic Authentication – The Client Viewer shall support logon using an account database which requires user name and password credentials.

   b. Windows Authentication – The Client Viewer shall support Microsoft Active Directory Support – The Client Viewer shall support logon using the NTLM (NT LAN Manager) challenge handshake with Microsoft Domain Controllers in conjunction with a local Microsoft Windows user account database.

C. GUI Menu Options Supported

1. The Client Viewer shall provide a main GUI menu uncluttered from other menu panes. Intelligent menu items shall appear as necessary. For instance, when a camera view is right-clicked or left-click/touched and held for 1 second, various relevant selection options shall be available to the end-user:

   a. A camera icon – to instantly select another camera; a selection of available cameras will be presented.

   b. A clipboard icon – to save the current view to the clipboard.

c. A push video icon – to push video to a recipient; a selection of available recipients will be presented.

d. A remove camera icon – to remove the camera from the pane.

2. In addition to the main camera view, the Client Viewer main GUI menu shall provide the end-user the following controls when "mouse" over occurs:

   a. Select View Setup/Editing Utility
   b. Exit
   c. About

3. Tool Bar - In addition to the main camera view, the Client Viewer main GUI menu shall at a minimum, provide the following tool bar selections:

   a. View Setup/Editing Utility.

      (1) Edit Views – Camera Views and Groups shall be organized as folders and the GUI shall provide an intuitive interface to select and change views and groups in a file folder manner. The Edit Views menu shall allow the options to add/delete shared or private views, add/delete groups, and perform other folder management functions. Camera matrix view setup options shall include: 1 x 1, 1 + 3 wide, 2 x 2, 1 + 5, 2 + 4 wide, 1 + 7, 1 + 8 wide, 3 x 3, 2 + 8, 4 x 3 wide, 4 x 4, 5 x 5, 6 x 6, 7 x 7, and 8 x 8 camera views. Edit Views shall provide utilities to configure either Shared Views or Private Views as follows:

         (a) Shared Views – The Client Viewer shall provide both the viewing and setup for Shared Views. These Shared Views shall typically be setup by a system administrator. The Shared Views shall be stored on the NVR and accessed by the end-user based on their log-on.

         (b) Private Views – The Client Viewer shall provide the capability for each end-user to create their own Private Views.

      (2) Cameras

         (a) Server – Within the folder "Server", the Client Server shall list the cameras by name and type of camera available within a given NVR. The Client Viewer shall allow easy manipulation of cameras and views by supporting "drag and drop" capability.

         (b) Hotspot – The Client Viewer shall support Hotspots which are typically used in the main (larger) viewing pane, surrounded by smaller panes. This feature shall allow one position of a view to be designated as a Hotspot. Specific to the Hotspot, settings for the Hotspot shall include:

            i. Image Quality.
            ii. Framerate.

         (c) Carousel – The Client Viewer shall support a Carousel feature for viewing of sequential multiple cameras. The setup menus for the Carrousel feature shall include:

            i. Image Quality.
            ii. Framerate.
            iii. Default Dwell Time – for each camera to be viewed.

         (d) Web Page – The Client Viewer shall provide the ability to view a "Web Page" by

inputting a Web URL within a text box or a JPEG image based on inputting the image file path.

(e) Push Video – The Client Viewer shall provide the ability to display on-event live video streams and alerts. The events will be displayed in a first-in-first-out order and rotate between the different push video panes. Within the Push Video display, the setup menus for the Push Video feature shall be:

i. Image Quality.
ii. Framerate.
iii. TCP/IP Port.
iv. Password.

(3) Image Properties – The following shall be the image quality settings (may vary based on type of camera):

(a) Quality – The Client Viewer shall provide the ability to vary picture quality. The options shall be:

i. Full – Native camera resolution.
ii. Super High.
iii. High.
iv. Medium.
v. Low.

(b) Framerate – The Client Viewer shall provide the ability to vary the Framerate. The options shall be:

i. No limit (full Framerate).
ii. Medium.
iii. Low.

(c) Audible Alert – The Client Viewer shall produce audio alerts based on events. The options shall be:

i. Never.
ii. On Motion.
iii. On Event.
iv. On Motion or Event.

(d) Aspect Ratio – The Client Viewer shall provide the ability to present the video as follows:

i. Keep Original.
ii. Fit to Window.

D. Client Viewer System Requirements

1. The Client Viewer shall allow the use of computer, servers, storage and switches from any manufacturer with components that meet the minimum requirements.

2. The following are the minimum requirements for the computers running the Client Viewer software:

a. The Client Viewer shall support Microsoft Windows XP Professional in conjunction with the Microsoft .Net 2.0 Framework, and DirectX 9.0 or newer.

b. CPU – Intel P4 or higher (Intel Core 2™ recommended), minimum 2.4 GHz.

c. RAM – Minimum of 1 GB.

d. Network – Ethernet (100 megabit or higher recommended).

e. Graphics Adapter – AGP or PCI-Express, 128 MB RAM, Direct 3D supported.

2.2 NETWORK DVMS - NVR SERVER

A. Video Compression Format - The NVR Server shall support H.264, MPEG-4 (both ASP and SP), and MJPEG video compression formats for the video stream from all devices including analog cameras connected to encoders, DVRs, and IP cameras connected to the system.

B. Multi-Stream Support - The NVR Server shall support multi-stream support - The NVR Server shall support H.264 / MPEG-4 / MJPEG optimized multi-streaming. The system shall allow a single video stream from a device to be independently recorded at one specified frame rate by the NVR Server, and viewed by Client Views at a different Framerate setting.

C. Storage and Archiving - Each NVR Server shall have a default storage area. A storage area is a directory where the database content, primarily recordings from the connected cameras is stored. Recordings from the connected cameras shall be stored in individual camera databases. The system shall allow an unlimited amount of storage to be allocated for each connected device. The system shall allow archiving to be enabled on a per camera basis and allow the user to define which archiving drive shall be used for each camera.

D. NAT Firewall Support - The system shall support port forwarding, which shall allow clients from outside of a Network Address Translation (NAT) firewall to connect to NVR Servers without using a VPN.

E. Supported Devices

1. The system shall support devices from the following manufacturers at a minimum: ACTi, Advantech, AgileMesh, Appro, Arecont Vision, Axis Communications, Baxall, Bosch, Canon, CBC Ganz, Convision, Digimerge, Discrete, D-Link, , DVTel, Etrovision, Extreme CCTV, FLIR Systems, GE Security, Hitron, Hunt, Infinova, Intellinet, Ipix Corporation, ipx, IQinvision / IQeye, JVC, Linudix, Lumenera, Mobotix (including support of MxPEG), Panasonic, Pelco, Pantax, Philips, Pixord, Polar, Samsung, Samsung Techwin, Sanyo, Sony, Speco, Stardot, Toshiba, Toshiba Teli, Vantage, Veo, Verint, Videology, Vivotek, Webgate, Xview.

2. The system shall support specific devices, where the specific supported model numbers shall be listed for each manufacture on an up-to-date on-line web-site.

F. Administrator Application – The Administrator Application shall provide a feature-rich administration window for system configuration and day-to-day administration of the system. Within the Administrator Application, the following shall be selectable to allow specific system administration setup functionality. This shall include: A Service Manager, A Scheduler, General Settings, Archive Setup, the ability to Add/Edit/Remove a Device, I/O Setup and Control, and Event Setup. Sub-features shall be the ability to setup PTZs, route messages and alerts including email and SMS messaging setup, and archive setup. Specific features supported by the Administrator Application shall be:

1. Audio Settings including the ability to associate an audio feed to a video input and 2-way audio support.

2. Motion Detection Settings including the ability to trigger video recording and events on motion.

3. Image Quality including settings for Compression Level, Brightness, Contrast, Color, Rotate Image, and Bandwidth Control/Priority

4. Event Notifications including how end-users will be notified when events occur.

5. Outputs Configuration including the ability to control outputs on devices based on motion, manual control or other settings.

6. I/O Setup including that ability to Add, Edit, Name, Enable/Disable Events and optionally assign timers to end an event sequence.

7. Event Buttons for manually triggered events.

8. I/O Control including a graphical mapping of all system events.

9. User Administration including the ability to add either Basic Users or Windows (Active Directory) Users, plus the ability to Delete Users, Change Passwords, set Global User Rights, and set Camera User Rights.

G. Outside Network Access – A user interface shall be provided to select if the system can be accessed from a client PC that has an IP address that is outside of the local IP address range. This function is used to allow access from a remote PC over the Internet. The configuration settings shall include the ability to select an Outside IP Address, Outside IP Port, Local IP Ranges, and Maximum Number of Clients

H. NVR Server System Requirements

1. The following are the minimum requirements for the computers running the NVR Server:

a. CPU – Intel P4 or higher (Intel Core 2 Duo recommended), minimum 2.4 GHz.

b. RAM – Minimum of 1 GB (2 GB recommended).

c. Network – Ethernet (100 megabit or higher recommended).

d. Graphics Adapter – AGP or PCI-Express, minimum 1024x768 (1280x1024 recommended), 16 bit color.

e. Hard Disk Type – E-IDE, PATA, SATA, ISCSI, SCSI, SAS (7200 RPM or faster).

f. Hard Disk Space – Minimum 80 GB free (depends on number of cameras and recording settings).

g. Operating System – Microsoft Vista Business/Enterprise/Ultimate (32 bit or 64 bit running as a 32 bit application), Windows 2003 Server (32 bit or 64 bit running as a 32 bit application), and Windows XP Professional (32 bit or 64 bit running as a 32 bit application).

2.3 TRANSACTION DATA INTEGRATION MODULE

A. The Transaction Data integration module shall allow the operator to search and view Transaction Data from third-party systems time-linked with video recordings of when the transaction activities occurred.

B. The module shall integrate digital video surveillance images with Point of Sale (POS) or Automated Teller Machine (ATM) transaction data. The module shall allow the operator to efficiently answer questions critical to an investigation.

C. The module shall allow the ATM or POS transaction data to be integrated with the system via an open interface supporting a serial server, serial cable or IP connection. The module shall be compatible with any

TCP/IP or serial ASCII data source.

D. The module shall include a filter to allow the user to edit the transaction data and remove unwanted or unnecessary data from the ATM or POS database.

E. The module shall allow the user to search for transactions by register/ATM, camera, date, time or free text. All Transaction Data shall be stored in a SQL database.

F. The module shall utilize a client / server architecture using HTTP or TCP directly for communication.

2.4 CENTRAL ALARM MANAGEMENT MODULE

A. The alarm management module shall allow for continuous monitoring of the operational status and event-triggered alarms from servers, cameras and other devices. The alarm management module shall provide a real-time overview of alarm status or technical problems while allowing for immediate visual verification and troubleshooting.

B. The alarm management module shall provide an interface and navigational tools through the client. The module shall provide a detailed listing of all active or incoming alarms with the ability to reassign alarms to other operators.

C. The module architecture shall be .NET based with the server component accessed through a client application running on Windows XP Professional or Windows Server 2003 servers. Central logging of incoming alarms and system information in a SQL database.

2.5 PDA CLIENT

A. The PDA Client shall allow for the viewing of live and recorded images within the Network DVMS using a wireless PDA.

B. The PDA Client shall provide a camera menu to select a camera to view, PTZ controls including presets, recorded video playback controls, and event management.

2.6 PDA SERVER

A. PDA Server shall be provided as an optional front-end add-on module to the NVR Server.

B. The PDA Server shall provide an interface between NVR Server and the remote PDA clients

C. The PDA Server shall use the Microsoft IIS (Internet Information Services) and .Net framework.

END OF SECTION 28 07 28